SECTION 26 0943
LIGHTING CONTROLS - WAVELINX WIRELESS
This specification was updated in April 2021 and supersedes all previous WaveLinx specifications. This section includes editing notes. These notes are hidden and can be viewed by Microsoft Word. To do this go to the FILE menu, select OPTIONS and then DISPLAY. Under the DISPLAY VIEW, select or deselect the HIDDEN TEXT option and click OK.

PART 1 GENERAL

1.1 SUMMARY

A. The following specification details the minimum compliance and related criteria for a complete and fully operational wireless digital addressable lighting control system for all interior lights.

1.2 RELATED SECTIONS

A. Section [26 2726 - Wiring Devices/Lighting Controls]
B. Section [26 5113 - Ballasts] Fluorescent lighting ballasts controlled by central dimming control system.
C. Section [26 0923 - Occupancy Sensors] Occupancy sensors used in conjunction with central dimming control system.
D. Section [26 2726 – Wiring Devices] Receptacles
E. Section [26 5113 – Interior Lighting Fixtures, Lamps, and Ballasts] Fluorescent electronic dimming ballasts
F. Section [25 0000 – Integrated Automation] Building integrator shall provide integration of the lighting control system with Building Automation Systems

1.3 REFERENCE STANDARDS

A. American National Standards Institute/ (ANSI) (www.ansi.org) C62.41-1991 – Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.
B. Institute of Electrical and Electronic Engineers (IEEE) (www.ieee.org) 802.3af-2003 – Power over Ethernet standard
C. International Electrotechnical Commission (www.iec.ch)IEC/EN 61000-4-2:2009 Electrostatic Discharge Testing Standard.
D. International Organization for Standardization (ISO) (www.iso.ch)9001:2000 – Quality Management Systems.
E. National Electrical Manufacturers Association (NEMA) (www.nema.org)WD1 (R2005) - General Color Requirements for Wiring Devices.
F. Underwriters Laboratories, Inc. (UL) (www.ul.com)916 – Energy Management Equipment
G. Federal Communications Commission (FCC) (www.fcc.gov)Title 47 CFR Part 15 Class A

1.4 COORDINATION REQUIREMENTS

A. Coordination
1. Coordinate the placement of lighting area controllers and supervisory controller
2. Coordinate the placement of sensors, wallstations, load controllers and other user input devices
3. Coordinate the placement of daylight sensors to achieve optimal daylight dimming
4. Coordinate the placement of luminaires including luminaires with integrated sensors
5. Notify Architect of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work.

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 lighting area controller and supervisory controller and locations
2. Control device locations
3. Load circuit wiring
4. Low voltage wiring requirements
5. Network IT requirements
6. Lighting control integration requirements and network wiring
7. Installer responsibilities
8. Startup and training schedule and actions

1.5   SUBMITTALS
A. Specification conformance document indicates whether the submitted system:
1. Meets specification exactly as stated.
2. Meets specification via an alternate means and indicate the specific methodology used.
B. An overview of the system.
C. Shop drawings:
1. Schematic (one-line diagram) will be specific to the project. Generic one-line diagrams will not be accepted. Provide drawing details for field installation that are specific to the project.
2. Wiring diagrams for typical application installation configurations.
3. Wiring diagrams for typical device installation configurations.
D. Product data: catalog data sheets with performance specifications demonstrating compliance with specified requirements and are specific to the project.
E. Sequence of operation to describe how each component operates and how any building wide functionality is achieved to exceed local energy code (California Title 24 2018, ASHRAE 90.1 2019, IECC 2018, or any newer versions of these codes.
F. System setup and programming to be provided by installer, certified technician or factory field service personnel.
1. This will involve an additional charge.
G. Follow-up by field services for "fine tuning" and additional configuration to occur approximately 90 days after system turnover.
1. This will involve an additional charge.
H. Re-occurring service contractor for site audit and continuing configuration on a 1, 2, or 3-year schedule after system turnover.
1. This will involve an additional charge.

1.6   CLOSEOUT SUBMITTALS
A. Sustainable design closeout documentation.
B. Wireless 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.

1.7   QUALITY ASSURANCE
A. Product shall confirm to requirements outlined in NFPA 70

B. Manufacturer: manufacturer shall have at least 10 years of experience in the manufacture of lighting control systems. Manufacturers that do not have at least 10 years of experience shall not be acceptable.
C. System components:
D. Listed by an OSHA Nationally Recognized Testing Laboratory specifically for the electronic ballast/driver loads. Provide evidence of compliance upon request.
E. Listed by FCC specifically for the required wireless communication protocols. Provide evidence of compliance upon request.

1.8 APPROVALS
A. 10-working days prior approval before bid date 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 30 business days in advance of the submission of approved construction documents.
C. For wired alternatives, manufacturer shall provide wiring diagrams and architectural details of interconnecting wiring for power signal and control. Contractor shall provide a labor cost (adder or deduction) to install the wired alternative to the lighting control system.

1.9 DELIVERY, STORAGE AND HANDLING
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.
E. The contractor is responsible for complete installation of the entire system according to strict factory standards and requirements.
F. Handling: packaging will include clear installation instructions for all components with typical illustrations of installation locations and connections. The installing contractor can easily match each package to the layout on the design floor plans.

1.10 PROJECT CONDITIONS
A. Do not install equipment until following conditions can be maintained in spaces to receive equipment:
B. Ambient temperature for indoor devices: 32°F to 104°F (0°C to 40°C)
C. Ambient temperature for outdoor devices: -40°F to 131°F (-40°C to 55°C)
D. Relative humidity: Maximum 90 percent, non-condensing.
E. Wireless lighting control system must be protected from dust during installation.
F. Ambient temperature for lighting management gateway: 32°F to 104°F (0°C to 40°C)
G. Coordinate layout and installation of luminaries and controls with other construction.
H. Coordinate site commissioning with manufacturer no less than 21 days prior to required date

1.11 WARRANTY
A. Manufacturer's standard limited warranty from the data of product shipment:
    1. Lighting Control Devices except supervisory controller: Five (5) years limited warranty
    2. Supervisory controller: One (1) year limited warranty

3.   Lighting Management software application: One (1) year warranty
B.   Contractor shall provide limited workmanship warranty for one (1) year from customer acceptance.
C.   Extended warranty options may be provided for an additional charge to extend the system warranty to a total of ten (10) years.
D.   Recommended spare parts:
   1.   WaveLinx ceiling sensors: provide one (1) of each product type for every 200 installed, to be used for maintenance.
   2.   Tilemount sensors: provide one (1) of each product type for every 100 installed, to be used for maintenance.
   3.   WaveLinx wallstations: provide one (1) of each product type for every 200 installed, to be used for maintenance.
   4.   WaveLinx receptacle: provide one (1) of each product type for every 100 installed, to be used for maintenance.
   5.   WaveLinx relay switchpack: provide one (1) of each product type for every 200 installed, to be used for maintenance.
   6.   Wireless Area Controller: provide one (1) of each product type for every 100 installed, to be used for maintenance.
   7.   Low-Voltage Power Module: provide one (1) for every 100 installed to be used for maintenance
   8.   WaveLinx touchscreens: provide one (1) of each product type for every 200 installed, to be used for maintenance.

