

SECTION 26 09 43 - NETWORKED LIGHTING CONTROLS

PART 1 - GENERAL

1.1 REFERENCED DOCUMENTS

- A. Comply with Division 1 - General Requirements and related documents.
- B. Comply with all other Division 26 sections as applicable.
- C. Refer to other Divisions for coordination of work with other portions of work.

1.2 DESCRIPTION

- A. Work Included: Provide a distributed, low voltage, lighting controls system with networked devices. Provide full web based central control software with lighting controls graphical user interface from an owner's networked PC.
- B. Related work specified in other Sections:
 - 1. 26 00 00 - Electrical
 - 2. 26 05 19 - Low Voltage Electrical Power Conductors and Cables
 - 3. 26 05 33 – Raceways and Boxes for Electrical Systems
 - 4. 26 09 23 – Lighting Control Devices
 - 5. 26 51 19 – LED Interior Lighting
 - 6. 26 56 19 – LED Exterior Lighting

1.3 QUALITY ASSURANCE

- A. Factory Assembly: All system components shall arrive at the job site completely pre-wired and ready for installation, requiring only the connection of lighting circuits and network terminations. All connections shall be made to clearly and permanently labeled termination points. Systems that require field assembly shall not be acceptable.
- B. Component Testing: All system components and assemblies shall be individually tested prior to assembly. Once assembled, all finished products shall be tested for proper operation of all control functions per specifications prior to shipment.
- C. NEC Compliance: All system components shall comply with all applicable sections of the National Electrical Code (NEC) as required.
- D. NEMA Compliance: All system components shall comply with all applicable portions of NEMA standards pertaining to types of electrical equipment and enclosures.
- E. UL Approval: All applicable equipment shall be tested to and listed under UL standard 508 and shall bear labels to indicate compliance. Lighting control relays shall be tested to UL standard 508 for both safety and endurance. System listed other ETL or other UL sections shall provide documentation proving compliance with UL standard 508.

1.4 SUBMITTALS

- A. Submittals shall include, but not be limited to, the following:
 - 1. Product data on all lighting control system components and accessories.
 - 2. Reflected ceiling plan drawings showing specific locations of occupancy sensors for lighting control including lines delineating sensor effective range, with and without furniture system partitions, sensor type, sensor mounting, and other pertinent data to allow evaluation of the proposed system.
 - 3. Wiring diagrams for occupancy sensors, related control units, and override switches including an overall system riser diagram.
 - 4. Make submittals in accordance with Division 01.
 - 5. Submit factory approved lighting controls layout showing all devices and proposed devices locations.
 - 6. Sample graphical user interface showing sample home page, floor plan graphics with lighting control zones, and sample scheduling and override features.
 - 7. Lighting controls system final report.

1.5 DELIVERY STORAGE AND HANDLING

- A. Deliver devices and cover plates in manufacturer's sealed unopened packages and protect from the introduction of dust and moisture.
- B. Do not install sensors and cover plate until adjacent finishes are complete and the area has been cleaned to a dust free dry environment.

1.6 MANUFACTURER

- A. The equipment shall be the product of a manufacturer with a minimum of ten years experience with the manufacture of similar equipment .
- B. Acceptable Manufacturer (no substitutions accepted):
 - 1. Wattstopper

1.7 WARRANTY

- A. Provide a five year parts and one year labor warranty. Warranty coverage shall begin at the time of Project Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Summary:
 - 1. The lighting control system specified in this section shall provide time-based, sensor-based (both occupancy and daylight), and manual lighting control.
 - 2. The system shall be capable of turning lighting loads on/off as well as dimming lights (if lighting load is capable of being dimmed). Specific dimmers will be capable of "dimming lights

- to off".
3. All system devices shall be networked together, enabling digital communication between devices, and shall be individually addressed.
 4. The system architecture shall be capable of enabling stand-alone groups (rooms) of devices to function in some default capacity, even if network connectivity to the greater system is lost.
 5. The system architecture shall facilitate remote operation via a computer connection.
 6. The system shall not require any centrally hardwired switching equipment.
 7. The system shall be capable of wireless, wired, or hybrid wireless/wired architectures.

