

**SECTION 260933**  
**CENTRAL DIMMING CONTROLS**

**Cooper Lighting Solutions WaveLinX Wired Connected Lighting System**

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**PART 1- GENERAL**

**1.1 SUMMARY**

- A. The following specification details the minimum compliance and related criteria for a complete and fully operational wired digital addressable lighting control system for all interior and exterior lights.
- B. Section Includes:
  - 1. Control Devices
    - a. Distributed dimming control systems
    - b. Central dimming control system
    - c. Area Controllers
    - d. DMX Controllers
  - 2. Input Devices
    - a. Occupancy, vacancy sensors
    - b. Sensor power packs
    - c. Daylight sensors
    - d. Multi Sensors
    - e. Touchscreens
    - f. Wallstations
  - 3. End Devices
    - a. Relays
    - b. Digital to Analog converters
    - c. 0-10V to Reverse phase converters
    - d. LED drivers
  - 4. Software and Integration
    - a. BMS integration
    - b. LAN/VLAN integration
    - c. Partition controls
    - d. DMX integration
    - e. ASCII integration
    - f. Programming software
    - g. Emergency lighting control (if applicable)
- C. Related Sections:
  - 1. Section [262726 - Wiring Devices/Lighting Controls.]
  - 2. Section [265113 - Ballasts:] Fluorescent lighting ballasts controlled by central dimming control system.
  - 3. Section [260923 - Occupancy Sensors:] Occupancy sensors used in conjunction with central dimming control system.
  - 4. Section [262726 – Wiring Devices:] Receptacles
  - 5. Section [265113 – Interior Lighting Fixtures, Lamps, and Ballasts:] Fluorescent electronic dimming ballasts
  - 6. Section [25000 – Integrated Automation] Building integrator shall provide integration of the lighting control system with Building Automation Systems

**1.2 REFERENCES**

- A. American National Standards Institute/Institute of Electrical and Electronic Engineers (ANSI/IEEE)
  - 1. C62.41-1991 – Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.

- B. ASTM International (ASTM)
  - 1. D4674 -02a Standard Test Method for Accelerated Testing for Color Stability of Plastics Exposed to Indoor Fluorescent Lighting and Window-Filtered Daylight.
- C. Canadian Standards Association (CSA).
  - 1. CSA C22.2 # 14 Industrial Control Equipment
  - 2. CSA C22.2 # 184 Solid-State Lighting Controls
  - 3. CSA C22.2 # 156 Solid-State Speed Controls
- D. International Electrotechnical Commission.
  - 1. (IEC) 801-2 Electrostatic Discharge Testing Standard.
  - 2. IEC/EN 60669-2-1 Switches for household and similar fixed electrical installations - electronic switches.
- E. International Organization for Standardization (ISO)
  - 1. 9001:2000 – Quality Management Systems.
- F. National Electrical Manufacturers Association (NEMA)
  - 1. WD1 (R2005) - General Color Requirements for Wiring Devices.
- G. Norma Oficial Mexicana (NOM).
  - 1. NOM-003-SCFI Productos eléctricos - Especificaciones de seguridad (Electrical products - Safety Specifications)
- H. Underwriters Laboratories, Inc. (UL):
  - 1. 489 (2002) - Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures.
  - 2. 508 (1999) - Standard for Industrial Control Equipment.
  - 3. 1472 (1996) - Solid-State Dimming Controls.
  - 4. 924 (2003) - Emergency Lighting and Power Equipment.

### 1.3 Coordination Requirements

- A. Coordination
  - 1. Coordinate the placement of area controllers and dimming panels
  - 2. Coordinate the placement of sensors, wallstations and other user input devices
  - 3. Coordinate the placement of daylight sensors to achieve optimal daylight dimming
- B. Prewire meeting: Conducted on-site or during design meeting with lighting control system manufacturers or designated representative prior to commencing work as part of the manufacturer's standard practice and startup services. Manufacturer to review with the installer:
  - 1. Installation of area controllers, dimming panels and locations
  - 2. Lighting control network wiring
  - 3. Network IT requirements
  - 4. Low voltage wiring requirements
  - 5. Lighting control integration requirements
  - 6. Lighting control system integration network wiring and connectivity
  - 7. Installer responsibilities
  - 8. Startup and training schedule and actions

### 1.4 SUBMITTALS

- A. Submit under provisions of Section [01330.]
- B. Specification Conformance Document: Indicate whether the submitted equipment:
  - 1. Meets specification exactly as stated.
  - 2. Meets specification via an alternate means and indicate the specific methodology used.
- C. Shop Drawings; include:
  - 1. Load schedule indicating actual connected load, load type, and voltage per circuit, circuits and their respective control zones, circuits that are on emergency, and capacity, phase, and corresponding circuit numbers.
  - 2. Schematic of system.
- D. Product Data: Catalog specification sheets with performance specifications demonstrating compliance with specified requirements.
- E. Project Record Documents: Installer to record actual installation location and settings of area controller and components.
- F. Title 24 Acceptance Testing Documentation: Submit certification of acceptance in accordance with

California Title 24 Part 6 when appropriate.

1.5 CLOSEOUT SUBMITTALS

- A. Sustainable design closeout documentation.
- B. Wired lighting control system manufacturer to provide an operation and maintenance manual that details the start-up procedure being performed including a process to follow, details on tests performed and an area that documents any test results.

1.6 QUALITY ASSURANCE

- A. Product shall confirm to requirements outlined in NFPA 70
- B. Manufacturer: Minimum [10] years experience in manufacture of architectural lighting controls.
- C. Manufacturer's Quality System: Registered to ISO 9001:2000 Quality Standard, including in-house engineering for product design activities.
- D. Central dimming control system:
  - 1. Meets UL, cUL, and/or CSA Standards specifically for the required loads. Provide evidence of compliance upon request.