1.12   COMMISSIONING
A.   Provide factory-certified field service engineer to a site visit to ensure proper system installation and operation under following parameters:
B.   Qualifications for factory-certified field service engineer:
   1.   Certified by the equipment manufacturer on the system installed.
C.   Conclude commissioning with a follow-up visit to:
   1.   Verify system control operation area by area.
   2.   Obtain sign-off on system functions.
   3.   User to be trained on system operation.

1.13   MAINTENANCE MATERIAL SUBMITTALS
A.   The manufacturer shall make available to the End-User a method of ordering new equipment for expansions, replacements, and spare parts through established distributor channels.
B.   The manufacturer shall make new replacement parts available for minimum of 5 years from date of manufacture.
C.   The manufacturer shall make directly available to the owner additional software apps that may be desired for a minimum of 10 years from the system's date of purchase.
D.   [The manufacturer shall provide extended support that is billable at an hourly rate] OR [support that can be purchased on an annual maintenance contract basis.]

PART 2 GENERAL SYSTEM REQUIREMENTS
2.1   DESCRIPTION & OPERATION
A.   The wireless lighting control system shall offer the following features:
   1.   Continuous dimming and automatic on/off controls

2. Indoor and outdoor occupancy control
3. Indoor and outdoor vacancy control
4. Indoor and outdoor daylight harvesting
5. Outdoor load control
6. Receptacle control
7. Load management
8. Multi-level scene control
9. 7-Days scheduling
10. Astronomic scheduling
11. Demand Response
12. Task Tuning
13. Manual control via wallstations or software apps
14. Energy usage data reporting
15. Occupancy data reporting
16. Automatic Energy Code Compliance
17. Configuration and management via mobile device for standalone area controller
18. Configuration and management via mobile device and web pages for connected area controller
19. Integration with third party systems via BACnet/IP and Public (REST) API
20. System health monitoring

B. The wireless lighting control system shall be capable of continuous dimming and switching allowing each fixture to monitor its local environment and provide distributed control in response to environmental changes.

C. The wireless lighting control system shall provide out-of-the-box functionality of all light fixtures with integrated sensors providing occupancy automatic on to 75% light level and automatic off after 20 minutes. Systems that do not include out-of-the-box functionality shall not be acceptable

D. The wireless lighting control system shall provide a method for the installer to verify wireless communications and address all wireless devices with a single push button. Systems that require device addressing using a manual data entry method through software shall not be acceptable.

E. The wireless lighting control system shall provide visible indication on all wireless devices when as each wireless device joins the wireless network. Systems that do not provide a visual indicator per device to the installer shall not be acceptable.

F. The wireless lighting control system shall provide the capabilities for the installer to create a construction group of all wireless occupancy sensors and wireless wallstations to control all installed wireless light fixtures.

G. The wireless lighting control system shall be able to be completely programmed and configured using a mobile application. Systems that require web or pc software for configuration shall not be acceptable.

H. The wireless lighting control system shall allow addressed wireless light fixtures with integrated sensors to be identified (reverse-identified) by the sensor with laser, flashlight, IR remote, etc. Identified light fixtures shall provide visible indication on the mobile application. Systems that do not permit reverse identification method shall not be acceptable.

I. The wireless lighting control system shall allow wireless wallstations, receptacles, wireless switchpack with 0-10V dimming and wireless battery powered sensors to be identified (reverse-identified) by a simple pushbutton method on each device. Identified devices shall

provide visible indication on the mobile application. Systems that do not permit reverse identification method shall not be acceptable.

J.   The wireless lighting control system shall support standalone and networked topologies. In a standalone topology, the Wireless Area Controllers shall not be connected to an IP network. The user shall be able to program the standalone area controller via a mobile app. In a networked topology, the Wireless Area Controllers are connected to an IP network and bi-directionally communicate with a supervisory system.

K.   The wireless lighting control system shall provide the energy usage, occupancy status, scene status and daylight information for all controlled spaces.

L.   The wireless lighting control system includes the following components:

1.   Wireless indoor ambient integrated sensors shall include passive infrared sensor, digital photocell, microprocessor, a wireless radio (IEEE 802.15.4), a Bluetooth radio for real-time location services (RTLS) and a load controller for ON/OFF/DIM.

2.   Wireless industrial integrated sensors shall include passive infrared sensor, digital photocell, microprocessor, a wireless radio (IEEE 802.15.4), a load controller for ON/OFF/DIM, and be field installed / replaced via an industry standard socket.

3.   Wireless outdoor integrated sensors shall include passive infrared sensor, digital photocell, microprocessor, a wireless radio (IEEE 802.15.4), a load controller for ON/OFF/DIM, and be field installed / replaced via an industry standard socket.

4.   Relay Switchpack with 0-10V control shall contain commercial grade power metering and a latching relay to control 20-amp load and 120mA 0-10V sink.   Device shall include LED indication and pushbutton for device override and identification.

5.   Contact Closure Input device shall be capable of providing a wired low-voltage input to the system with two (2) possible output results:
   a.   Connectivity to a wired low-voltage sensor or sensors up to 40mA
      •   Shall be capable of Passive Infrared (PIR) and multi-tech (PIR + ultrasonic)
      •   Shall be commissioned for occupancy or vacancy behavior
   b.   Connectivity to a maintained dry contact closure input
      •   Shall be commissioned to drive a scene for the included area

6.   Tilemount sensor kit shall include a digital photocell, microprocessor, a wireless radio (IEEE 802.15.4), a Bluetooth radio for RTLS services and a load controller for ON/OFF/DIM. Tilemount Sensor kit shall be capable of installation in indoor ceiling tile applications, and standard junction boxes

7.   Wallstation shall be available in two (2) input power varieties:
   a.   mains powered (120-277VAC)
   b.   Commercially available alkaline AAA battery powered
   c.   Both versions including the following features:
      •   Numerous button configurations, supporting small and large engraved buttons
      •   LED indication
      •   Universal light icon with raise/lower buttons
      •   Each button fully programmable for Area Scene or Zone control
      •   Wireless radio (IEEE 802.15.4)

8.   Battery-powered, wireless ceiling sensor shall include the following features:
   a.   Commercially available alkaline AA battery powered
   b.   Passive infrared motion sensor
   c.   Photocell daylight sensor

      d.   Wireless radio (IEEE 802.15.4)

      e.   LED indication and pushbutton for device identification.