B. System Requirements:

1. System shall have an architecture that is based upon three main concepts; 1) intelligent lighting control devices 2) standalone lighting control zones 3) network backbone for remote or time based operation.
2. Intelligent lighting control devices shall consist of one or more basic lighting control components; occupancy sensors, photocell sensors, relays, dimming outputs, manual switch stations, and manual dimming stations. Combining one or more of these components into a single device enclosure should be permissible so as to minimize overall device count of system.
3. System must interface directly with intelligent LED luminaires such that only plenum rated CAT-5 cabling is required to interconnect luminaires with control components such as sensors and switches (see Networked LED Luminaire section).
4. Intelligent lighting control devices shall communicate digitally, require <7 mA of current to function (Graphic wall stations excluded), and possess RJ-45 style connectors.
5. Lighting control zones shall consist of one or more intelligent lighting control components, be capable of stand-alone operation, and be capable of being connected to a higher level network backbone.
6. Devices within a lighting control zone shall be connected with plenum rated CAT-5e low voltage cabling in any order.

2.2 DIGITAL ROOM CONTROLLER

- A. As indicated and where shown on the plans, install room controllers to control the quantity of lighting and plug loads required.
- B. Room controllers shall provide 0 - 10 volt dimming capability for the required number of lighting loads.
- C. Room controllers shall integrate the functionality of connected control components including wall switch stations, occupancy sensors and daylight sensors to provide the required sequence of operation for the space.
- D. Room controllers and associated room control components shall operate in a totally stand alone mode and not require the use of a network, software, computer or server for local control and time based functions.
- E. Functional:
 1. Provide an integral pushbutton and LED indicator for each load for status and to allow operation of the relays and dimmers for testing and verification without requiring other control devices to be connected.
 2. The room controller shall have a default operation providing an automatic logical sequence of operation for each load as the room control devices are plugged into the Smart Port connectors.
 3. Default operation for occupancy sensors shall be automatic on, automatic off for all loads.
 4. Upon connection of a switch, the operation shall automatically change to manual on,

- automatic off (vacancy) mode for all loads.
5. Provide capability to convert each load independently to automatic on or vacancy mode using only the integral push buttons and LED indicators on the room controller.
 6. When in vacancy mode, provide a 30 second grace period after an off during which automatic on shall be temporarily enabled.
 7. It shall be possible to connect up to eight (8) room controllers together using Cat5 patch cables to provide configurations up to 16 switched and dimmed loads operating as a single zone.
 8. Provide the following set up and configuration functions without the need for additional devices or software:
 - a. Assign/reassign relays for control by wall switch station buttons.
 - b. Configure relays for occupancy or vacancy operation.
 - c. Assign/reassign dimmers to raise/lower switches.
 - d. Assign dimming channels for response to daylight sensor control.
 - e. Auto calibrate default daylight sensor sequence of operation.
 - f. Save preset scenes.

2.3 NETWORK BRIDGE MODULE

- A. The network bridge module allows multiple room controller zones to be networked with other system devices for whole building administration of lighting control functions.
- B. The bridge shall connect to and be powered from a room controller smart port via a standard plenum rated Cat5 cable.
- C. Two additional RJ-45 ports on the bridge shall provide an in and out connection point for an Ethernet based network.
- D. The network bridge module shall provide a communication link between the room control devices and the system area controller via an Ethernet based network. At a minimum, the network link shall provide the following functionality through a web browser user interface:
 1. Report the current occupancy status for each lighting control zone.
 2. Indicate the status of each relay and dimming channel.
 3. Allow reconfiguration of system device input and output parameters.
 4. Report the real time power consumption for each Room Controller.
 5. Set up daylight harvesting for zones equipped with photocells.
 6. Configure and download schedules to panels and Room Controllers.