1.7 PROJECT CONDITIONS

- A. Do not install equipment until following conditions can be maintained in spaces to receive equipment:
  - 1. Ambient temperature: 0° to 40° C (32° to 104° F).
  - 2. Relative humidity: Maximum 90 percent, non-condensing.
  - 3. Lighting control system must be protected from dust and sprays during installation.
  - 4. Coordinate layout and installation of luminaries and controls with other construction.
  - 5. Coordinate site commissioning with manufacturer no less than 21 days prior to required date

1.8 WARRANTY

- A. Provide manufacturer's enhanced 5-year limited warranty:
  - 1. 5-year limited warranty for the replacement of defective system components from the date of system shipment (except software application).
- B. Trellix Core hardware: One (1) year 100 percent parts coverage, one (1) year 100 percent manufacturer labor coverage.
- C. Contractor shall provide limited workmanship warranty for one year from customer acceptance.
- D. WaveLinx Wired fixtures with standard 0-10V dimmable ballast or driver module warranty is five (5) years. When purchased with the WaveLinx Wired Connected Lighting system this warranty shall also be five (5) years by the lighting fixture manufacturer.
- E. Extended warranty options may be provided for an additional charge to extend the system warranty to a total of ten (10) years.
- F. Recommended extra materials:
  - 1. WaveLinx Wired multi-sensors: provide one (1) for every 200 installed, to be used for maintenance.
  - 2. WaveLinx Wired wallstation: provide one (1) for every 200 installed, to be used for maintenance.
  - 3. WaveLinx Wired field relay: provide one (1) for every 200 installed, to be used for maintenance.
  - 4. Wireless Wired DAC: provide one (1) for every 100 installed, to be used for maintenance.
  - 5. WaveLinx Wired touchscreens: provide one (1) of each product type for every 100 installed, to be used for maintenance.

1.9 COMMISSIONING

- A. Provide factory-certified field service engineer to a site visit to ensure proper system installation and operation under following parameters:
  - 1. Qualifications for factory-certified field service engineer:
    - a. Certified by the equipment manufacturer on the system installed.
  - 2. Make a visit upon completion of installation of central dimming control system:
    - a. Verify connection of power feeds and load circuits.
    - b. Verify connection Wallstation controls.
    - c. Verify proper connection.
    - d. Download system data to controllers and devices.
    - e. Check dimming panel load types and currents and remove by-pass jumpers.
    - f. Verify system operation control by control, circuit by circuit.
    - g. Obtain sign-off on system functions.
    - h. User to be trained on system operation.

3. Conclude commissioning with:
  - a. Verify system control operation area by area.
  - b. Obtain sign-off on system functions.
  - c. User to be trained on system operation.
4. Optional follow-up visits to:
  - a. Provide additional user training.
  - b. Verify system continuous commissioning and control
  - c. Provide troubleshooting and/or suggestions for controls improvement

#### 1.10 MAINTENANCE

- A. Make ordering spare parts available to end user.
- B. Make new replacement parts available for minimum of ten years from date of manufacture.
- C. Provide factory direct technical support hotline.
- D. Provide on-site service support where required.
- E. Offer renewable service contract on yearly basis, to include parts, factory labor, and annual training visits to customer if desired.

#### 1.11 DELIVERY, STORAGE AND FIELD CONDITIONS

- A. Ensure products are delivered as shipped, including pallet assembly and packaging has not been damaged in shipment.
- B. Store products in a clean, dry location in manufacturers original packaging.
- C. Store products in an environment that meets products ambient and storage temperature per products specification sheets.
- D. Store products in an environment that meets products relative humidity of less than 90 percent, non-condensing as outlined on the product specification sheets.

#### 1.12 SYSTEM DESCRIPTION & OPERATION

- A. The wireless lighting control system shall be capable of providing all of the following functions for all lighting:
  1. Continuous dimming and automatic on/off controls.
  2. DMX input and output controls.
  3. Forward and reverse phase output controls.
  4. Indoor (low and hi bay) and outdoor (low and hi bay) occupancy control.
  5. Indoor and outdoor vacancy control.
  6. Indoor (low and hi bay) and outdoor (low and hi bay) daylight harvesting.
  7. Outdoor load control.
  8. Receptacle control.
  9. Load management.
  10. Partition control.
  11. Multi-level scene control.
  12. 7-Day scheduling.
  13. Astronomic scheduling.
  14. Demand Response.
  15. Task Tuning.
  16. Mobile device scene setting and control.
  17. Integration with third party systems via BACnet/IP and Public (REST) API.
  18. Alarms monitoring console.
- B. The wired connected lighting control system shall be capable of continuous dimming and switching allowing individual fixture and/or zone control to monitor its local environment and provide distributed control in response to environmental changes.
- C. The wired connected lighting control system shall provide network communication of all sensor and device data for all wired devices on the local bus, providing occupied/unoccupied status, scene status and daylight information.
- D. The wired connected lighting control system shall provide a method for the installer to verify the WaveLinx Wired local bus communications and address all devices on the local bus.
- E. Centralized dimming control system – Factory assembled dimming and switching solutions that allow for applications to scale from small to enterprise while providing simplified low voltage wiring to allow for system completion faster. This system includes third party integration and features to simplify

complex application designs.

- F. Occupancy Sensors – PIR, DT and ULT Auto adjusting, NEMA WD7 compliant occupancy or vacancy sensors.
- G. Wallstations – Smart device that are fully programmable, pre-engraved digital pushbutton wallstations and dimmers.
- H. Scene Wallstation – Smart device that are fully programmable, pre-engraved digital pushbutton scene wallstations, dimmers and programmable scene buttons.
- I. Daylight Photosensor – Smart device that is a multi-zone open loop daylight sensor with two-way active infrared (IR) communications, which can provide dimming control for daylight harvesting.
- J. Touchscreens – Full color touchscreen that can be programmed to control any area on the lighting control network. Shall include multiple screens with templates for simplified programming as well as password protected screen locking features.
- K. Partitioning – Simplified or complex partition control that allows room and control join mechanisms via button press, key switch, or IR wall close sensors.
- L. 3<sup>rd</sup> Party Integration – Interface shall be provided to allows for 3<sup>rd</sup> party integration via serial or Ethernet into the WaveLinx Wired connected lighting system using standard ASCII commands or an Public (REST) API.
- M. BMS Integration – BACnet interface shall be available to allow BMS systems to detect and control area status.
- N. Demand Response – OpenADR or other demand response input shall be connected to one or more WaveLinx Wired area controllers. The DR signal will trigger a response to the lighting and is fully programmable based on a single area or the entire network.
- O. WaveLinx Wired communication network – wiring using Belden 1502 or 1502P network wire to daisy chain the WaveLinx Wired connected lighting system network.
- P. WaveLinx Wired local bus - 2 wire topology free polarity free low voltage network – 18AWG or 14AWG twisted pair wire (purple and purple) is preferred for connecting user interface devices to the WaveLinx Wired area controllers. This simplifies the design, installation and controls allowing the installer and designer to get off the job faster.