9.   Low-Voltage Power modules to power:

      a.   12 X 100W (90W MAX) Class 2 outputs to connect low-voltage luminaires

      b.   Addressable digital communications

      c.   Integrated Class 1 wiring compartments for normal and emergency circuit wiring for centralized UL924 input

      d.   Two (2) low-voltage output circuits for emergency output (emergency lighting)

      e.   Daisy-chain wiring (up to 90W per output) with individually addressable low-voltage luminaires

      f.   Contact closure input for high priority system override

      g.   Plenum rated and passively cooled

      h.   IP communication to the area controller

10.   Touchscreen:

      a.   Send up to sixteen (16) pre-configured scene commands to an area

      b.   Change the light level of a lighting zone or zones within an area

      c.   PoE powered and IP communication to the area controller

      d.   Change the color temperature of a space via the associated correlated color temperature zone

11.   Wirelessly controlled receptacles shall include a constant hot and controlled plug output and include the following features:

      a.   The receptacle control shall provide a single input for incoming power, devices that require constant hot and switched inputs shall not be acceptable.

      b.   The receptacle control shall be clearly marked "Controlled" and with the NEMA defined controlled symbol ⏻

      c.   The receptacle control shall include a wireless radio (IEEE 802.15.4) to provide control and energy measurement data.

12.   Wireless Area Controllers shall support the following features:

      a.   Wirelessly communicate (IEEE 802.15.4) with all wireless sensors, wireless wallstations, wireless relays, and wireless receptacles to coordinate control areas and zones.

      b.   Wired communications through network switch to touchscreen interface to coordinate control areas and zones.

      c.   Power over Ethernet port to power the Wireless Area Controller and allow the connection of a Wireless Area Controller to a local area network (LAN).

      d.   802.11 radio acting as a Wi-Fi AP allowing a mobile device to connect to the Wireless Area Controller to program the lighting system.

      e.   802.11 radio acting as a wireless gateway allowing a mobile application or a supervisory system to communicate with the Wireless Area Controller via a wireless local area controller.

      f.   Up to 16 areas

      g.   Up to 16 zones per area

      h.   Up to 16 scene configurations per area

      i.   Up to 6 occupancy sets per area

      j.   Multiple daylight sets per area

      k.   Demand Response reduction values

      l.   Scheduling configuration

      m.   System backup and restore capabilities

n. Automatic Code Commissioning
o. Built-in astronomical clock

13. Mobile application shall communicate using Wi-Fi to a single Wireless Area Controller or a building IT network with multiple Wireless Area Controllers. The Mobile application shall include the following features:
a. Ability to connect to multiple Wireless Area Controllers
b. Administrative and user login credentials
c. Modes for both demonstration and live use
d. Automatic Code Commissioning
e. Drag and drop or multi select programming of wireless lighting system

14. Supervisory system shall allow users to monitor and control the lighting system from a central human machine interface (HMI) as well as integrate with third party system via standard based interfaces. The supervisory system shall include the following feature:
a. Ability to discover and connect to multiple Wireless Area Controllers
b. Aggregate data from the Wireless Area Controllers
c. Display the health data, i.e. devices faults notifications, and other system's notifications on a web-based HMI application.
d. Building editor allowing users to create their building hierarchy (campus, building, floors, areas, zones, devices) as well as floorplans for each floor
e. View areas/zones and devices on a floor plan and their status (on/off/dim and override)
f. Provide troubleshooting tips for each detected fault that would allow the individuals responsible to maintain and easily troubleshoot the system.
g. Display the energy usage of the lighting system including controlled receptacles.
h. Expose the data aggregated from the networked Wireless Area Controllers to third party system via BACnet/IP and Public (REST) API
i. Receive automatic demand response signal for load shedding from third party system via OpenADR, BACnet/IP and Public (REST) API and broadcast it to the connected Wireless Area Controllers.
  • The OpenADR interface shall be listed in the OpenADR certified product database
j. Send manual actions/overrides
k. Create/manage lighting system schedules
l. Create/Manage user accounts and user roles and associate areas to each user
m. Provide from deployed sensor network Real Time Location Services (RTLS) information with "Room Level" accuracy
  • This may require an additional software license charge and trackable devices.
n. Manage the supervisory system's software upgrades as well as Wireless Area Controllers
o. Backup/restore the Supervisory System (OS, application and database)

15. The supervisory system shall host applications that use the data gathered by the sensors to improve business processes. The applications shall provide the following benefits:
a. Locate equipment and personnel based on the BLE signals emitted by the BLE tags/badges associated to the equipment/personnel and received by the wireless integrated sensor and ceiling tile mounted sensors.
b. Provide insights about space usage based on occupancy data

c. These applications shall be pre-installed on the supervisory server and may require an additional software license.

2.2 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, without the need of programming or software. Systems that require software or commissioning to provide demand response integration shall not be acceptable. (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.

2.3   CYBERSECURITY

A. The IP network connectable products within the Wireless Lighting Control system must be UL2900-1 certified to the Standard for Software Cybersecurity for Network-Connectable Products. A letter of compliance by UL2900 authorized lab shall be provided for all IP connectable product. Self-certification will not be accepted.

B. Alternatively, the IP network connectable products within the Wireless Lighting Control system can comply with the IEC 62443-4-2 cybersecurity standard. A letter of compliance by an IEC authorized certification lab shall be provided for all IP connectable product. Self-certification to the standard will not be accepted.

PART 3 PRODUCTS

3.1   MANUFACTURERS

A. Acceptable Manufacturer: Cooper Lighting Solutions

B. Basis of design product: WaveLinx Wireless Connected Lighting system or subject to compliance and prior approval with specified requirements of this section, one of the following:

1. WaveLinx Connected Lighting (WCL) system

2. Or Pre- Approved Equal

C. Substitutions:

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. Proposed substitutes must be accompanied by a review of the specification noting compliance on a line-by-line basis.

2. 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.

3. By using pre-approved substitutions, the contractor accepts responsibility and associated costs for all required modifications to circuitry, devices and wiring. The contractor shall provide complete engineered shop drawings (including power and control wiring) with deviations from the original design, highlighted in an alternate color, to the engineer for review and approval prior to rough-in.

3.2   CONNECTED DEVICES

A. Load control devices

1. Product: WaveLinx Relay Switchpack with 0-10V Dimming [WSP-UV-010]

   a. Plenum rated

b. Integrated, self-contained unit consisting internally of an isolated load switching control relay [and a power supply to provide low voltage power].
c. 20amp 120/277/347VAC General Purpose
d. 16amp 120/277/347VAC electronic ballast (LED load)
e. Single class 2 0-10V dimming output (IEC 60929 Annex E) sinks up to 120mA per (40 μA max per circuit leakage to line)
f. 0-10V output supports up to 60 ballasts/drivers that draw a standard 2mA each
g. Calculated energy consumption data available through Trellix
h. Shall be compatible with electronic ballast, LED, incandescent, magnetic or electronic low voltage, and magnetic or electronic fluorescent, as well as motor loads.
i. Shall be capable of controlling up to 20 amp receptacle or plug loads.
j. Controls incorporate non-volatile memory. Settings and parameters saved in protected memory shall not be lost should power be interrupted and subsequently restored.
k. Relay Switchpack shall be FCC certified.
l. Relay Switchpack shall be a Class 1 device