2.4 LIGHTING CONTROL PANELS

- A. Panels shall be configured with the quantity of relays and 0 - 10 volt dimming channels as indicated.
- B. Functional:
 1. The lighting control panels shall be of the distributed intelligence type and shall not be dependent a network connection to execute schedules or perform programmed functions.
 2. Relays, dimmers, and low voltage inputs shall be assignable to control zones as required via the web browser user interface.
 3. Each panel shall have low voltage input terminals for connection of Class 2 devices.
 4. Inputs shall be programmable to support momentary or maintained contact types and shall provide for alternate action on/off, on only, off only, raise, lower, timed on or preset recall operation.
 5. Each panel shall provide capability to control external devices through integral form-C low voltage contacts.

6. Dimming outputs shall be industry standard 0 - 10 volt current sinking type and provide continuous dimming for compatible dimming ballasts and LED drivers.
7. Dimming channels shall be assignable to control zones as required via the web browser user interface.
8. Dimming channels shall be configurable to respond to manual raise/lower wall switch control stations, preset scenes, or daylight harvesting photocells.

2.5 LOW VOLTAGE SWITCH STATIONS

- A. Low voltage digital wall switch stations shall be of the programmable type using plenum rated Cat5 cabling for connection to system smart port.
- B. Stations shall have one to six buttons and provide lighting control functions as called out and shown on the plans.
- C. All switches shall be single gang and be of the generic decorator style allowing easy ganging and use of a wide array of standard wall switch plate options.
- D. Provide two RJ-45 ports per switch to allow for daisy chain connection of up to eight switches to each smart port.
- E. Switch station color shall be white with white cover plates.

2.6 OCCUPANCY / VACANCY SENSORS

- A. Occupancy sensors shall be ceiling or wall mounted and use dual technology (ultrasonic and passive infrared), ultrasonic and/or passive infrared (model specific) sensing technology as indicated. Dual Technology shall be the default selection.
- B. Sensors shall be Class 2 and connect to any room controller smart port using a wiring adaptor and standard Cat5 patch cable.
- C. Occupancy sensors shall be self adaptive and not require manual calibration after installation. Digital circuitry and logic shall automatically make adjustments to the sensitivity and time delay based on learned occupancy patterns and the environment in which the sensor is installed.
- D. Sensors using both ultrasonic and passive infrared (dual technology) shall operate such that detection by both technologies is required to initiate occupancy and continued detection by either technology will maintain occupancy.
- E. Up to four occupancy sensors may be connected to one room controller.

2.7 DAYLIGHT SENSORS

- A. Daylight sensors shall provide ambient light level information to the room controller allowing daylight responsive lighting control.
- B. The system shall operate in an open loop sequence of operation reducing the amount of electric light as the quantity of daylight entering the room increases.
- C. It shall be possible to configure up to six daylight zones in a room. Each zone shall be programmable to proportionally respond to the light level provided by the daylight sensor.

- D. The daylight sensor shall be mounted and positioned to provide an unobstructed view of the windows per the manufacturer's directions.

2.8 AREA CONTROLLER

- A. Web browser based system programming, monitoring and administration shall be provided by the area controller.
- B. The Area Controller shall have the ability to communicate by means of TCP/IP over Ethernet allowing enterprise connectivity between the NX Distributed Lighting Control System and external LAN or WAN networks.
- C. Provide integral capability to communicate with the Building Automation System via BACnet MSTP protocol.