#### 1.13 LIGHTING CONTROL APPLICATIONS

- A. Minimum lighting control performance required, unless local energy code is more stringent.
- B. Occupancy/vacancy requirements – provide an occupancy/vacancy sensor with manual on/ automatic off or automatic on/ automatic off functionality in all spaces. Manual on vacancy sensors should be used for any enclosed space with a manual on switch that does not require hands free operation. Spaces with multiple occupants or where line of sight might be obscured ceiling or corner mount sensors and manual wallstations would be required. Automatic on of lighting via occupancy sensor cannot exceed 50% of lighting. Systems that do that allow the user to select occupancy or vacancy mode shall not be acceptable.
- C. Bi-level switching – provide multi-level switching and/or variable dimming for maximum energy savings. (qualifies for epact tax deductions of \$0.60 per foot)
- D. Task lighting / receptacle control – provide automatic shut off of non-essential plug loads and task lighting in all spaces. Provide manual on or automatic on of receptacles whenever spaces are occupied. Receptacle control will only be shut off when no occupancy is detected within the space. Systems that do not provide receptacle control for a full 20 amp circuit shall not be acceptable.
- E. Daylight zones – primary sidelit or toplit areas within an enclosed space shall be controlled separately and automatically by individual integrated daylight sensors. Adjustments to the daylight zones must be provided by a simple to use, intuitive mobile application.
- F. Provide smooth and continuous daylight dimming for areas marked on drawings. Daylighting control system may be designed to dim electric light to the lowest light level and off.
- G. Provide the ability to adjust the high-end and low-end trim of the dimmers to ensure the lighting automatically provides energy saving even when daylighting calls for full illumination.
- H. Provide the ability for the dimmers and the relays to function separately. Systems where the 0-10v dimmers and relays are tied together reduce design capabilities and shall not be acceptable.
- I. Shall be capable of automatically responding to a demand response signal and adjusting the lighting level. (required for California Title 24 2013)
- J. Additional controls:
  - 1. Provide occupancy or vacancy sensors (Auto On or Manual On) for any enclosed office, conference, meeting or training rooms. Spaces with multiple occupants or where line of sight may be obscured require ceiling or wall/corner mounted sensors with Manual On switches.

2. Conference, meeting, training, auditoriums and multi-purpose rooms shall have controls that allow for scene based and independent control of each output. Rooms larger than 300 square feet shall support at least four (4) pre-set lighting scenes. Occupancy or vacancy sensors shall ensure all lighting, receptacles.
3. Egress lighting control shall be integral to the system. The system shall provide an automatic control of adjacent corridor and/or egress lighting based upon room occupancy. Systems that do not ensure that adjacent corridor and/or egress lighting is controlled with room occupancy shall not be acceptable.
4. Shall be able to communicate with third party system such as a building automation system by means of native BACnet/IP communication hosted on the supervisory system. The supervisory system shall be on the same subnet as the third-party system.
5. Shall be able to communicate with third party systems such as IoT platforms or AV systems by means of restful API commands via the public API interface hosted on the supervisory system. The supervisory system shall be able to communicate to the third system via the IP network provided by the customer through the proper ports.

1.14 CYBERSECURITY

- A. The network connectable products within the Wired Connected Lighting Control system must be include an industry cybersecurity plan and publicly available statement of best practices. Wired Connected Lighting Control Systems that fail to meet this requirement will not be accepted.
- B. The enterprise connectable products within the Wired Connected Lighting Control system must be UL2900-1 listed to the Standard for Software Cybersecurity for Network-Connectable Products. Wired Connected Lighting Control Systems that fail to meet this requirement will not be accepted.

**PART 2- PRODUCTS**

2.1 MANUFACTURERS

- A. Acceptable Manufacturer: Cooper Lighting Solutions
- B. Basis of design product: Cooper Lighting Solutions WaveLinx Wired Connected Lighting system or subject to compliance and prior approval with specified requirements of this section, one of the following:
  1. Cooper Lighting Solutions WaveLinx Wired Connected Lighting system
  2. <other>
  3. <other>
- C. Substitutions: [Not Permitted]
  1. All proposed substitutions (clearly delineated as such) must be submitted in writing for approval by the design professional a minimum of 10 working days prior to the bid date and must be made available to all bidders.
  2. Proposed substitutes must be accompanied by a review of the specification noting compliance on a line-by-line basis.
  3. Any substitutions provided by the contractor shall be reviewed at the contractor's expense by the electrical engineer at a rate of \$200.00 per hour.
  4. By using pre-approved substitutions, the contractor accepts responsibility and associated costs for all required modifications to circuitry, devices, and wiring.
  5. Provide complete engineered shop drawings (including power wiring) with deviations for the original design highlighted in an alternate color to the engineer for review and approval prior to rough-in.

2.2 GENERAL

- A. Provide system hardware that is designed, tested, manufactured, and warranted by a single manufacturer.
- B. Architectural Lighting Controls: 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.
- C. Designed and tested to withstand electrostatic discharges up to 12,000 V without impairment per IEC 801-2.

2.3 Trellix Smart IoT Servers

- A. Trellix Core [TRX-TCPRO2],[TRX-TCENT2],[TRX-TCVRT2]
  1. The Trellix Core shall support up connections to both WaveLinx Wireless and WaveLinx Wired Connected Lighting system concurrently.

2. Each Trellix Core model shall communicate to a defined number of WaveLinx Wireless Wireless Area Controller and or WaveLinx Wired EG2's.
3. The entry level model (Trellix Core Pro) shall support up to 20 Wireless Area Controllers
4. The enterprise level model (Trellix Core Enterprise/ Trellix Core Virtual) shall support up to 500 Wireless Area Controllers.
5. The Trellix Core shall support all Trellix Connected Applications (see section 2.10) and 3rd party interfaces (BACnet/IP, REST API, OpenADR).
6. The Trellix Core shall be a UL-2900 listed product where UL-2900 is a standard Cybersecurity for Network Connectable Products (see section 1.14).

#### 2.4 WaveLinx Wired Area Controllers

##### A. Mechanical:

1. Meets UL, cUL, and/or CSA Standards specifically for the required loads. Provide evidence of compliance upon request.
2. Delivered and installed as a factory assembled panel listed to UL508.
3. Field wiring accessible from front of panel without need to remove dimmer or relay assemblies or other components.
4. Area Controllers passively cooled via free-convection, unaided by fans or other means.