2. Product: WaveLinx Emergency Relay Switchpack with 0-10V Dimming [WSP-UV-010-EM]
a. Plenum rated
b. Integrated, self-contained unit consisting internally of an isolated load switching control relay [and a power supply to provide low voltage power].
c. 20amp 120/277/347VAC General Purpose
d. 16amp 120/277/347VAC electronic ballast (LED load)
e. Single class 2 0-10V dimming output (IEC 60929 Annex E) sinks up to 120mA per (40 μA max per circuit leakage to line)
f. 0-10V output supports up to 60 ballasts/drivers that draw a standard 2mA each
g. Calculated energy consumption data available through Trellix
h. Shall be compatible with electronic ballast, LED, incandescent, magnetic or electronic low voltage, and magnetic or electronic fluorescent, as well as motor loads.
i. Shall be capable of controlling up to 20-amp receptacle or plug loads.
j. Controls incorporate non-volatile memory. Settings and parameters saved in protected memory shall not be lost should power be interrupted and subsequently restored.
k. Relay Switchpack shall be FCC certified.
l. Relay Switchpack shall be a Class 1 device
m. UL924 Listed for use with centralized EM generators

3. Product: WaveLinx Universal Dimming Switchpack with Dry Contact Closure [WSP-CA-010]
a. Plenum rated
b. Integrated, self-contained unit consisting internally of an isolated load switching control relay [and a power supply to provide low voltage power].
c. 20amp 347VAC General Purpose
d. 16amp 347VAC electronic ballast (LED load)
e. Single class 2 0-10V dimming output (IEC 60929 Annex E) sinks up to 30mA
f. 0-10V output supports up to 30 ballasts/drivers that draw

g. Calculated energy consumption data based on maximum connected power available through Trellix

h. Shall be compatible with electronic ballast, LED, incandescent, magnetic or electronic low voltage, and magnetic or electronic fluorescent, as well as motor loads.

i. Shall be capable of controlling up to 20Amp receptacle or plug loads.

j. Controls incorporate non-volatile memory. Settings and parameters saved in protected memory shall not be lost should power be interrupted and subsequently restored.

k. Relay Switchpack shall be FCC certified.

l. Relay Switchpack shall be a Class 1 device

m. Contact Closure Input capable of wired low-voltage sensor or maintained contact closure interface

4. Product: WaveLinx Receptacle [WR-15]

a. Integrated, self-contained unit providing a constant hot plug connection and a controlled plug connection.

b. 15amp 120VAC constant hot

c. 15amp 120VAC controlled load

d. Controlled load plug shall be labelled with "Controlled" and NEMA standard symbol for controlled plug loads.

e. Controlled outlet calculated energy consumption data available through Trellix

f. Shall provide LED indication of status and wireless communication as well as override button.

g. Controls incorporate non-volatile memory. Settings and parameters saved in protected memory shall not be lost should power be interrupted and subsequently restored.

h. WaveLinx Receptacle shall be FCC certified.

i. WaveLinx Receptacle shall be a Class 1 device

5. Product: WaveLinx Receptacle [WR-20]

a. Integrated, self-contained unit providing a constant hot plug connection and a controlled plug connection.

b. 20amp 120VAC constant hot

c. 20amp 120VAC controlled load

d. Controlled load plug shall be labelled with "Controlled" and NEMA standard symbol for controlled plug loads.

e. Controlled outlet calculated energy consumption data available through Trellix

f. Shall provide LED indication of status and wireless communication as well as override button.

g. Controls incorporate non-volatile memory. Settings and parameters saved in protected memory shall not be lost should power be interrupted and subsequently restored.

h. WaveLinx Receptacle shall be FCC certified.

i. WaveLinx Receptacle shall be a Class 1 device

6. Product: Control Module

a. Calculated energy consumption data based on maximum connected power available through Trellix

b. Controller to include latching relay, to decrease power requirements of the power pack.

     c.   Operate Bounce Time: 3 milli-seconds (MAX)
     d.   Max Switching Voltage 277VAC and 125VDC.
     e.   Insulation Rating: Class B and Class F.
     f.   Operations:
          •   Control Module and Sensor shall communicate energy usage Wireless Area Controller.
     g.   Listed to UL 916.
     h.   FCC Part 15 Class A certified.
     i.   Manufacturer to pre-wire control module in fixture.
     j.   Control module shall be plenum rated.
     k.   Connection between sensors and control module shall be Class 2, 18-24 AWG, stranded or solid depending on the application U.L Classified, PVC insulated or TEFLON jacketed cable suitable for use in plenums.

7.   Product: Low Voltage Power Module
     a.   12 X 100W to power and control up to 36 addressable low-voltage luminaires
     b.   Ethernet connectivity to a WaveLinx Wireless Area Controller
     c.   Support normal and emergency power inputs with two (2) EM outputs
     d.   ALERT dry contact closure input drives all connected low-voltage luminaires immediately to 100%
     e.   Passively cooled and plenum rated design for above ceiling installation
     f.   cUL listed
     g.   UL 2108 certified

8.   Product: WaveLinx Outdoor Load Control [WOLC]
     a.   Power failure memory:
          •   Controls incorporate non-volatile memory. Settings and parameters saved in protected memory shall not be lost should power be interrupted and subsequently restored.
     b.   Control wireless reporting:
          •   Load status
     c.   Outdoor load control shall turn ON/OFF/DIM connected outdoor luminaire based on wireless communications signal from the WaveLinx Wireless Area Controller.
     d.   The WaveLinx Wireless Area Controller shall control the Outdoor load controller using the following:
          •   Time Schedule
          •   Astronomic time schedule
          •   Manual pushbutton from a connected wallstation
          •   BACnet command
          •   API command
     e.   Controller shall wirelessly transmit; light level, power to the WaveLinx Wireless Area Controller which allows the data to be stored in a central location on premises and displayed via the WaveLinx Mobile Application.
     f.   Controller shall have remotely adjustable settings for dimming levels, time based light levels.
     g.   Controller shall have the ability to remotely adjust light output to reduced levels and remain at that reduced level for an adjustable time period before turning off when a space is vacant.

  h. Default programming is stored in each sensor in addition to the Wireless Area Controller. Sensors operate independently of from Wireless Area Controller, so there cannot be single point failure. Systems must operate so there is no single point of failure.