2.9 WIRED OR HYBRID ROOM HANDHELD CONFIGURATION TOOL

- A. Provide handheld configuration tool to facilitate customization of Wired DLM devices using two-way infrared communications. Can be used with or without PC software that connects to each local network via a USB interface (LMCS described later).
- B. Features and functionality of the handheld configuration tool shall include:
 - 1. Two-way infrared (IR) communication with DLM IR-enabled devices within a range of approximately 30 feet.
 - 2. High visibility organic LED (OLED) display, pushbutton user interface and menu-driven operation.
 - 3. Must be able to read and modify parameters for load controllers and relay panels, occupancy sensors, wall switches, daylighting sensors, network bridges, and identify DLM devices by type and serial number.
 - 4. Save up to eight occupancy sensor setting profiles and apply profiles to selected sensors in same room or other rooms.
 - 5. Adjust current light level of any load(s) on the local network and capture those levels in scene setting. If fixtures with DLM tunable white Blanco devices are present in room, handheld can also adjust their CCT level.
 - 6. Set room mode for testing of Normal Hours (NH) and After Hours (AH) parameter settings, enable or disable load shed status, and identify all IRB connected devices by their part number, and hardware/firmware versions.
 - 7. Adjust or fine-tune daylighting settings established during auto-configuration, and input light level data to complete configuration of open loop daylighting controls.
 - 8. Verify status of Bridge Devices connected to Wired or Wireless Segment networks.
- C. Wattstopper Product Numbers: Handheld LMCT-100-2

2.10 FRONT END NETWORK CONTROLLER WITH SEGMENT MANAGER STATION AND BAS INTEGRATION

- A. For networked applications, the Digital Lighting Management system can include one or more Front End Network Controllers with Segment Manager Interface (referred to as a Network Controller below) to manage network communication. It shall be capable of serving up a user interface to a standard web browser.
- B. Each Network Controller shall have integral support for two wired MS/TP segment networks.

Segment networks may alternately be connected to the Network Controller via external BACnet/IP interface routers or Wireless Border Routers and Network switches using Ethernet structured wiring. Each router shall accommodate one "segment" - respectively a wired MS/TP run or Wireless Mesh Segment Network. Provide the quantity of routers and switches as shown on the Drawings.

- C. Operational features of the Network Controller shall include the following:
1. Connection to PC or LAN via standard Ethernet TCP/IP via standard Ethernet TCP/IP with the option to use SSL encrypted connections for all traffic.
 2. Easy to use graphical user interface, compatible with current Chrome or equivalent browser. The Network Controller shall not require installation of any lighting control software on an end-user PC, but if Manufacturer's Lighting Control Software is installed, it shall be able to work in tandem with the Network Controller without issue.
 3. Log in security capable of restricting some users to view-only or other limited operations.
 4. Network Controller with N4 operating systems shall include two main sets of interface screens - those used to initially configure the unit (referred to as the config screens), and a those used to allow users to dynamic monitor the performance of their system and provide a centralized scheduling interface. Capabilities using the Config Screens shall include:
 - a. Automatic discovery of DLM devices and relay panels on the segment network(s). Discovery function shall provide communication, monitoring or control of all local devices and lighting control panels.
 - b. Allow information for all discovered DLM devices to be imported into the Network Controller via a single XML based site file from manufacturer's software, reducing the time needed to make a system usable by the end user. Importable information can include text descriptions of every DLM component and individual loads, and automatic creation of room location information and overall structure of DLM network. Info entered in LMCS should not have to be re-entered manually via keystrokes into the Network Controller
 - c. After discovery, all rooms and panels shall be presented in a standard navigation tree format. User selection of a device in the tree will allow its settings and operational parameters to be viewed and changed.
 - d. Ability to view and modify DLM device operational parameters. It shall be possible to set device parameters independently for normal hours and after-hours operation including sensor time delays and sensitivities, and load response to sensor of Manual-On or Auto-On.
 - e. Provide capabilities for integration with a BAS via BACnet protocol. Depending on project hardware, previously mentioned BACnet points shall be available to the BAS via BACnet/IP connection to the Network Controller: room occupancy state; room schedule mode; room switch lock control; individual occupancy sensor state; room lighting power; room plug load power; load dimming level. BACnet items shall be capable of being moved into an "Export Table" that will provide any integrator with only the data they need, and by using the Export Table effectively create a firewall between the integrator's request for info and the overall system performance.
 5. Capabilities using the Network Controller with N4 operating system's Dashboard Screens shall include:
 - a. Ability to set up schedules for DLM local networks (rooms) and panels. Schedules shall be capable of controlling individual rooms or groups of loads with either on/off or normal hours/after hours commands. Support for annual schedules, holiday schedules and unique date-bound schedules, as well as Astro On or Astro Off events with offsets. Schedules shall be viable graphically as time bars in a screen set up to automatically show scheduled events by day, week, or month.
 - b. For fixtures that have CCT capability as specified under paragraph "Digital Wall Switch and Timer For Correlated Color Temperature", the Network Controller will provide schedule functionality similar to the CCT Wall Timer.
 6. If indicated by the Drawings, Network Controllers shall be integrated into a larger overall network by the addition of a Network Supervisor package. The Supervisor is a server level