##### B. Electrical:

1. Electrolytic capacitors to operate under the component manufacturer's maximum temperature rating when device is under fully-loaded conditions in 40° C (104° F) ambient temperature.
2. Design and test dimmers/relays to withstand line-side surges without impairment to performance.
  - a. Area Controllers and Dimming Panels: Withstand surges without impairment of performance when subjected to surges of 6,000 volts, 3,000 amps per ANSI/IEEE C62.41 and per IEC 61000-4-5 surge requirements.
  - b. Other power handling devices: Withstand surges without impairment of performance when subjected to surges of 6,000 volts, 200 amps per ANSI/IEEE C62.41.
3. Utilize air gap off, activated when user selects "off" at any control to disconnect the load from line supply.
4. Power failure memory and dimmer/relay recovery:
5. When power is interrupted and subsequently returned, lights will automatically return to same levels (dimmed setting, full on, or off) prior to power interruption.
6. In 3 phase Dimming Panels loss of power to any phase should not effect operation or control dimmers on any other phase.

##### C. Performance:

1. Shall be UL listed to relevant standards (UL508A, UL916, cULus)
2. Shall be capable of mixed voltages 120/277VAC 50/60Hz
3. Shall be capable of mixed sources including normal and emergency power
4. Shall include a panel SCCR rating of 25kA
5. Shall be capable of providing a mixed module solution panel including relays, dimmers and two wire addressable controls.
6. Shall be capable of meeting the latest IECC, ASHRAE and Title 24 energy codes
7. Shall support three area controller sizes
  - a. Small area controller
    - 1) Shall support up to two modules
  - b. Medium area controller
    - 1) Shall support up to four modules and PC connection module
    - 2) Shall include configurations with Ethernet connection to building LAN or VLAN
  - c. Large area controller
    - 1) Shall support up to eight modules and PC connection module
    - 2) Shall include configurations with Ethernet connection to building LAN or VLAN
  - d. Relay Module: (SCMR1220)
    - 1) Up to 24 relays in small area controller
    - 2) Up to 48 relays in medium area controller

- 3) Up to 96 relays in large area controller
- 4) Each relay module shall support up to twelve 20A fully rated relays
  - a) Shall include heavy duty 20A @40C relays
  - b) Shall support a maximum of 192A per SCMR1220
- 5) Rated life of relay: Minimum 1,000,000 cycles.
- 6) Load switched in manner so that there is no arcing at mechanical contacts when power is applied to and removed from load circuits.
- 7) Fully rated output continuous duty for inductive, capacitive, and resistive loads.
- 8) Relay controller shall include the capability for DMX input control with base address
- 9) Relay controller shall include alert dry contact input for hardware override of all relays
- e. Dimmer Module: (SCMH1200)
  - 1) Up to 24 Low Voltage Dimming (0-10V) channels in small area controller
  - 2) Up to 48 Low Voltage Dimming (0-10V) channels in medium area controller
  - 3) Up to 96 Low Voltage Dimming (0-10V) channels in large area controller
  - 4) Each dimmer module shall support up to twelve 0-10V channels; Meet following requirements:
    - a) Capable of controlling any 0-10V source.
    - b) 0-10V dimmers shall include a fail to full output safety feature by default
    - c) Provide isolated 0-10V output signal conforming to IEC 60929.
    - d) 50mA sink current per channel via IEC 60929.
    - e) 50mA source current per channel
- f. Local bus Module: (SCMD4)
  - 1) Up to 8 WaveLinx Wired local bus connections in small area controller
  - 2) Up to 16 WaveLinx Wired local bus connections in medium area controller
  - 3) Up to 32 WaveLinx Wired local bus connections in large area controller
  - 4) Each local bus module shall support up to four two wire local buses
  - 5) Each local bus shall be polarity and topology free allowing for flexible wiring installation.
  - 6) Shall include dedicated test/override buttons for each local bus
  - 7) Shall include a separate power supply for each local bus
    - a) Shall provide 16V nominal, 250mA max current per local bus
    - b) Shall support 64 standard local bus devices per local bus
  - 8) Local bus modules shall include the capability for DMX input control with base address
  - 9) Local bus module shall include alert dry contact input for hardware override of all relays
- g. Ethernet: (EG2)
  - 1) Shall provide a single ethernet port for connection to the building LAN or VLAN
  - 2) Shall be capable of facilitating a LAN or Wi-Fi connection to the WaveLinx Wired Connected Lighting system
  - 3) Shall include an integral web server
  - 4) Shall include the capability to WaveLinx Wired network scheduling.
    - a) EG2 must be connected to a network with a NTP server to ensure accurate system scheduling
    - b) Scheduling done using the WaveLinx Wired software or via the Trellix Core
  - 5) Shall provide the capability for mobile devices to override the lighting system via scene or channel slider commands
  - 6) Shall provide the capability for 3rd party integration via ASCII control strings
  - 7) Shall provide the capability for bridging the WaveLinx Wired network across LAN or VLAN connections

## 2.5 WaveLinx Wired SC-UN Series Dimming Panels

### A. Mechanical:

1. Meets UL, cUL, and/or CSA Standards specifically for the required loads. Provide evidence of WaveLinx Wired Connected Lighting System **260933-8** CENTRAL DIMMING CONTROLS



- compliance upon request.
  - 2. Delivered and installed as a factory assembled panel listed to UL508.
  - 3. Field wiring accessible from front of panel without need to remove dimmer or relay assemblies or other components.
  - 4. Dimming Panels passively cooled via free-convection, unaided by fans or other means.
- B. Electrical:
- 1. Dimming Panels contain branch circuit protection for each input circuit unless the panel is a dedicated feed-through type panel or otherwise indicated on the drawings.
  - 2. Branch circuit breakers; meet following performance requirements:
    - a. Listed to UL 489 as molded case circuit breaker for use on lighting circuits.
    - b. Contain visual trip indicator; rated for:
    - c. SC-UN: 10,000 AIC, 120 V Dimming and 14,000 AIC, 277 V Dimming.
    - d. SC-RPB: 25,000 AIC, 120 V and 277 V relays
    - e. Thermal-magnetic construction for overload, short-circuit, and over-temperature protection. Use of breakers without thermal protection requires dimmers/relays to have integral thermal protection to prevent failures when overloaded or ambient temperature is above rating of panel.
    - f. Replaceable without moving or replacing dimmer/relay assemblies or other components in panel. Breakers shall be designed for use in frequent switching applications (switching duty rated) so that loads can be switched on and off by breakers.
  - 3. Electrolytic capacitors to operate under the component manufacturer's maximum temperature rating when device is under fully-loaded conditions in 40° C (104° F) ambient temperature.
  - 4. Design and test dimmers/relays to withstand line-side surges without impairment to performance.
    - a. Dimming Panels: Withstand surges without impairment of performance when subjected to surges of 6,000 volts, 3,000 amps per ANSI/IEEE C62.41 and per IEC 61000-4-5 surge requirements.
    - b. Other power handling devices: Withstand surges without impairment of performance when subjected to surges of 6,000 volts, 200 amps per ANSI/IEEE C62.41.
  - 5. Utilize air gap off, activated when user selects "off" at any control to disconnect the load from line supply.
- C. Power failure memory and dimmer/relay recovery:
- 1. When power is interrupted and subsequently returned, lights will automatically return to same levels (dimmed setting, full on, or off) prior to power interruption.
  - 2. In 3 phase dimming panels loss of power to any phase should not effect operation or control dimmers on any other phase.
- D. Dimming Panel to contain 4 line LCD display controller in each panel
- 1. All set up and adjustments of the panel can be made from this device.
  - 2. USB, RS485, Ethernet, and DMX connections must be included.
  - 3. Include Timeclock standard with control of:
    - a. Scene selections.
    - b. Fade zone to a level.
- E. Dimmers:
- 1. Each individual circuit dimmer is designed and tested to specifically control incandescent/tungsten, magnetic low voltage, electronic low voltage, neon/cold cathode, fluorescent dimming ballasts, 0-10V low voltage loads, and non-dim loads without additional internal or external modules.
  - 2. Utilize universal 16A continuous-use dimmer listed to UL508.
  - 3. Limit current rise time to minimum 350 µsec as measured from 10-90 percent of load current waveform at full dimmer capacity at a 90 degree conduction angle.
  - 4. Load faults only affect the given circuit.
  - 5. Ship dimming panels with each dimmer in mechanical bypass position by means of jumper bar inserted between input and load terminals. Jumpers to carry full rated load current and be reusable at any time without requiring a tool to reinstall them. Mechanical bypass device to allow for switching operation of connected load with dimmer removed by means of circuit

