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| **EDIT NOTE: VERIFY WITH OWNER PRIOR TO INCLUDING THIS SECTION IN THE PROJECT** |

**PART 1 - GENERAL**

* 1. **SUMMARY**

1. Section Includes:
   1. Low-voltage lighting control system.
2. Related Requirements:
   1. Division 01 - General Requirements.
   2. Section 26 05 00 – Common Work Results for Electrical.
   3. Section 26 05 13 – Basic Electrical Materials and Methods.
   4. Section 26 05 19 – Low-Voltage Wires (600 Volt AC).
   5. Section 26 05 26 – Grounding and Bonding.
   6. Section 26 05 33 – Raceways, Boxes, Fittings, and Supports.
   7. Section 26 08 00 – Electrical Systems Commissioning.
   8. Section 26 24 16 – Panelboards and Signal Terminal Cabinets.
   9. Section 26 50 00 – Lighting.
   10. **SUBMITTALS**
3. Provide in accordance with Division 01.
4. Submit a complete one-line diagram of the proposed system configuration for Architect/Engineer’s review. The riser diagram shall identify but not be limited to wiring, equipment, components, interconnection with other systems, and location and type of raceways.
5. Manufacturer's Data: Submit catalog cuts and description of each system component.
6. Provide wiring diagrams and installation details for lighting control equipment.
7. Provide a complete sequence of operation and system interface requirements with fire alarm, and other applicable systems as depicted in construction documents.
8. Shop Drawings: Submit a complete set of detailed Shop Drawings for the entire lighting control system; the shop drawings shall include but not be limited to relay panels with designations and dimensions, day light sensors locations based on manufacturer’s recommendations, and system components with manufacturer’s part numbers.
9. Installation Instructions: Submit manufacturer's written installation instructions, wiring diagrams. Instructions shall include recommendations for handling of equipment and parts, and protection and storage requirements.
10. Software flow diagram of and complete sequence of operation.
11. Software licenses and electronic keys, and list of assigned passwords.
12. Supplemental local or factory training schedule for post warranty support.
13. A complete list of recommended spare parts with pricing for the OWNER’s use in keeping the environmental control system downtime to a minimum.
    1. **SUBSTITUTIONS**
14. Deviations from these requirements shall not be accepted without written approval from OWNER’S Design Standards and Maintenance and Operations Technical Units. Substitutions requests shall be accompanied with the following information:
15. Substitution request form documented with substantiating reasons for the deviation and proposed benefits to the OWNER.
16. Provide proof of compliance with characteristics indicated in this specifications section.
17. Documentation must comply with contract general provisions.
    1. **QUALITY ASSURANCE**
18. Components shall be listed and labeled by Underwriter's Laboratories (UL), or another Nationally Recognized Testing Laboratory (NRTL).
19. Lighting control system and peripheral devices with IP addresses shall be UL listed in compliance with UL-2900-1 – Standard for Safety, Software Cybersecurity for Network-Connectable Products.
20. Lighting Control Systems shall comply with the state of California Building and Electrical Codes, and Title 24 energy requirements in effect at time of submittal for building permit.
21. Conduct a coordination meeting with the lighting control contractor, electrical contractor, EOR, Manufacturer Representative, Commissioning Agent, and the OAR to validate the location of lighting control system components, including daylight, vacancy, motion sensors. Sensors shall be located based on manufacturer’s recommendations.
22. Systems components shall be Title 24 compliant and listed as California Energy Commission approved products.
    1. **COMMISSIONING**
23. A Commissioning Services Provider (CxSP) retained by the OWNER will lead and provide Commissioning (Cx) of the lighting control system, including submittal review, installation, testing, documentation, and training as indicated in section 26 0800 – Electrical Systems Commissioning.
24. CONTRACTOR shall follow the commissioning responsibilities stated in Section 01 9113, General Commissioning Requirements.
25. CONTRACTOR shall provide all tools and personnel, and perform start-up, prefunctional and functional performance testing in the presence of the OWNER’s Commissioning Services Provider.
    1. **WARRANTY**
26. Lighting control system shall be warranted to be free from defects in materials and fabrication for a period of three-years from the date of substantial completion.
27. Installer shall provide a two-year installation warranty.
28. Warranty exclusions for third party components is not acceptable.
    1. **TRAINING**
29. Provide a competent instructor who is factory trained and has comprehensive knowledge of system components and operations to provide full instructions to designated personnel in the system operation, maintenance, and programming. Training shall be specifically oriented to installed equipment and systems.
30. Training shall include system overview, time schedules, override commands, emergency operation, and programming and report generation for school based non-technical personnel.
31. Provide an eight hours OWNER’s school-based personnel and Maintenance and Operations technical employees training session; this training session shall cover and provide the following:
32. As-built drawings of System layouts and point to point connection diagrams.
33. System components cut sheets.
34. Operations and maintenance data.
35. Programmer and maintenance training: database entry; trend logs application programs, diagnostic routines, reporting, failure recovery and calibration, and expose the trainees to system’s features, components, system architecture, operations, programming, report generation, communications, reading and interpreting alarms, and any other pertinent information required for the operations and maintenance of the system.
36. Training sessions shall accommodate a minimum of 20 persons and be facilitated at CONTRACTOR’s training facility, which should be no more than 50 miles from the Project Site.
37. Obtain OWNER’s approval for training locations exceeding 50 miles. In such cases, the CONTRACTOR shall be responsible for transportation expenses.
38. CONTRACTOR shall provide training computers for all attendees. Computers shall be ready for live training sessions.
39. Instructor(s) shall give the trainees the opportunity to practice on simulated and actual (installed) systems.
40. The training session shall have an itemized agenda covering all aspects of the training to be covered in the sessions. CONTRACTOR shall obtain agendas approval from OWNER and Commissioning Agent.