computer running a version of the Network Controller software with dedicated communication and networking capability, able to pull information automatically from each individual Network Controller. Using a Supervisor, information from individual Network Controllers can be accessed and stored on the Supervisor's hard drive, eliminating the risk of data being overwritten due to Network Controller memory limits.

D. BAS Integration

1. Existing BAS system is EIOS Tridium N4
 - a. Version 3.x segment manager shall be ready to integrate via a BACnet driver/controller to read points from Wattstopper System
2. Integration shall be via BACnet export table from the LMJA JACE and shall be capable of integration via BACnet IP
3. Ensure that all components are included for a fully functional integrated system

2.11 EMERGENCY LIGHTING INTERFACE

- A. Where emergency lighting is to be controlled by the lighting control system, provide UL924 listed load control relays as necessary to insure that emergency lights are automatically turned full on upon loss of normal power to the area.

2.12 WEB BASED CENTRAL CONTROL SOFTWARE

- A. Web based Central Control Software: Central control software application is used to commission, configure and manage the system. Every system parameter in the building and associated exterior areas is configured for each individual user or space and baseline settings are established for each of the following (depending on the basis of design) system features:
1. Daylight harvesting.
 2. Occupancy control.
 3. Smart time scheduling.
 4. Task tuning.
 5. Personal control.
 6. Load shedding.
- B. Software utilizes a web-based interface that permits a user to easily navigate between zones, floors or different buildings and allows a user to zoom in or zoom out of specific areas of a building. Both 3-dimensional and two-dimensional multi-floor views shall be available. System features such as creation of zone hierarchies, overlapping and support zone definitions, user access rights, timeout settings for occupancy sensors, calibration of light levels for daylight harvesting and the configuration of multiple time schedule profiles shall be available. A web based Graphical User Interface (GUI) application integral to the system will be used to develop a dynamic, real-time, point- and-click graphic of each floor plan with representation of all light luminaire, wall stations, sensors, switches, etc. A central system server will be provided to support system data base and enterprise control management.
1. System Requirements:
 - a. Software must be able to run on a Windows operating system (Windows 10) and also on Apple Mac Intel PCs.
 - b. Must support all common browsers, i.e.,
 - 1) Internet Explorer
 - 2) Mozilla Firefox
 - 3) Safari
 - 4) Google Chrome

- c. Must provide network connection/access to all network-enabled devices.
- C. The GUI shall give the user the ability to temporarily override timeclock and zone parameters on a zone-by-zone basis for after-hours events.
- D. All programming shall be provided by the lighting controls system manufacturer.

2.13 EMERGENCY MANAGEMENT SYSTEM (EMS) GATEWAY

- A. System shall provide a BACnet IP gateway as a downloadable software plug-in to its management software.
- B. System shall be capable of communicating and receiving input from the owner's Alerton EMS system.
- C. BACnet IP connection shall also be available utilizing JACE-600 hardware unit.
- D. BACnet IP hardware shall be capable of supporting up to 1500 total devices across up to 5 total Gateways.
- E. BACnet IP connection shall communicate information gathered by networked system to other energy management systems.