breaker.

6. Provide real-time cycle-by-cycle compensation for incoming line voltage variations including changes in RMS voltage, frequency shifts, dynamic harmonics, and line noise.
  7. Control compatible light sources in smooth and continuous manner. Dimmers with visible steps are not acceptable.
  8. Each dimmer to be configurable in the field to provide a proper dimming curve for the specific light source.
  9. Minimum and maximum light levels user adjustable on circuit-by-circuit basis.
  10. Each individual circuit must include the ability to control the following load types standard, without additional modules or equipment.
    - a. Magnetic Low Voltage (MLV) transformer:
      - 1) Contain circuitry designed to control and provide a symmetrical AC waveform to input of magnetic low voltage transformers per UL 1472, Section 5.11.
      - 2) Dimmers using unipolar load current devices (such as FETs or SCRs) to include DC current protection in the event of a single device failure.
    - b. Forward Phase Electronic Low Voltage (ELV) transformer:
    - c. Dimmer to be approved for use on the specific ELV transformer being used, Dimming equipment manufacturer to offer free testing services to ensure compatibility. Neon and cold cathode transformers:
      - 1) Magnetic transformers: UL listed for use with normal (low) power factor magnetic transformers.
    - d. Fluorescent electronic dimming ballast: Refer to Section 16580 for dimming ballast specifications and performance.
  11. Low Voltage Dimming (0-10V); Meet following requirements:
    - a. Capable of controlling any 0-10V source.
    - b. 0-10V analog voltage signal.
    - c. Provide isolated 0-10V output signal conforming to IEC 60929.
    - d. 50mA sink current per channel via IEC 60929.
    - e. 50mA source current per channel
- F. Non-dim Relays:
1. Rated life of relay: Minimum 1,000,000 cycles.
  2. Load switched in manner so that there is no arcing at mechanical contacts when power is applied to and removed from load circuits.
  3. Fully rated output continuous duty for inductive, capacitive, and resistive loads.

## 2.6 INPUT DEVICES

### A. WALLSTATIONS & TOUCHSCREENS

1. Product: Local Bus Wallstation [DW-\*TSB-RL-\*][DW-\*TLB-\*]
  - a. Communication: WaveLinx Wired local bus.
  - b. Power: From the WaveLinx Wired local bus
  - c. Maximum Current Draw: 3.75 mA.
  - d. Connections: Two (2) wires (16/18AWG, FT6, non-twisted, non-shielded, non-polarized and plenum rated) connected to the WaveLinx Wired local bus and the SCMD4 module.
  - e. Functionality:
    - 1) Upon button press, LEDs to immediately illuminate.
    - 2) Each button shall be programmable to control any area, scene, channel
  - f. Color: White, Black, Ivory, Gray
  - g. Provide color matching faceplates with concealed mounting hardware where specified.
  - h. Engrave wall stations with appropriate button, zone, and scene descriptions as specified.
2. Product: TSE Touchscreens [TSE55-B, TSE80-B]
  - a. Communication: WaveLinx Wired protocol.
  - b. Power: PoE
  - c. Connections: PoE network

- d. Sizes:
    - 1) TSE55-B: 5.5" diagonal backlit capacitive LCD touchscreen
    - 2) TSE80-B: 8" diagonal backlit capacitive LCD touchscreen
  - e. Mounting: Wallbox
    - 1) TSE55-B: Single gang standard box (landscape or portrait mounting)
    - 2) TSE80-B: Double gang standard box (landscape or portrait mounting)
  - f. 1280x800 pixel resolution, 16.7M colors available
  - g. Shall allow up to 250 pages to be stored in memory
  - h. Groups: The set of fixtures controlled by a given touchscreen shall be completely configurable through software and can span entire WaveLinx Wired network.
  - i. Shall support individual zone level adjustment and save scene controls.
  - j. Requires the TSI-1-NA TSE Touchscreen Interface to connect to the WaveLinx Wired network
3. Product: TSE Touchscreen Interface [TSI-1-NA]
- a. Communication: WaveLinx Wired protocol.
  - b. Power: WaveLinx Wired Network or Aux 12VDC power supply (optional)
  - c. Connections: PoE network and WaveLinx Wired network
    - 1) PoE network must be the same network as the TSE Touchscreens
    - 2) Use either static or dynamic IP addresses
    - 3) IP addresses are defined by the site IT coordinator
  - d. Mounting: Surface mount to wall
  - e. Shall allow communications from up to 25 TSE Touchscreens to the WaveLinx Wired network
- B. ADDRESSABLE MULTI-SENSOR
1. Product: [MTS-6], [MTS-12], [MTS-HB]
- a. Communication: WaveLinx Wired local bus.
  - b. Power: From the WaveLinx Wired local bus..
  - c. Maximum Current Draw: 3.75 mA.
  - d. Connections: Two (2) wires (16/18AWG, FT6, non-twisted, non-shielded, non-polarized and plenum rated) connected to the WaveLinx Wired local bus and the SCMD4 module.
  - e. Sensing Technologies: Occupancy, daylight and temperature.
  - f. Daylight Sensing Range: 0-400 lux.
  - g. Daylight Sensing Coverage: Light input within 60° cone.
  - h. Occupancy Detection Technology: Passive infrared.
  - i. Occupancy Detection Coverage Area: 600 sq. ft. or 1,200 sq. ft.
  - j. Occupancy Detection Angle: 360°.
  - k. Mounting: Junction box or ceiling tile.
  - l. Mounting Height: 8-12ft [MTS-6],[MTS-12]
  - m. Mounting Height: 40FT [MTS-HB]
  - n. Groups: The set of fixtures controlled by a given multi-sensor shall be completely configurable through software and can span WaveLinx Wired network..
  - o. Timers: All times shall be configurable through the web software and shall not require any manual configuration of settings prior to installation. Timer values can range from 1 second to 24 hours
  - p. Shall be capable of occupancy forwarding to send occupancy status to other areas within the system
- C. LOCAL BUS ADDRESSABLE SENSOR POWERPACK
1. Product: [SPP-MV-DC2], [SPP-MV-DC1], [SPP-347-DC2], [SPP-347-DC1], [SPP-240-DC2], [SPP-24-DC1]
- a. Communication: WaveLinx Wired local bus.
  - b. Power: 120/277VAC, 240VAC OR 347VAC..
  - c. Maximum Current Draw: 2 mA.