**PART 2 - PRODUCTS**

1. **SYSTEM REQUIREMENTS**
2. The lighting controls shall be a centralized system furnished with digital room controllers, capable of working as a network system that communicates via common data line (s).
3. The system shall be furnished with transformers, control electronics, hardware, resident software and complete programming, occupancy sensors, constant light controllers, exterior light sensors, photocells, digital and analog switches, dimmer switches, conduit and wiring for a complete and functional installation.
4. Software shall be resident within the lighting control system.
5. System shall provide local access to programming functions at the master Lighting Control Panel (LCP) and remote access to programming functions via computers or other intelligent communication devices running an industry standard internet browser.
6. System software shall provide real time status of all components and ancillary devices.
7. For on-site access, the lighting control system shall have a built-in touchscreen allowing authorized access to localized control and programming.
8. Areas controlled by a motion sensor; such as rooms with one luminaire and emergency fixtures designed to operate 24 hours a day, seven days a week shall be programmed accordingly.
9. The system shall have a server built into the master LCP. The server shall effectively work/operate through HTML pages from any authorized workstation.
10. WEB front end shall be accessible over an OWNER provided Ethernet 10/100 Mpbs to the local area network.
11. Protocol shall be TCP/IP and allow either http (hypertext transfer protocol) or https (hypertext transfer protocol secured) connections.
12. Desktop computers are not part of this section and will be provided by others. Non-networked, non-digital, non-server capable systems are not acceptable.
13. Lighting control system shall be able to be monitored and take commands from a remote Personal Computer (PC); should the remote PC go off-line system programming uploaded to the lighting control system shall continue to operate as intended. Systems requiring an on-line PC or server for normal operation are not acceptable
14. Devices shall be factory pre-addressed but be able to be field addressable also. Systems requiring field addressing only are not acceptable.
15. Programs, schedules, time of day, etcetera, shall be held in non-volatile memory at power failure. At restoration of power, lighting control system shall implement programs required by current time and date.
16. System shall be capable of flashing lighting OFF/ON for any relay or lighting zone prior to the lights beings turned OFF. The warning interval time between the flash and the final lights off signal shall be definable for each zone. Occupant shall be able to override any scheduled OFF sweep using local lighting zone override switches within the zone or occupied space. Occupant override time shall be pre-programmed not to exceed two hours, or current California Title 24 requirements.
17. The system shall be capable of implementing ON, OFF, Raise (dimming), and Lower (dimming), and preset commands, group or zone by means of devices connected to programmable inputs in the lighting control system.
18. Programming and scheduling shall be done at the master LCP and/or remotely via the Internet. Remote connections shall function in real time control and real time feedback.
19. System may consist of centralized relay panels, room controllers, digital switches, analog switches, photocells, motion sensors, lumen control devices, dimmer switches, and various digital interfaces. All system components, including remote and centralized room controllers, digital switches, etc. shall operate and be integrated as a network.
20. Remote Room Controllers (RRC) shall control lighting fixtures in that area or space.
21. The RRC shall provide power to ancillary and control devices, such as occupancy sensors, and take input from controlling devices, such as daylight and occupancy/vacancy sensors.
22. RRP’s shall be capable of taking inputs from OWNER specification line voltage type switches.
23. RRC, switches, photocells and occupancy sensors, and ancillary devices and components shall be integrated per lighting control manufacturer’s instructions.
24. Location of devices and relay panels or relay controllers installed above ceilings shall be identified with a printed label attached to ceiling elements. Locate label directly below equipment location.
25. **LIGHTING CONTROL OVERVIEW-BY AREA CONTROLLED**
26. Classrooms:

Classrooms shall be controlled by a combination of vacancy sensors, daylight controllers and dimmers switches.

* 1. The vacancy sensor is to automatically switch lights OFF when the room is not occupied for 15 minutes.
  2. Daylight controls shall automatically adjust light intensity according to the natural light level in the room to maintain a uniform level of lighting in the range of 30-50 foot-candles.
  3. The daylight sensors shall be enabled and disabled by the vacancy sensors to ensure daylight-controlled lights never automatically turn ON when room is unoccupied. The lighting control system shall allow an authorized person to disable the daylight sensors and dimming controls.
  4. Wall switches, and dimmers are to manually switch lights ON and OFF. Switches shall comply with the operational requirements of the current T24, and include location of device, accessibility and override capability.
  5. Quiet time switch is to temporarily bypass the occupancy sensors for a pre-programmed period of one hour, or as indicated on drawings.

1. Corridors and Open Areas:

Corridors and other common areas are to be controlled by a combination of programmable low voltage keyed switches and time schedules supplied by the networked lighting control system.

* 1. Low voltage keyed switches to manually switch lights ON and OFF.
  2. The central timer is to automatically sweep lights OFF after hours and provide scheduling capability where and when occupancy sensors are not used.
  3. Interior corridors require occupancy sensors.

1. Custodial, Unsupervised and Equipment Rooms:

Provide occupancy sensors with automatic on-off capability in addition to manual switches, and programming features indicated on plans. These sensors shall turn off the lights in the room via 15 minutes pre-set programmable interval after the room has been vacated.

1. Exterior Security Lights:

Program exterior wall packs and security lights to be controlled via exterior light sensors, and time switches as indicated on drawings.

* 1. Program lights to ON state when natural lighting is below 5 foot-candles
  2. Program lights to OFF when natural light level is greater than 5 foot-candles.

1. Exterior, Non-Security Lights:

Exterior non-security lighting in parking lots, corridors and pathways, and decorative lights shall be controlled via exterior light sensor working in conjunction with programmable controlled time schedules via the lighting control system.