2.14 MAINTENANCE AND OPERATIONAL SERVICES AND PRODUCTS

- A. Remote Access and Enhanced Warranty for Networked Lighting Controls: Provide Manufacturer's Remote Access and Enhanced Warranty for Networked Lighting Controls as follows:
 - 1. Configure to allow the manufacturer remote access to the lighting control system. Configuration includes at a minimum: cellular modem, antenna for the modem, cellular service contract and any components required to enable communication to the specified Network Lighting Control system.
 - 2. Remote Access program automatically triggers a First Year Enhanced Warranty Agreement starting once lighting control system startup is complete and accepted by the Owner. During this one year period, the Owner's authorized site contact can request the manufacturer to check the system for proper operation and make any programmable changes desired. Manufacturer shall provide a phone number dedicated to customer calls concerning Remote Accessible systems and a support organization capable of enabling cellular communication to the system for troubleshooting and making requested changes to the system. Users requesting remote support on the system shall be fully verified by the Remote Operations Center (ROC) before providing remote support or making any changes to the system. Systems that allow the modem to be always accessible will not be acceptable. Access must be by a secured VPN connection to the private lighting control network that is completely isolated from the Owner's internal network. Remote access that requires a connection through the Owner's internal network is not acceptable.
 - 3. Owners may continue the Remote Access Program after the first year. However, if the Owner does not continue the enhanced warranty the cellular contract will lapse, and all hardware components, while still remaining property of the manufacturer, will remain in situ so that they can be re-activated at a later time should the Owner desire.
 - 4. Manufacturer's Remote Access capability shall provide at a minimum the following features:
 - a. Ability to provide initial system diagnostics through LMCS Software to detect fault conditions in wiring or connected devices.
 - b. Access to all devices via LMCS Software to program device functions. This will include scheduling of Time of Day Events and programming of individual device parameters to meet Sequence of Operation requirements.

- c. Access to the LMJA-8xxx browser-based interface (if included on project) to verify it is setup per project documentation and is completely functional.
 - d. On demand access to manufacturer technical support via a Remote Operations Center (ROC) that will provide remote troubleshooting, diagnostics, and configuration/programming assistance.
 - e. Additional client training and tuning on the Lighting Control System after building occupancy can be performed while remotely connected to the site.
 - f. Site Readiness Check (SRC) which allows the Remote Operations Center to perform a remote discovery of all devices connected to the lighting control network during installation. DLM Networked projects that have a RACCESS cellular modem and have successfully completed the SRC process, defined as 80% or more of the networked devices are found during network discovery, will receive priority scheduling. After scheduled on site startup, all manufacturer provided startup work for a site with a successful SRC will be done remotely, or via complimentary return trips.
5. Remote troubleshooting, programming, and configuration support shall be included complimentary for one (1) year of service. Included two (2) additional years of support for a total of three (3) years of service. Cellular modem and antenna to be included in the system as a part of Wattstopper controls.
- a. Wattstopper product numbers: RACCESS

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install lighting controls as required and where indicated, in accordance with manufacturer's written instructions and project shop drawings, applicable requirements of NEC, and recognized industry practices to ensure that products serve intended function.
- B. Sensor Design and Layout:
 - 1. It shall be the equipment manufacturers'/ contractors' responsibility to provide the quantity of sensors required for complete and proper coverage without gaps within the range of coverage of controlled areas. Rooms shall have 100% coverage to completely cover the controlled area to accommodate all occupancy habits of single or multiple occupants at any location within the room. The locations and minimum quantities of sensors shown on the Drawings are diagrammatic and indicate only rooms which are to be provided with sensors. The equipment manufacturer/contractor shall provide additional sensors if required to properly and completely cover the respective room. Proper judgment must be exercised in executing the work so as to ensure the best possible installation in the available space and to overcome local difficulties due to space limitations or interference of structural components.
 - 2. Exact locations of control unit hardware boxes shall be based on observing good installation practice and shall be coordinated with other elements of the reflected ceiling plan. Control unit hardware shall be fully concealed.
- C. Box Condition: Install low voltage lighting control devices only in electrical boxes which are clean, free from excess building material, debris, and similar matter.
- D. Wiring:
 - 1. All branch circuit wiring shall be installed in an approved raceway.
 - 2. Low voltage wiring shall be installed in an approved raceway where concealed in inaccessible locations or exposed. Where low voltage wiring is concealed in accessible ceiling plenums, it may, with pre-approval from the Owner and Engineer, be routed without a raceway using