B. User Interfaces

 1. Product: WaveLinx Line-Voltage Wallstation [W1L-*],[W1L-RL-*],[W2L-*],[W2L-RL-*],[W3L-*],[W2S-*],[W2S-RL-*],[W4S-*],[W4S-RL-*],[W5S-*],[W6S-*]

  a. Mains powered wireless wallstation providing multi-level control of an area or zone

  b. 120-1277VAC input

  c. Shall provide individual button LED indication of status and wireless communication as well as selected button.

  d. Controls incorporate non-volatile memory. Settings and parameters saved in protected memory shall not be lost should power be interrupted and subsequently restored.

  e. WaveLinx Line-Voltage Wallstation shall be FCC certified.

  f. WaveLinx Line-Voltage Wallstation shall be a Class 1 device

  g. Wireless momentary pushbutton switches in 2, 3, 4, 5 and 6 button configurations; available in white, ivory, grey and black; compatible with wall plates with decorator opening. WaveLinx Line-Voltage Wallstations shall include the following features:

- Multi-level scene selection
- Scene raise/lower
- Toggle ON/OFF
- Removable buttons for field replacement with engraved buttons and/or alternate color buttons [ENGRV-*BTNL-*], [ENGRV-*BTNS-*]. Button replacement may be completed without removing the switch from the wall.
- Intuitive button labeling to match application and load controls.
- Pre-defined digital button configurations. Each wallstation is shipped with pre-defined digital button configurations which are automatically mapped to specific area/zone controls when added to an area in the WaveLinx Mobile Application.

  h. Multiple WaveLinx wallstations may be installed in an area by simply connecting them to the WaveLinx network. No additional configuration will be required to achieve multi-way switching.

  i. WaveLinx Line-Voltage Wallstations are delivered with pre-defined functions including, raise, lower, Half Lights, Full Lights, Read, Relax, Dimmed, Night, manual and scene control.

  j. WaveLinx Line-Voltage Wallstations may also be delivered with field programmable generic labeled buttons such as Scene 1, Scene 2, etc.

  k. Optional custom labeling is available for application or location specific wallstation button labels.

 2. Product: WaveLinx Battery Powered Wallstation [WB2L-*],[WB3L-*],[WB5-*],[WB6S-*]

  a. Battery powered wireless wallstation providing multi-level control of an area or zone

  b. Four (4) AAA standard alkaline batteries

      c.   Shall provide individual button LED indication of status and wireless communication as well as selected button.

      d.   Controls incorporate non-volatile memory. Settings and parameters saved in protected memory shall not be lost should power be interrupted and subsequently restored.

      e.   WaveLinx Battery Powered Wallstation shall be FCC certified.

      f.   Wireless momentary pushbutton switches in 2, 3, 5 and 6 button configurations; available in white; compatible with wall plates with decorator opening. WaveLinx Battery Wallstations shall include the following features:

- Multi-level scene selection
- Scene raise/lower
- Toggle ON/OFF
- Intuitive button labeling to match application and load controls.

      g.   Multiple WaveLinx wallstations may be installed in an area by simply connecting them to the WaveLinx network. No additional configuration will be required to achieve multi-way switching.

      h.   WaveLinx Battery Powered Wallstations are field programmable with specific labeling (FULL LIGHTS, HALF LIGHTS, etc.) or generic labeled buttons (Scene 1, Scene 2, etc.)

      i.   Optional custom labeling is available for application or location specific wallstation button labels.

    3.   Product: Touchscreen [TSE57-WLX-B]

      a.   Power over Ethernet (PoE – IEEE 802.3af) powered

      b.   Touchscreen to Wireless Area Controller communications via Ethernet

      c.   5.7” diagonal capacitive touch display screen

      d.   Installs to standard single gang wall box

      e.   Touchscreen to provide the following functions:

      f.   Send user-defined or pre-configured scene commands to an area

      g.   Change light levels for lighting in an area or zone

      h.   Change color temperatures for lighting in an area or zone

C.   Connected Sensors

    1.   Product: WaveLinx Ceiling Sensor [CWPD-1500]

      a.   Occupancy Sensing:

- PIR multiple segmented lens, with internal grooves to eliminate dust and residue build-up.
- Products tested in identical manner, complaint to NEMA WD 7 -2011 Occupancy Motion Sensors Standards
- Sensor shall have time delays from 10 to 20 min
- Sensor battery life shall be 10 years based on approximately 30 activations and wireless signals per day.

      b.   Daylight Sensing:

- Open loop daylight sensor
- 100-900lux
- Light input within 60° cone

      c.   Power failure memory:

- Controls incorporate non-volatile memory. Settings and parameters saved in protected memory shall not be lost should power be interrupted and subsequently restored.
- Sensor is battery powered by two (2) AA standard alkaline batteries

d. Sensor wireless reporting:
- Battery life through the WaveLinx Mobile Application
- Occupancy status
- Ambient light level

e. All sensors shall provide an LED as a visual means of indication at all times to verify that motion is being detected during both testing and normal operation

f. Sensor shall wirelessly transmit occupancy; light level, power to the WaveLinx Wireless Area Controller which allows the data to be stored in a central location on premises and displayed via the WaveLinx Mobile Application and Trellix software.

g. Sensors shall be fully adaptive with the ability to have the sensitively and timing to be remotely adjusted to ensure optimal lighting control for any use of the space.

h. Sensors have remotely adjustable settings for dimming levels, occupied/unoccupied light levels, occupancy/vacancy sensing, and sensitivity to changes in motion and changes in ambient light levels.

i. Sensors may remotely adjust light output to reduced levels and remain at that reduced level for an adjustable time period before turning off when a space is vacant.

j. Programming is stored in each sensor in addition to the Wireless Area Controller. Sensors operate independently of from Wireless Area Controller, so there cannot be single point failure. Systems must operate so there is no single point of failure.

2. Product: WaveLinx Integrated Sensor [WAA]
   a. Sensing mechanism:
   - [Infrared]: Utilize multiple segmented lens, with internal grooves to eliminate dust and residue build-up.
   - [Daylight]: Utilize integrated daylight sensor to provide closed loop daylight dimming control. Each WaveLinx Integrated Sensor provides an individual daylight dimming zone to provide highly accurate daylight levels at the work surface throughout the entire space.
   - [Location]: Utilize additional internal Bluetooth radio capable of offering Real Time Location Services (RTLS) – IoT Software Upgrade Required

   b. Power failure memory:
   - Controls incorporate non-volatile memory. Settings and parameters saved in protected memory shall not be lost should power be interrupted and subsequently restored.

   c. Products tested in identical manner, complaint to NEMA WD 7 -2011 Occupancy Motion Sensors Standards

   d. Sensor shall have time delays from 10 to 20 min

   e. Sensor shall provide unique daylight calibration considering light level at the sensors, work surface and integrated luminaire light output.

   f. All sensors shall provide an LED as a visual means of indication to verify that motion is being detected during both testing and normal operation