1. Program lights to ON state when natural lighting is below 5 foot-candles, and when scheduled time is set to ON.
2. Program lights to OFF state when natural light level is greater than 5 foot-candles, and when scheduled time is set to OFF.
3. Restrooms:
   1. Student Restroom Lighting and Exhaust Fans (Fans interlocked with lights):
      1. Restroom lights shall be controlled from the lighting control panel via assigned relays.
      2. Provide by-pass lock type, vandal resistance key operated switch adjacent to the door, and ceiling mounted occupancy sensors for on/off controls.
      3. The sensor shall turn off the lights via a programmable pre-set 15 minutes interval, after the room has been vacated.
   2. Staff Restrooms Lights and Exhaust Fans (Fans interlocked with lights):
      1. Restrooms lights and fan shall be controlled from the lighting control panel via assigned relays.
      2. Provide ceiling mounted occupancy sensors, and by-pass toggle switches for system override adjacent to the door.
      3. The sensor shall turn off the lights via a programmable pre-set 15 minutes interval, after the room has been vacated.

G. Emergency Lighting:

1. Provide emergency lighting controls circuitry to achieve override or bypass of manually operated switches, lighting control systems, dimmers and occupancy sensors during power failures.
2. Each area of luminaries or groups of luminaries shall be equipped with and be controlled by a UL924 listed emergency lighting control unit to allow the detection of localized power failures.
3. **CENTRAL LIGHTING CONTROL PANELS**
4. Central Lighting Control Panels (CLCP) shall be in electrical closets.
5. Panels shall be surface or flush mounted type as indicated on Drawings, with a hinged door assembly. Doors shall be furnished with flush type locks, spring latching, Corbin locks for metal doors, keyed to Corbin No. 60 keys. Panels shall include the following components or features:
   1. Shall be preprogrammed and preassembled with control equipment and relays as indicated on the lighting plans.
   2. Shall be equipped with suitable dividers separating Class 1 and Class 2 compartments, 120v and 277v compartments as well as “normal and emergency” compartments.
   3. Lighting control relays as indicated on Drawings. Provide 10 percent spare relays for centralized relay panels up to the maximum capacity of panel.
   4. Shall be equipped with a neatly typewritten schedule with number and name of rooms or areas served by the relay circuits. Room numbers and names used shall be determined at the Project site and may not be those indicated on Drawings. Schedule shall indicate panel designation and voltage and shall be mounted in a frame under transparent plastic 1/32-inch-thick on inside of panel cabinet.
   5. Each panel shall be rated for 120 or 277 VAC.
   6. Shall be preassembled, preprogrammed and include relays capable of switching 20 amps lighting loads for 120 or 277 VAC.
   7. Central lighting control panels, remote lighting control panels, relays, low voltage switches, interior light sensors, exterior light sensors, and associated control electronics shall be furnished by Lighting Control and Design (LC & D), Douglas Lighting Controls, or equal.
   8. Approved products: Douglas PWEX Series, LC & D #GR-2400 series, or equal.
6. **REMOTE ROOM CONTROLLERS**
7. Remote Room Controllers (RRC) shall be mounted in the ceiling space as indicated on plans.
   1. Each RRC shall be connected to the network lighting control system using manufacturer’s recommended wiring method and configuration.
   2. Provide a printed label “RLCP” to the T-bar grid below the RRC”.
   3. Approved products: LC&D GR-2404 Series or Douglas WSP-2718.
8. Each RRC shall contain the following hardware features:
   1. Digital dataline switch inputs.
   2. 12 VDC and 24 VDC inputs for occupancy sensors requiring DC voltage for analog occupancy sensors, or Digital dataline type inputs for occupancy and light sensors.
9. Switches shall be capable of switching individual relays, local groups of relays within the panel or global groups of relays system wide. Each switch shall be configured to be ON, OFF, RAISE, LOWER, or Toggle.
10. The RRC shall digital dataline occupancy sensors. The sensors shall be configured for OFF only or ON/OFF switching scenarios.
11. Photo sensor shall be linked with occupancy sensing so that when light levels are high enough, the occupancy/vacancy sensor will not switch the photo-controlled relays ON.
12. **RELAYS**
13. Relays shall be warranted for a minimum of three-years.
14. Relays shall be individually added or replaced. Lighting control systems incapable of replacing individual relays are not acceptable.
15. Each lighting control relay shall be capable of controlling incandescent, fluorescent, LED sources, and HID lighting loads. Relays not rated for all types of lighting loads are not acceptable.
16. Approved Products:
    1. Single Pole: Douglas WR-6161, LC&D SL-277-NC, or equal.