- d. Maximum number of sensors: Up to five (5) PIR or DT sensors are connected and report to the system as a single address.
- e. Communications Connections: Two (2) wires (16/18AWG, FT6, non-twisted, non-shielded, non-polarized and plenum rated) connected to the WaveLinx Wired local bus and the SCMD4 module.
- f. Sensor Connections: Five (5) wires (16/18AWG, FT6, non-twisted, non-shielded, non-polarized and plenum rated) connected to sensor for controls and addressing.
- g. Main Power Connections: Three (3) wire (hot, neutral, ground connections)

#### D. CEILING MOUNTED SENSORS

1. Product: [OAC-DT-2000-R], [OAC-DT-1000-R], [OAC-P-1500-R], [OAC-U-2000-R].
  - a. Provide all necessary mounting hardware and instructions.
  - b. Sensors shall be Class 2 devices.
  - c. Connect up to five (5) sensor to the Local Bus Addressable Powerpack for power and signal back to the WaveLinx Wired system
  - d. Device calibration and features:
    - 1) Sensitivity – 0-100% in 10% increments.
    - 2) Time delay – 1-30, self-adjusts to 10 min based on room occupancy.
    - 3) Test mode – Fifteen second time delay.
    - 4) Detection technology – PIR, Ultrasonic or Dual Technology activation and/or re-activation.
    - 5) Walk-through mode.
    - 6) Ultrasonic and Dual Technology Sensors utilize two independent sensor detection circuits simultaneously to ensure optimum performance, regardless of location or proximity to walls and structures.
    - 7) Ultrasonic and Dual Technology Sensors utilize Variable Drive Circuitry (VDC) in cases of over saturation from misapplication, which automatically adjusts the volumetric output without reducing detection capability. Systems that reduce detection coverage area shall not be acceptable.
    - 8) Automatically and continually self-adjust ultrasonic frequency to ignore specific frequency, continuous noise from airflow to prevent detuning which can lead to inadvertent lights out. Sensors that require detuning shall not be acceptable.
  - e. Device Status LEDs including:
    - 1) PIR Detection
    - 2) Ultrasonic detection
  - f. Manual override of controlled loads.
  - g. Where specified, sensor packaging shall be 100% recycled [made entirely from post-consumer waste (100% post-consumer fiber content) as well as, 100% recyclable].
  - h. Sensors shall be RoHS compliant.

#### E. WALL/CORNER MOUNTED SENSORS

1. Product: [OAWC-P-120W-R], [OAWC-P-009L-H-R], [OAWC-DT-120W-R],
  - a. Provide all necessary mounting hardware and instructions.
  - b. Sensors shall be Class 2 devices.
  - c. Connect up to five (5) sensor to the Local Bus Addressable Powerpack for power and signal back to the WaveLinx Wired system
  - d. Device calibration and features:
    - 1) Sensitivity – 0-100% in 10% increments.
    - 2) Time delay – 1-30, self-adjusts to 10 min. based on room occupancy.
    - 3) Test Mode – Fifteen second time delay.
    - 4) Detection technology – PIR, Ultrasonic or Dual Technology activation and/or re-activation.
    - 5) Walk-Through Mode.
    - 6) Automatically and continually self-adjust ultrasonic frequency to ignore specific frequency continuous noise from airflow to prevent detuning which can lead to inadvertent lights out. Sensors that require detuning shall not be acceptable.
  - e. Device Status LEDs including:

- 1) PIR Detection
- 2) Ultrasonic detection
- f. Manual override of controlled loads.
- g. Where specified, sensor packaging shall be 100% recycled [made entirely from post-consumer waste (100% post-consumer fiber content) as well as, 100% recyclable].
- h. Sensors shall be RoHS compliant.

## 2.7 END DEVICES

### A. ADDRESSABLE RELAYS AND DRIVERS

1. Product: [DAC-DC1], [DAC-DC2] LED 0-10V Controller
  - a. 0-10V Addressable Dimming Modules
  - b. Communication: WaveLinx Wired local bus.
  - c. Power: From the WaveLinx Wired local bus.
  - d. Maximum Current Draw: 3.75 mA.
  - e. Connections: Two (2) wires (16/18AWG, FT6, non-twisted, non-shielded, non-polarized and plenum rated) connected to the WaveLinx Wired local bus and the SCMD4 module.
  - f. Power Ratings: Up to 4A Ballast 120/277/347 VAC.
  - g. Dimming Control: 0-10V, 50 mA max current sink.
  - h. Mounting: Fixture or conduit (90° elbow and mounting clips included).
  - i. UL 924 Listed component.
2. Product: [HPRS-MV-DC1] Relay Controller
  - a. Communication: WaveLinx Wired local bus.
  - b. Power: From the WaveLinx Wired local bus.
  - c. Maximum Current Draw: 3.75 mA.
  - d. Enclosure: Standard outlet box or NEMA 250, Type 1, unless otherwise indicated.
  - e. Communication Connections: Two (2) wires (16/18AWG, FT6, non-twisted, non-shielded, non-polarized and plenum rated) connected to the WaveLinx Wired local bus and the SCMD4 module.
  - f. Relay Ratings: Up to 20 A at 347 VAC.
  - g. Field relays shall be capable of controlling plug loads.
  - h. Mounting: Junction box.