- Green LED indication when sensor is in out-of-the-box operation mode
- White LED indication when sensor has been connected to the WaveLinx lighting control system
  g. Test mode - fifteen second time delay
  h. Walk-through mode
  i. Sensors are RoHS compliant
  j. Sensor shall provide out-of-the-box functionality of occupancy detection, directly controlling integrated fixture.
- Occupied default light level is 75%
- Unoccupied default light level is OFF
- Occupancy default time out is 20 minutes
  k. Sensors shall monitor changes in occupancy, changes in ambient light levels and communicate digital control commands to light fixtures according to a control strategy.
  l. Sensor shall wirelessly transmit occupancy status and light level to the WaveLinx Wireless Area Controller which allows the data to be stored in a central location on premises and displayed via the WaveLinx Mobile Application and Trellix software.
  m. Calculated energy consumption data available through Trellix
  n. Sensors shall be fully adaptive with the ability to have the sensitivity and timing to be remotely adjusted to ensure optimal lighting control for any use of the space.
  o. Sensors have remotely adjustable settings for dimming levels, occupied/unoccupied light levels, occupancy/vacancy sensing, and sensitivity to changes in motion and changes in ambient light levels.
  p. Sensors may remotely adjust light output to reduced levels and remain at that reduced level for an adjustable period before turning off when a space is vacant.
  q. Default programming is stored in each sensor in addition to the Wireless Area Controller. Sensors operate independently of from Wireless Area Controller, so there cannot be single point failure. Systems must operate so there is no single point of failure.
3. Product: WaveLinx Tilemount Sensor Kit [WTA]
   a. Sensing mechanism:
- [Infrared]: Utilize multiple segmented lens, with internal grooves to eliminate dust and residue build-up.
- [Daylight]: Utilize integrated daylight sensor to provide closed loop daylight dimming control. Each WaveLinx Integrated Sensor provides an individual daylight dimming zone to provide highly accurate daylight levels at the work surface throughout the entire space.
- [Location]: Utilize additional internal Bluetooth radio capable of offering Real Time Location Services (RTLS) – IoT Software Upgrade Required
   b. Power failure memory:
- Controls incorporate non-volatile memory. Settings and parameters saved in protected memory shall not be lost should power be interrupted and subsequently restored.
   c. Tilemount sensor connects to a control module which supports up to 3 amps of connected fixtures.

d. Tilemount is designed to be installed in a ½" or ¾" ceiling tile within 54" (137cm) of the control module and connected fixtures.

e. Sensor shall provide unique daylight calibration considering light level at the sensors, work surface and integrated luminaire light output.

f. All sensors shall provide an LED as a visual means of indication and diagnostics.

g. Sensors are RoHS compliant

h. Control Module:

- Sensor shall connect to a 0-10V dimmable ballast or driver via a control module or connect to a WaveLinx enabled driver without the use of WaveLinx control module.

- Sensor shall connect to a controller via a low voltage cable for interior applications.

- If power dropouts in the event of a brown-out or black-out, when power is restored, the lighting system should recover quickly and automatically return to the last lighting levels. A momentary interruption (1 or 2 seconds) of power should not cause extended periods (20 seconds or more) without lighting while the system reboots and all other electrical equipment is back on.

- Control Module shall be installed by luminaire manufacturer and is shipped as an integral component to the luminaire.

i. Sensor shall be FCC certified.

j. Sensor shall be a Class 2 device.

k. System shall support user initiated manual demand response and utility or BMS initiated automatic demand response.

4. Product: WaveLinx Industrial Integrated Sensor [SWPD2, SWPD3]

a. Sensing mechanism:

- [Infrared]: Utilize multiple segmented lens, with internal grooves to eliminate dust and residue build-up.

- [Daylight]: Utilize integrated daylight sensor to provide closed loop daylight dimming control. Each WaveLinx Integrated Sensor provides an individual daylight dimming zone to provide highly accurate daylight levels at the work surface throughout the entire space.

b. Power failure memory:

- Controls incorporate non-volatile memory. Settings and parameters saved in protected memory shall not be lost should power be interrupted and subsequently restored.

c. Products tested in identical manner, complaint to NEMA WD 7 -2011 Occupancy Motion Sensors Standards

d. Sensor shall have time delays from 10 to 20 min

e. Sensor shall provide unique daylight calibration considering light level at the sensors, work surface and integrated luminaire light output.

f. All sensors shall provide an LED as a visual means of indication to verify that motion is being detected during both testing and normal operation

- Green LED indication when sensor is in out-of-the-box operation mode

- White LED indication when sensor has been connected to the WaveLinx lighting control system

g. Test mode - fifteen second time delay

h. Walk-through mode

i. Sensors are RoHS compliant

j. Sensor shall provide out-of-the-box functionality of occupancy detection, directly controlling integrated fixture.
- Occupied default light level is 100%
- Unoccupied default light level is 10%
- Occupancy default time out is 20 minutes

k. Sensors shall monitor changes in occupancy, changes in ambient light levels and communicate digital control commands to light fixtures according to a control strategy.

l. Sensor shall wirelessly transmit occupancy status and light level to the WaveLinx Wireless Area Controller which allows the data to be stored in a central location on premises and displayed via the WaveLinx Mobile Application and Trellix software.

m. Calculated energy consumption data available through Trellix

n. Sensors shall be fully adaptive with the ability to have the sensitivity and timing to be remotely adjusted to ensure optimal lighting control for any use of the space.

o. Sensors have remotely adjustable settings for dimming levels, occupied/unoccupied light levels, occupancy/vacancy sensing, and sensitivity to changes in motion and changes in ambient light levels.

p. Sensors may remotely adjust light output to reduced levels and remain at that reduced level for an adjustable period before turning off when a space is vacant.

q. Default programming is stored in each sensor in addition to the Wireless Area Controller. Sensors operate independently of from Wireless Area Controller, so there cannot be single point failure. Systems must operate so there is no single point of failure.

5. Product: WaveLinx Outdoor Integrated Sensor [SWPD4, SWPD5]

a. Sensing mechanism:
- [Infrared]: Utilize multiple segmented lens, with internal grooves to eliminate dust and residue build-up.
- [Daylight]: Utilize integrated daylight sensor to provide closed loop daylight dimming control. Each WaveLinx Integrated Sensor provides an individual daylight dimming zone to provide highly accurate daylight levels at the work surface throughout the entire space.

b. Power failure memory:
- Controls incorporate non-volatile memory. Settings and parameters saved in protected memory shall not be lost should power be interrupted and subsequently restored.

c. Products tested in identical manner, complaint to NEMA WD 7 -2011 Occupancy Motion Sensors Standards

d. Sensor shall have time delays from 10 to 20 min

e. Sensor shall provide unique daylight calibration considering light level at the sensors, work surface and integrated luminaire light output.

f. All sensors shall provide an LED as a visual means of indication to verify that motion is being detected during both testing and normal operation
- Green LED indication when sensor is in out-of-the-box operation mode

- White LED indication when sensor has been connected to the WaveLinx lighting control system
g. Test mode - fifteen second time delay
h. Walk-through mode
i. Sensors are RoHS compliant
j. Sensor shall provide out-of-the-box functionality of occupancy detection, directly controlling integrated fixture.
   - On at dusk / Off at dawn
   - Occupied default light level is 100%
   - Unoccupied default light level is 50%
   - Occupancy default time out is 15 minutes
k. Sensors shall monitor changes in occupancy, changes in ambient light levels and communicate digital control commands to light fixtures according to a control strategy.
l. Sensor shall wirelessly transmit occupancy status and light level to the WaveLinx Wireless Area Controller which allows the data to be stored in a central location on premises and displayed via the WaveLinx Mobile Application and Trellix software.
m. Calculated energy consumption data available through Trellix
n. Sensors shall be fully adaptive with the ability to have the sensitivity and timing to be remotely adjusted to ensure optimal lighting control for any use of the space.
o. Sensors have remotely adjustable settings for dimming levels, occupied/unoccupied light levels, occupancy/vacancy sensing, and sensitivity to changes in motion and changes in ambient light levels.
p. Sensors may remotely adjust light output to reduced levels and remain at that reduced level for an adjustable period before turning off when a space is vacant.
q. Default programming is stored in each sensor in addition to the Wireless Area Controller. Sensors operate independently of from Wireless Area Controller, so there cannot be single point failure. Systems must operate so there is no single point of failure.