    2. Double Pole: Douglas WR-6172, LC&D SL-480-NC, or equal.
17. **LOW VOLTAGE SWITCHES**
18. Low voltage switches shall be wired in compliance with manufactures requirements. Digital switches shall be part of the lighting control system network.
19. Provide stainless steel switch plates, unless noted otherwise in construction documents.
20. Approved Products: LC&D Chelsea series, Douglas WSW-3500 series, or OWNER approved equal.
21. Physical removal of any single switch shall have no effect on the communication between relay panels in the rest of the lighting control network. Lighting control systems requiring the continuous connection of all low voltage switches are not acceptable.
22. Keyed switches shall be digital.
23. Approved products: Douglas WSK-35XX Series, LC&D KS Series, or equal.
24. Provide stainless steel switch plates, unless noted otherwise in construction documents.
25. Classrooms witches controlling luminaires in classrooms shall be digital and be wired to programmable inputs in the lighting control system network.
26. Each switch shall be programmed to control ON only, OFF only or ON and OFF, dimming, audio/visual and quiet time one, some, or all relays in the entire network.
27. Whiteboard luminaires shall be controlled independently with On, Off, and dimming capabilities.
28. High abuse areas (common areas, gymnasiums, etcetera) shall be controlled using a vandal resistant, touch sensitive high abuse switch and available with up to three buttons in a single gang. Multi gang versions shall also be available.
29. Touch pads shall be stainless steel and capable of handling both high abuse and power wash cleaning crews’ activities.
30. Switches shall be digital or analog as indicted on plans.
31. High abuse switch touch buttons shall control a single relay or group(s) of relays of the lighting control system.
32. Touch buttons shall be controllable via programmed commands to enable or disable, ON, OFF, Toggle or Maintain operation functions. Programming shall be done locally or remotely.
33. Touch pad(s) shall be identified as to function by an engraved label.
34. Switches must be capable of handling electrostatic discharges of at least 30,000 volts (1cm spark) without any interruption or failure in operation.
35. **INTERIOR DAYLIGHT SENSORS**
36. Interior daylight sensors shall cause light fixtures to brighten or dim to maintain pre-determined and uniform light levels.
37. The sensors shall permit any relay to switch at a unique light level and shall attempt to maintain a constant light level by switching individual relays ON or OFF as the ambient light level changes.
38. Controllers offering single set point controls are not acceptable.
39. Each interior daylight sensor shall continuously monitor the true light label and shall broadcast this level to lighting control network. Controllers requiring readings at the sensor head itself are not acceptable.
40. Each interior daylight sensor shall be fully adjustable via the lighting control software. Controllers requiring adjustments at the sensor head are not acceptable.
41. Provide daylight sensors in all rooms with windows, skylights, or daylight filtration. Refer to lighting plans to determine which switch legs are controlled by the daylight controller.
42. Approved Products: LC&D iPC Series, Douglas WPS-3711, Douglas WPP-INT, or equal.
43. **EXTERIOR LIGHT SENSORS**
44. One exterior light sensor shall permit different relays to switch at different light levels. Sensors offering less than 14 remotely settable trip points are note acceptable.
45. Exterior light sensor shall continuously monitor light levels and shall broadcast this level over the lighting control network. Exterior light sensor shall be fully adjustable via the networked lighting control system.
46. Sensors and controllers requiring adjustments at the sensor head are not acceptable.
47. Sensors shall be UL or NRTL listed for exterior application.
48. Approved products: Douglas WPS-3741B, LC&D PCO, or equal.
49. **DIMMING CONTROLLER**
50. Remote relay panels shall be capable of outputting 0V – 10V dimming signal for each relay provided in the remote room controller. LED Dimming drivers shall be controlled by industry standard 0V-10V control input.
51. LED Drivers using proprietary control protocols shall not be acceptable.
52. To maximize daylight harvesting and minimize disruption to occupants, each dimming output shall provide adjustment for baseline, start point, mid-point, end point, trim fade up rate, fade down rate, time delay and enable/disable masking.
53. Photocells settings must be remotely accessible.
54. Systems that provide ON, OFF with Time Delay only and systems that do not provide remote accessibility are not acceptable.
55. Mount photocells in locations indicated on plans and according to manufacturer’s recommendations for daylight system type, open or closed loop. Trip points shall be able to be programmed and altered remotely via programming functions at the master Lighting Control Panel (LCP) and remote access to programming functions via computers or other intelligent communication devices.