### B. POWER CONVERTERS

1. Product: [LDCM-PL-120-277-010V-GR] 0-10V to Reverse Phase Controller
  - a. Communication: 0-10V
  - b. Power: 120/277VAC
  - c. Maximum Current: 450W @ 120V or 1000W @ 277V
  - d. Shall control ELV loads(reverse phase) based on 0-10V input signal
  - e. Shall provide ON/OFF capability of load through external relay providing power to unit
  - f. Mounting: Junction box.

## 2.8 INTEGRATION AND ACCESSORIES

### A. BMS INTEGRATION

1. Product: [FPA-W34-1130] BMSPro 2 - BACnet Interface
  - a. The WaveLinx Wired network shall permit data protocol translation through a building automation interface Gateway. The BACnet Gateway shall permit BACnet communication protocol to operate individual areas, scenes or channels and read the status. The WaveLinx Wired network shall respond efficiently to the requested information from the BACnet network.
  - b. The BMSPro2 provides up to 10,000 points of control and can communicate to multiple panel types.
  - c. The BMSPro 2 requires a dedicated EG2 interface for connectivity either installed in an WaveLinx Wired area controller or as a separate accessory.
  - d. Provide PIC list definition and object model to other system manufacturers.

### B. LAN/VLAN INTEGRATION

1. Product: [EG2-NA] Ethernet Gateway

- a. Shall provide a single ethernet port for connection to the building LAN or VLAN
- b. Shall be capable of facilitating a LAN(by others) or Wi-Fi (by others) connection to the WaveLinx Wired network
- c. Shall include an integral web server
- d. Shall provide the capability for mobile devices to override the lighting system via scene or channel slider commands
- e. Shall provide the capability for 3rd party integration via ASCII control strings
- f. Shall provide the capability for bridging the WaveLinx Wired network across LAN or VLAN connections including across fiber networks (provided by others)
- g. Provide ability for bi-direction communication by means of Ethernet communication to system by means of user-supplied PC, digital audiovisual, or BMS equipment. Control to be located on the same Local Area Network.

C. SERIAL INTEGRATION

- 1. Product: [SI-2-NA] RS232 Interface
  - a. Communication: WaveLinx Wired network.
  - b. Power: From the WaveLinx Wired network wire.
  - c. Connections: Five (5) wires Belden 1502 or 1502P
  - d. Mounting: Junction box
  - e. Provide ability for bi-direction communication by means of RS232 serial communication to system by means of user-supplied PC, digital audiovisual, or BMS equipment. Control to be located within 50 feet (15 meters) of RS232 source.
  - f. Allow for custom RS-232 command strings to be entered in to software to allow lighting control system to control any other device.

D. PARTITION CONTROL;

- 1. Product: [UIG-NA], [UIM-NA] Universal Input Module
  - a. Communication: WaveLinx Wired network.
  - b. Power: From the WaveLinx Wired network wire.
  - c. Connections: Five (5) wires Belden 1502 or 1502P
  - d. Inputs: Four (4) digitally optically isolated inputs
  - e. Mounting: Junction box
  - f. Partitioning: Shall provide partitioning and room join capabilities using either a button press, input, or IR wall partition sensors
  - g. Low Voltage Input: Shall provide the capability for contact closures to integrate between lighting controls and other systems.
    - 1) The contact closure input device will accept both momentary and maintained contact closures.
- 2. Product: [IRTR] Infrared Transmitter/ Receiver
  - a. Infrared Transmitter & Receiver
  - b. Provide the ability to sense the presence or absence of partitions.
  - c. Requires the connection to a UIG-2-NA or UIM-NA

E. DMX INTEGRATION

- 1. Product: [SCD96-NA] DMX Output Controller
  - a. Communication: WaveLinx Wired network.
  - b. Power: 120VAC
  - c. Connections: Five (5) wires Belden 1502 or 1502P
  - d. DMX Connection: Three (3) wire DMX cable (by others)
  - e. Inputs: Eight (8) digitally optically isolated inputs
  - f. Relay Outputs: Eight dry contact N.O./N.C.
  - g. DMX Output: 96 channels of DMX
  - h. Mounting: Surface
  - i. Provide the ability to control standard DMX devices such as RGB fixtures, moving lights, dimmers and effects.
  - j. Provides the ability to map any WaveLinx Wired wall station button to a DMX

channel.

F. CURTAIN/SHADE INTEGRATION

1. Product: [RI-2-NA] Relay Controller
  - a. Communication: WaveLinx Wired network.
  - b. Power: 120VAC
  - c. Connections: Five (5) wires Belden 1502 or 1502P
  - d. Inputs: Eight (8) digitally optically isolated inputs
  - e. Relay Outputs: Eight dry contact N.O./N.C.
  - f. Mounting: Surface
  - g. Provide eight dry contact programmable low power relays to control curtain, shades, AV screens and other equipment.

G. NETWORK ACCESSORIES

1. Product: [LCNJ]
  - a. Communication: WaveLinx Wired network.
  - b. Power: From the WaveLinx Wired network wire.
  - c. Connections: Five (5) wires Belden 1502 or 1502P
  - d. Mounting: Junction box
  - e. Shall allow direct access to the iLumin lighting control network while in the space being modified.
2. Product: [BN-2-NA]
  - a. Network Bridge
  - b. Communication: WaveLinx Wired network.
  - c. Power: From the WaveLinx Wired network wire
  - d. Connections: Five (5) wires Belden 1502 or 1502P
  - e. Mounting: Junction box
  - f. Shall allow the network to extend more than 1000m/3200 feet.
  - g. Shall permit the connection of multiple networks allowing up to 65,000 devices on one system.

2.9 COMMISSIONING SOFTWARE

A. WaveLinx Wired Software

1. Product: [SOFT-ILP]
  - a. Software shall support multiple functions to setup entire enterprise WaveLinx Wired system
    - 1) WaveLinx Wired local bus addressing tool
    - 2) Device editor for system programming and scheduling
    - 3) iCANsoft editor for system programming and scheduling
    - 4) Smartphone configuration tool for mobile applications
    - 5) TSE Designer Software
  - b. Software shall support multiple diagnostic tools for troubleshooting the WaveLinx Wired system
    - 1) Network monitor
    - 2) Flash tool for updating system device firmware
    - 3) Device simulator
  - c. Shall include with user-friendly software suitable for operation on computer workstations which serve as central control stations for the selection and operation of lighting scenes
  - d. Clients shall interface with the software via Cooper Lighting Solutions WaveLinx Wired software

2.10 CONNECTED APPLICATIONS

A. Trellix Lighting

1. The application shall be accessible via HTML5 compatible web browsers such as Microsoft Edge, Google Chrome and Apple Safari.