6. Product: WaveLinx Outdoor Load Controller [WOLC]
   a. Sensing mechanism:
      - [Daylight]: Utilize integrated daylight sensor to provide open loop daylight dimming control. Each WaveLinx Outdoor Load Controller provides an individual daylight dimming zone to provide highly accurate daylight levels.
   b. Power failure memory:
      - Controls incorporate non-volatile memory. Settings and parameters saved in protected memory shall not be lost should power be interrupted and subsequently restored.
   c. Sensors are RoHS compliant
   d. Sensor shall provide out-of-the-box functionality of daylight detection, directly controlling integrated fixture.
      - On at dusk / Off at dawn
   e. Sensors shall monitor changes in ambient light levels and communicate digital control commands to light fixtures according to a control strategy.

f. Sensor shall wirelessly transmit light level to the WaveLinx Wireless Area Controller which allows the data to be stored in a central location on premises and displayed via the WaveLinx Mobile Application and Trellix software.

g. Calculated energy consumption data available through Trellix

h. Sensors shall be fully adaptive with the ability to have the sensitivity and timing to be remotely adjusted to ensure optimal lighting control for any use of the space.

i. Sensors have remotely adjustable settings for dimming levels and changes in ambient light levels.

j. Sensors may remotely adjust light output to reduced levels.

k. Default programming is stored in each sensor in addition to the Wireless Area Controller. Sensors operate independently of from Wireless Area Controller, so there cannot be single point failure. Systems must operate so there is no single point of failure.

3.3   Controllers and Supervisory Appliance

A.   Product: WaveLinx Wireless Area Controller [WAC-POE]

a. A server-class gateway that allow users to discover, program and manage WaveLinx connected devices, connected sensors and connected Apps.

b. Power source: standardized Power over Ethernet (IEEE802.3af) input, enables building PoE network switches (by others) or a PoE injector [WPOE-120] (accessory by Cooper Lighting Solutions) for power and network connection.

c. Maximum Ethernet (CAT5 or better) cable distance between the Wireless Area Controller and a network PoE switch is 328 feet (100 meters). Care shall be taken when routing the cable to not exceed the 328 feet (100 meter) limitation including travel distance up and down structures.

d. Wi-Fi access point to allow users to use the WaveLinx mobile app to program the system.

• User shall be able to disable/enable the Wi-Fi access point.

e. 2.4 GHz Transceiver for IEEE 802.15.4 wireless radio for communication to connected devices and sensors.

f. Shall support AES 128-bit encryption

g. Shall use industry standard HTTPS security with AES-128 encryption safeguards the integrity of the entire system.

h. LED indicators for status of various wireless radios and communications.

i. Shall be FCC Part 15 Class A, RoHS certified.

j. Wireless Area Controller connection cables shall be plenum rated.

k. Shall be Class 2 devices.

l. Shall have UL-2900 or IEC62443-4-2 certified by an authorized lab. Self-certification will not be accepted.

m. Spaces defined within the area controller shall be equipped with a control device to automatically shut off lighting in those areas. This automatic control device shall function on either:

• A timeclock scheduling basis where the interior and exterior lights controlled by the Wireless Area Controller are changed based on the time of day or the astronomic (sunrise and sunset).

a) The astronomical timeclock shall be integrated into the Wireless Area Controller and shall not require any internet connection to maintain its time.

b) The timeclock programming and time clock settings shall be retained after a power loss.
c) The timeclock shall allow weekly recurrences
d) Time clock events can be scheduled to:
. Set areas to desired scenes
. Zone light levels to the desired light level
. Zone light levels when occupied
. Zone light levels when unoccupied
- An occupancy basis where the interior and exterior lights controlled by the Wireless Area Controller are changed based on the occupancy set status. The occupancy set is composed of one or more occupancy sensors and it shall turn lighting off within 20 minutes of an occupant leaving a space
- A manual command basis where a user or a program send an override command using a wireless wallstation, the mobile application or via BACnet/IP or Public API. The BACnet/IP and Public API signal will be received via the Insight Manager/supervisory system.

n. Shall allow users to back-up the programming to prevent data loss and restore fixtures to operational modes.

o. Construction Grouping
a) PAIR button to allow automatic creation of Construction Group allowing simplified automatic control of all connected devices and sensors.
b) The patent-pending Construction Grouping mode permits contractors to complete a quick system start-up to confirm that the devices have been installed correctly, instead of waiting for factory-trained technicians to get the lights on a project in working order. Contractors follow a simple process to pair the wireless devices with the appropriate WAC and initiate occupancy-based lighting control functionality. This saves lighting energy during the construction phase of the project by ensuring that the lights are turned off when the area is unoccupied.
c) Construction grouping provides visual indication to the installer that devices have received wireless communication from the Wireless Area Controller and received a unique individual address. Systems that do not provide visual indication of device connection to the wireless network shall not be acceptable.
d) Construction grouping provides automatic grouping of connected devices to provide simple occupancy-based and wallstation control of all devices, without the need of a factory trained technician. Systems that require special software or training to group wireless devices shall not be acceptable.

p. Scalability and Data Integrity
a) The Wireless Area Controller can be deployed as a dedicated installation managing up to 150 wireless devices (connected devices, connected sensors). When deployed as a dedicated installation the Wireless Area Controller acts as a local wireless access point for Wi-Fi connection method to the WaveLinx Mobile Application.
b) The Wireless Area Controller can be deployed as a network installation managing up to 150 wireless devices (connected devices, connected sensors) per Wireless Area Controller. When deployed as a network

installation the Wireless Area Controller connects to the building LAN or wireless network as a client using DHCP. The maximum number or Wireless Area Controllers on the building network is dependent upon the building network configuration.

B. Trellix Core [TRX-TCPRO2, TRX-TCENT2, TRX-TCVRT2]
   a. An appliance that allows user to manage a connected system remotely via a web browser or mobile app.
   b. Ability to connect to up to 300 Wireless Area Controllers. The entry level model (Trellix Core Pro) shall support up to 20 Wireless Area Controllers while the enterprise level model (Trellix Core Enterprise) shall support up to 500 Wireless Area Controllers.
   c. Shall be able to be hosted on a virtual VMWare appliance (TRX-TCVRT2)
   d. Shall host all applications needed to manage the lighting system, analyze the data gathered by the sensors and locate assets/personnel.
   e. No need to install a software application.
   f. Shall hosts interfaces used to exchange data with third party system: BACnet/IP, REST API and OpenADR (for Title24 compliance).
   g. Shall have UL-2900 or IEC62443-4-2 certified by an authorized lab. Self-certification will not be accepted.