56. Photocells requiring manual trip point adjustment, or systems that provide local adjustment only are not acceptable.
57. Photocells used for interior lighting control shall have multiple settings such as start-point, mid-point, off-point, fade-up rate, fade-down etc.
58. Approved Products: Douglas WPS-3711, Douglas WPP-INT, LC&D iPC series, or equal.
59. **OCCUPANCY SENSORS**
60. Occupancy Sensors:
    1. Ceiling-Mounted Dual Technology Sensors:
       1. Sensors shall be dual technology infrared-ultrasonic capable of detecting presence in floor area to be controlled, by detecting Doppler shifts in transmitted ultrasound and infrared technology.
          1. ADI-Voice technology may be used in addition to the required infrared-ultrasonic features.
       2. Detection shall be maintained when a person moves only within a maximum distance of 12 inches, in either a horizontal or vertical manner, at approximate speed of 12 inches per second. Lights shall not go off when a person is reading or writing while seated at a desk.
       3. Each sensor shall be furnished with a convenient shunt provision, which will enable a person to by-pass sensor in event of failure.
       4. Sensitivity shall not change more than ten percent in temperature range of 0 degrees F. to 120 degrees F., and in humidity range of ten percent to 80 percent. Sensitivity adjustment shall be provided for each technology.
       5. Time delay range shall be adjustable from 15 seconds to 15 minutes.
       6. Sensors power supply shall be provided by power pack, consisting of a transformer and contact closure relay in one package. Power output of transformer shall be capable of operating a minimum of two sensors.
       7. Approved products: Watt Stopper No. DT-200, similar as manufactured by Leviton, Sensor Switch, Unenco, or equal.
61. Dual Technology Passive Infrared Wall Switch Sensors with Daylight Controls:
    * 1. Sensors shall be capable of detecting presence in floor area to be controlled, by detecting changes in infrared-ultrasonic energy. Small movements shall be detected such as when a person is writing while seated at a desk.
      2. Passive infrared sensor shall utilize a dual-element sensor and a multi-element fresnel lens.
      3. Sensor shall be furnished with a daylight filter which ensures that sensor is insensitive to short-wavelength infrared waves, such as those emitted by the sun.
      4. Sensors shall be furnished with convenient bypass provisions, which enable lighting to be turned on in case of failure.
      5. Time delay range shall be adjustable from 15 seconds to 15 minutes.
      6. Sensitivity adjustment shall range from 0 (off) to ten (maximum).
      7. Adjustments and mounting hardware shall be concealed under a removable cover to prevent tampering with adjustments and hardware.
      8. Each sensor shall cover up to 800 square feet, with a field-of-view of 180 degrees.
      9. Sensor shall be a completely self-contained control system.
      10. Power shall be provided via an internal transformer.
      11. Switching mechanism shall be a latching dry contact relay.
      12. Sensor shall be capable of switching from 30 to 1000 Watts, LED, incandescent or fluorescent light sources.
      13. Sensor shall be furnished with a daylight feature, adjustable from ten to 400 foot-candles, that maintains lighting off when a desired foot-candle level is present.
      14. Sensors shall be dual voltage, 120 volt and 277 Volt.
      15. Approved products: Watt Stopper No. WI 200, I 300, similar as manufactured by Leviton Sensor Switch, Unenco, or equal.
62. **LIGHT LEVEL CONTROLERS (EXISTING FACILITIES)**
    1. Controller shall be capable of detecting changes in lighting levels; it shall utilize an internal photoconductive cell to measure light levels through 50 percent diffused lens.
    2. Controller shall be capable of controlling any type of lighting. It shall be a self-contained 24 VDC device that controls lighting through use of power switch packs.
    3. Controller shall be capable of turning lighting on and off between ten and 200 foot-candles.
    4. Controller shall be furnished with an adjustable dead-band feature to prevent lighting from cycling when lighting goes on and off, and from minor changes due to cloud cover.
    5. Controller shall be furnished with an adjustable time delay range of five seconds to five minutes.
    6. Controller shall be furnished with an LED lamp indicating status of sensor. LED shall have different colors for on and off status.
    7. Adjustments and mounting hardware shall be concealed under a removable cover to prevent tampering with adjustments and hardware.
    8. Each controller shall be equipped with a by-pass mechanism, which will enable lighting to be turned on during failure conditions.
    9. Approved manufacturers: Watt Stopper No. LS-100 XA, or similar products by Leviton, Sensor Switch, Unenco or equal.
63. **UNIT INVERTERS**