2. The application shall support multiple computing device types, i.e. smartphones, tablets, laptops and desktop computers.
  3. The software application shall support touch interaction.
  4. The application shall utilize HTTPS (industry-standard certificate-based encryption and authentication for security).
  5. The system shall display the location of zones and areas on a floor plan (jpeg or svg)
  6. The system shall allow users to monitor and control the lights:
    - a. Area lights can be monitored for on/off status
    - b. Area lights can be modified to a predefined scene or defined light level
    - c. Zone lights can be monitored for on/off status
    - d. Zone lights can be modified to defined light level
  7. The system shall allow users to monitor and control the light schedules:
    - a. Display the light schedule on a daily, weekly or monthly calendar
    - b. Configure light schedule based on a specific time of day or astronomic time clock event.
  8. The system shall display system's fault in near real-time. System faults include loss of communication with the WaveLinx Wired network.
  9. The system shall log all current and past system faults to provide better insight of the system's health.
  10. The system shall offer context-sensitive troubleshooting tips for each alarm
  11. The system shall be able to send e-mail notifications to subscribe users for each fault. The user shall provide the SMTP server information to allow the Trellix to send out email notifications.
- B. BACnet Interface
1. The BACnet/IP interface shall support the following capabilities:
    - a. BACnet integrator can monitor:
      - 1) Area scene
      - 2) Dimming zone level (0-100%)
      - 3) On/off zone level (on/off)
    - b. BACnet integrator can command:
      - 1) System-wide Demand Response enable/disable
      - 2) Area scene
      - 3) Dimming zone level (0-100%)
      - 4) On/off zone level (on/off)
  2. The system shall be able to allow users to select which object types the system shall expose, i.e. Area, Zones.
  3. The system shall be able to generate the electronic PICS document and allow users to be able to send the PICS document to the proper stakeholders.
- C. The Public API shall support the following capabilities:
1. The Public API interface shall support the following get/put capabilities:
    - a. Get:
      - 1) Building hierarchy information (areas, zones, devices)
      - 2) Area scene
      - 3) Dimming zone level (0-100%)
      - 4) Zone level (on/off)
    - b. Put:
      - 1) System-wide Demand Response enable/disable
      - 2) Area scene
      - 3) Dimming zone level (0-100%)
      - 4) Zone level (on/off)
- D. OpenADR interface shall support the following capabilities:
1. Register the OpenADR interface of the WaveLinx system with a utility's Demand Response Automation Server (DRAS)
  2. Initiate load shed event using OpenADR protocol in an auto-Demand-Response event without additional interfaces or gateways.

## **PART 3- EXECUTION**

### **3.1 INSTALLATION**

- A. Install equipment in accordance with manufacturer's installation instructions.
- B. Provide complete installation of system in accordance with Contract Documents.
- C. Define each dimmer's/relay's load type, assign each load to a zone, and set control functions.



- D. Provide equipment at locations and in quantities indicated on Drawings. Provide any additional equipment required to provide control intent.
- E. 100 digital devices (Source Controllers, User Interfaces, etc) may reside on a single network segment with a network length not to exceed 3000 feet. Additional network segments shall be accomplished by the employment of a network bridge up to 65000 devices. Network segments shall be terminated at the end of each segment.
- F. Devices to be connected via Daisy Chain topology.
- G. Network wire recommended is Belden#1502R or 1502P (plenum) or similar. Wire shall meet color code requirements to insure proper installation of the network polarity.
- H. All area controllers and dimming panels are "masters" and may be added to the network in any location and any amount as long as network installation guidelines are met.
- I. Area controllers and dimming panels are designed to function independently from external control devices.

### 3.2 FACTORY COMMISSIONING (OPTIONAL)

- A. Upon completion of the installation, the system shall be commissioned by the manufacturer's factory authorized representative who will verify a complete fully functional system.
- B. The electrical contractor shall provide both the manufacturer and the electrical engineer with twenty-one (21) working days written notice of the system startup and adjustment date.
- C. Upon completion of the system commissioning the factory-authorized technician shall provide the proper training to the owner's personnel on the adjustment and maintenance of the system.
- D. Qualifications for factory certified field service engineer:
  - 1. Certified by the equipment manufacturer on the system installed.
- E. Make first visit upon completion of installation of WaveLinx Wired Connected Lighting system:
  - 1. Verify locations of WaveLinx Wired Area Controllers and Dimming Panels
  - 2. Identify connected devices and program using WaveLinx Wired Configuration Software.
  - 3. Verify that system operation control based on defined Sequence of Operations (SOO).
  - 4. Obtain sign-off on system functions.
- F. Make second visit (optional) to demonstrate and educate Owner's representative on system capabilities, programming, fine tuning and maintenance.
- G. Due to building operations, start-up of WaveLinx Wired Connected Lighting system may be required outside of normal business hours (Monday through Friday, 7 a.m. to 5 p.m.).

### 3.3 CLOSEOUT ACTIVITIES (OPTIONAL)

- A. Training Visit
- B. Lighting control system manufacturer to provide one (1) day additional on-site system training to site personnel. This shall be a part of the second visit by field service to the site. A separate third visit will require an additional charge.
- C. For LEED projects, manufacturer shall conduct an on-site walkthrough to demonstrate system functionality to a Commissioning Agent.
- D. During this visit, the manufacturer's Field Service Engineer will perform tasks, at the request of the facility representative or Commissioning Agent, such as to demonstrate wall control functions, explain or describe occupancy and/or daylight sensor functionality.
- E. On-site Walkthrough
- F. Lighting control system manufacturer to provide a factory certified Field Service Engineer to demonstrate system functionality to the Commissioning Agent.

### 3.4 MAINTENANCE

- A. Capable of providing on-site service support within 48 hours anywhere in continental United States and within 72 hours worldwide except where special visas are required.
- B. Offer renewable service contract on yearly basis, to include parts, factory labor, and annual training visits. Make service contracts available up to ten (10) years after date of system startup. Additional service contracts and warranties need to be verified as being available.
- C. Prior to bid, confirm if an on-site meeting between the Lighting Control System Manufacturer and a Facility Representative will be required to evaluate system usage after the building has been in operation for a predetermined period. If a field service visit is required for Acceptance Testing or building commissioning, it shall be as an additional charge unless specifically stated in the specification and confirmed on the WaveLinx Wired Connected Lighting bill of materials.

END OF SECTION