- air plenum rated cable.
3. All low voltage wiring shall be color coded and identified or tagged at terminals to assist with future maintenance.

E. Sensor Testing and Adjustment: At the time each sensor is installed, it shall be adjusted as follows:

1. Sensitivity shall be adjusted for proper occupant detection appropriate to the usage of the room.
2. Set time delay at approximately 6 minutes after setting in 30 second test to verify sensor/control unit operation.
3. Check indicator light of each sensor to verify that occupancy is being detected in the range desired.
4. Sensor operating frequencies shall be selected to select interference with other units in the vicinity as required.
5. Ensure that there are no obstructions which could block proper sensor coverage, thereby minimizing the sensor detection zone.
6. Occupancy sensors may be affected by various conditions in the room. It may be necessary for the Contractor to make adjustments, change the location or type of sensor to obtain proper operation in a specific room. The Contractor/equipment manufacturer shall have final responsibility for proper operation and coverage of the system in each room and should therefore make labor allowance for such changes and adjustments. The Contractor is also responsible for acquiring approval from Engineer for any changes or deviations from project specifications.

3.2 SPARES

- A. Provide 10% spare sensors and switch packs of each type used on the project.
- B. Deliver spares to the Owner at completion of project.

3.3 SYSTEM COMMISSIONING

- A. The contractor shall provide lighting system functional testing per C408.3.1 of the 2015 International Energy Conservation Code. A lighting control system manufacturer's representative and a DFW personnel familiar with the site shall be on site to assist the contractor during testing. Any deficiencies in the system's performance shall be corrected immediately prior to issuing a final report.
- B. All occupancy sensors shall be tested for location and functional acceptability.
- C. Time switch controls shall be tested for the correct time, date and owners control schedule. Lighting on time switch controls shall be tested for on / off / dimming status.
- D. Daylight responsive controls shall be tested for location and functional acceptability.
- E. All building management system software, graphics, reporting and remote control shall be tested and accepted by the Owner prior to issuing the functional testing final report.
- F. A final report certifying that the installed lighting controls meet documented performance criteria of section C405 of the 2015 International Energy Conservation Code shall be submitted to the Owner, Architect and Engineer for approval within 90 days from the date of receipt of the Certificate of Occupancy.
- G. All field commissioning and testing results shall be provided to the Architect and the Owner for

review in a Field Quality Test Report.

- H. Commissioning Scope: In addition to the commissioning scope indicated herein and in the individual System Sections, the Controls Contractor shall work and cooperate fully with the Owner's Third-Party Commissioning Agent in demonstrating that the BAS is in compliance with the approved design.

3.4 **DEMONSTRATION/TRAINING**

- A. Upon completion of testing and adjustment, the Contractor shall demonstrate operation of the system to representatives of the Owner and Engineer.
- B. The lighting controls manufacturer shall provide eight hours of in-person instruction for the owner's personnel in proper maintenance, adjustment, and operation of the lighting controls and graphical user interface. The training shall be recorded and turned over to the owner for future education and training.

3.5 **PROJECT CLOSEOUT DOCUMENTATION**

- A. Provide a factory published manual:
 - 1. Warranty
 - 2. Technical support contact
 - 3. Electronic manual

END OF SECTION