A. Unit Inverters shall be rapid start type consisting of emergency power packs designed to be installed in channels of new lighting fixtures.

1. Power pack construction shall be of durable polycarbonate housing.
2. Units shall be furnished with test switches and pilot lights.
3. Units shall automatically power designated lamp(s) for 90 minutes of emergency service upon failure of utility power.
4. Upon return of utility power, battery shall automatically recharge.
5. Batteries shall be field-replaceable, sealed, rechargeable, spill-proof, maintenance-free nickel cadmium.
6. High efficiency inverter/charger design shall include low voltage disconnects to prevent deep discharge of battery and dual voltage designed for connection to either 120 or 277 volts. Chargers shall recharge fully discharged batteries to provide 90 minutes operation within 24 hours. Power pack shall not operate if shut off manually.
7. An unconditional five-year warranty is required.
8. Approved products: Dual-Lite UFO-5 Series, Bodine, Iota I series, or equal.
9. **INTERFACE TO BUILDING MANAGEMENT SYSTEM**

A. When interface to the Building Management System is required, The lighting control system shall provide a BACnet/IP interface module that communicates with the BMS via a BACnet/IP network. (a collection of one or more IP sub networks (IP domains) that are assigned a single BACnet network number). Verify if interface to BMS is required.

1. BACnet/IP interface module shall provide the capability for the BMS to:

1. Communicate directly with each relay in the lighting control system network and each group used within the lighting control system.

2. Monitor the status and status changes of each relay and each group.

1. Install wiring and confirm operation of the lighting control BACnet/IP interface module per the lighting control manufacturer’s instructions. Installing, wiring, and interfacing of BMS components to the lighting control system.