3.4   CONNECTED APPLICATIONS
A. Product: WaveLinx Mobile Application [WAPP]
   1. Administrative programming and editing may be conducted via an intuitive iOS or Android mobile application.
   2. WaveLinx Mobile Application shall support the following features:
      a. Network discovery of multiple Wireless Area Controllers
      b. Naming and identification of Wireless Area Controllers
      c. Unique administrative login credentials for each Wireless Area Controller
      d. Discovery of wireless devices per Wireless Area Controller (Find Devices)
      e. Creation of up to sixteen (16) areas per Wireless Area Controller
      f. Creation of up to sixteen (16) zones per area
      g. Creation of up to six (6) occupancy sets per area
      h. Creation of daylight sets for each integrated luminaire
      i. Creation of Demand Response values for each area
      j. Definition of scene values for each area
      k. Definition of schedules for each Wireless Area Controller
      l. Blink identification and reverse identification of each connected devices and sensor
      m. Identified connected devices and sensors will indicate on the WaveLinx Mobile Application their selection by the device icon pulsing on the screen.
      n. Ability to utilize drag and drop, multi select and filter capabilities for easy association of connected devices and sensors to a defined area.
      o. Automatic Code Commissioning features include:
         • Automatic association of all devices added to an area to provide a California Title 24 code compliant sequence of operations
         • All occupancy sensors are joined together to provide an Automatic ON to 50% light level

- All occupancy sensors are joined together to provide an Automatic OFF of all luminaires and plug loads after 20 minutes of with no occupancy detected.
- Automatic closed loop daylighting to approximately 500 lux (46 footcandles)
- Automatic wallstation button mapping providing the dominant button providing a 50% light level all other buttons provide multi-level dimming control from 30%-100%
- Automatic display of area power measurement data
- Automatic Demand Response of 20%
- Additional screens if needed to adjust Automatic Code Commissioning settings.

B. Product: Trellix Lighting [TRX-LGT250]
1. The application shall be offered as a mobile application running on Android and IOS devices as well as 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 be designed for 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 devices, 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
   e. Individual control devices can be monitored for on/off status
   f. Individual control devices can be modified to define light levels or on/off status.
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 Wireless Area Controller, wireless wallstation, wireless ceiling sensor, wireless switchpack, wireless daylight sensor, wireless control module and low battery alarms.
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.
12. The system shall display the energy usage for the buildings controlled by the WaveLinx system:
    a. The user shall be able to filter the data based on the building hierarchy, i.e. building, floors, areas and zones as well as the source type, i.e. lighting and/or receptacles.

b. The system shall be able to collect energy usage data for 13 consecutive months.
c. The user shall be able to change the period for the energy usage, i.e. last 24 hours, last 7 days, last 30 days, last 3 months, last 12 months.
d. The user shall be able to see the energy savings generated by the lighting system at minimum in kWh for the selected period.
e. The user shall be able to see the average energy savings for the selected period.
13. The system shall display the space for the buildings controlled by the WaveLinx system:
    a. The user shall be able to filter the data based on the building hierarchy, i.e. building, floors, areas and zones.
    b. The system shall be able to collect space usage data for 13 consecutive months.
    c. The system shall display the space usage based on 24 hours or working hours.
    d. The system shall display in sorting order the least to most used spaces.
    e. The system shall display on a floorplan the space usage for each area based on selected period.
C. Product: BACnet Interface (TRX-BAC250)
    a. Allow a building automation system to gather data from the lighting system and control the light levels within difference spaces.
    b. The BACnet/IP interface shall support the following capabilities:
- Monitor (Read):
    a) Area scene
    b) Area energy usage
    c) Dimming zone level (0-100%)
    d) On/off zone level (on/off)
    e) Occupancy sensor's occupied/unoccupied status
    f) Daylight sensor's level
- Control (write):
    a) System-wide Demand Response enable/disable
    b) Building light level
    c) Floor light level
    d) Area scene
    e) Dimming zone level (0-100%)
    f) On/off zone level (on/off)
    g) Occupancy sensor
    c. The system shall be able to allow users to select which object types the system shall expose, i.e. Area, Zones, input devices and output devices.
    d. 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.
D. Product: Public API (TRX-API250)
    a. The Public API shall support the following capabilities:
- The Public API interface shall support the following get/put capabilities:
    a) Get:
      . Building hierarchy information (areas, zones, devices)
      . Area scene
      . Area energy usage
      . Dimming zone level (0-100%)
      . Zone level (on/off)
      . Occupancy sensor's occupied/unoccupied status

. Occupancy set status
. Daylight sensor's level
b) Put:
. System-wide Demand Response enable/disable
. Area scene
. Dimming zone level (0-100%)
. Zone level (on/off)
. Occupancy sensor
E. Product: OpenADR interface (TRX-OPNADR)
   a. The interface shall allow user to connect their lighting system with utility companies' Demand Response Automation Server (DRAS) using OpenADR 2.0b standard.
   b. Initiate load shed event using OpenADR protocol in an auto-Demand-Response event without additional interfaces or gateways.
   c. The OpenADR interface shall be
F. Product: Trellix Locate (TRX-LOCBAS)
   a. The application shall enable users to enable real time location services on the sensors.
   b. The application shall allow users to assign Bluetooth Low Energy tags to assets or people.
   c. The application shall allow users to track equipment and locate people in real-time in a floor plan view and table view with "room-level accuracy"
   d. The application shall allow users to search and filter for a particular asset they are looking for using the parameters defined.
   e. The application shall allow users to review historical movement of an asset or a person in floor plan view.
   f. The application shall provide location data through Application Programming Interface (API)

PART 4 Execution

4.1   INSTALLATION
A. The control system shall be installed and fully wired as shown on the plans by the installing contractor. The contractor shall complete all electrical connections to all control circuits.
B. Install the work of this Section in accordance with manufacturer's printed instructions unless otherwise indicated.
C. Provide written or computer-generated documentation on the commissioning of the system including room by room description including:
D. Sensor parameters, time delays, sensitivities, and daylighting setpoints.
E. Sequence of operation, (e.g. manual ON, Auto OFF. Etc.).
F. Load parameters (e.g. blink warning, etc.).

4.2   PRODUCT SUPPORT AND SERVICE
A. Factory telephone support shall be available at no cost to the owner. Factory assistance shall consist of solving programming or application questions concerning the control equipment.

4.3   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 Connected Lighting system:
   1. Verify locations of Wireless Area Controllers
   2. Verify implementation of Construction Group process
   3. Identify connected devices and program using WaveLinx Mobile and Automatic Code Commissioning.
   4. Verify that system operation control based on defined Sequence of Operations (SOO).
   5. 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 Connected Lighting system may be required outside of normal business hours (Monday through Friday, 7 a.m. to 5 p.m.).

4.4 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.

4.5 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 Connected Lighting bill of materials.

END OF SECTION