**PART 3 – EXECUTION**

* 1. **GENERAL**

1. Lighting control system shall not be used for ay other purpose other than its intended use and application.
2. Provide required interconnections with other systems such as emergency power sources, fire alarm systems, and building management system as required or indicated on drawings.
3. Installation shall meet or exceed standard practice of workmanship and quality.
4. Drawings are diagrammatic in nature and indicate work to be provided, but do not provide means and methods, bends, transitions, or special fittings required to clear beams, girders or other work already in place. Investigate conditions where conduits are to be installed and furnished and install required fittings.
   1. **INSTALLATION AND SET-UP**
5. Verify that conduit for line voltage wires enters panel in line voltage areas and conduit for low-voltage control wires enters panel on low-voltage areas. Refer to manufacturer's drawings for location of line and low-voltage areas.
6. Provide for digital type switches and make all connections according to lighting control manufactures requirements.
7. Central Lighting Control Panels and Remote Room Controllers shall be connected via a data line (Douglas uses a non-polarized two No. 18 and LC&D uses Cat6 four twisted pair cable, with RJ45 end connectors). Connect entire lighting control system per manufacturer’s requirements. Do not exceed manufacturer’s total data line length requirement.
8. Panels shall be located so that they are readily accessible and not exposed to physical damage.
9. Panel locations shall be furnished with enough working space around panels to comply with the California Electrical Code.
10. Panels shall be securely fastened to the mounting surface by at least four points.
11. Unused openings in the cabinet shall be effectively closed.
12. Cabinets shall be grounded in accordance with Article 250 of the California Electrical Code, and manufacturer’s recommendations.
13. Lugs shall be suitable and listed for installation with the conductor being connected.
14. Conductor lengths shall be maintained to a minimum within the wiring gutter space. Conductors shall be long enough to reach the terminal location in a manner that avoids strain on the connecting lugs.
15. Maintain the required bending radius of conductors inside cabinets.
16. Clean cabinets of foreign material such as cement, plaster and paint.
17. Distribute and arrange conductors neatly in the wiring gutters.
18. Follow the manufacturer's torque values to tighten lugs.
19. Before energizing the panelboard, the following steps shall be taken:
    1. Retighten connections to the manufacturer's torque specifications. Verify that required connections have been furnished.
    2. Remove shipping blocks from component devices and the panel interior.
    3. Remove debris from panelboard interior.
20. Follow manufacturers’ instructions for installation.
    1. **OPERATING/SERVICE MANUALS**
21. Service and Operation Manuals:
    1. Submit operation and service manuals. Complete manuals shall be bound in flexible binders and data shall be typewritten or drafted.
    2. Record drawings: Provide (3) printed and one electronic copy on flush media of as built documents in latest version of ACAD of the entire system; including, floor plans with equipment, and devices layouts and wiring, interconnections with other systems, conduit and cable runs, programmed configurations, sequence of operations, system labeling codes, system passwords, and other pertinent information.
    3. Manuals shall include instructions necessary for proper operation and servicing of system and shall include complete wiring circuit diagrams of system, wiring destination schedules for circuits and replacement part numbers. Manuals shall include as-built cable Project site plot plans and floor plans indicating cables, both underground and in each building with conduit, and as-built coding used on cables. Programming forms of systems shall be submitted with complete information.
    4. **PROTECTION**
22. Protect all work, equipment and components of the lighting control system until Substantial Completion.
    1. **TESTING**

A. Set-up, commissioning and testing of the lighting control system, and OWNER instruction shall include:

* 1. Confirmation of system programming.
  2. Confirmation of operation of individual relays, switches, occupancy sensors and daylight sensors.
  3. Operation of system’s features under normal and emergency operations.
  4. Before energizing check and demonstrate in the presence of the Project Inspector that cables and wire connections are free from short circuits, ground faults, and that there is continuity, and necessary insulation.
  5. Confirm system operations and functionality.
  6. Check system interface response to other systems such as fire alarm and emergency power system conditions.
  7. **INSTRUCTION PERIODS**

1. Before substantial completion, arrange and provide an 8 hour of Owner instruction period for designated personnel.
   1. **SPARE PARTS**
2. Provide a minimum of five percent spare parts of each type of relay, sensors, switches, and peripheral devices.
   1. **CLEANUP**
3. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

END OF SECTION