1. GENERAL
   1. SYSTEM DESCRIPTION
      1. The Unified Lighting Control System shall consist of panels, interiors, and kits incorporating BACnet native lighting control and I/O modules that reside on the BACnet network of the Building Automation System (BAS). It shall be an integral part of the BAS so that the operator experiences one unified system for controlling, monitoring, scheduling, trending, alarming, etc.
         1. Systems requiring option cards, gateways, or protocol translators are unacceptable.
            1. BACnet MSTP/IP Routers are acceptable when detailed in the drawings.
         2. Systems that require separate master controllers, servers, or front-end computers are not acceptable.
         3. Systems that require client or server licensing are not acceptable.
         4. Systems with an actuation time greater than 100 milliseconds are unacceptable. Actuation time is measured from an occupant signal (via low-voltage field device, addressable stations, occupancy sensors, wall switches, etc.) to the first output actuation. Succeeding outputs may be delayed, minimizing peak demand.
      2. The Unified Lighting Control System shall also consist of low-voltage field devices such as stations, occupancy sensors, wall switches, and light level sensors (as detailed in the drawings).
         1. Systems requiring pre-manufactured cables or proprietary wire to connect low-voltage field devices to controllers are unacceptable.
      3. The Unified Lighting Control System shall directly control the lighting as specified in Section 3.6—Sequence of Operations for Unified Lighting Controls.
   2. SCOPE OF WORK
      1. The BAS Contractor shall furnish all Unified Lighting Control System components as detailed on the drawings and specifications. These components shall consist of controllers, I/O modules, and low voltage field devices such as stations, occupancy sensors, wall switches, and light level sensors. The BAS Contractor shall provide the Electrical Contractor with all necessary documents, including the approved submittal package consisting of riser diagrams and termination schematics required to provide a complete and correct installation.
      2. The Electrical Contractor under Division 26 shall furnish all labor to install the Unified Lighting Control System furnished by the BAS Contractor. The Electrical Contractor shall receive the Unified Lighting Control System components from the BAS Contractor and store them in a secure and dry location. The Electrical Contractor shall provide all of the required materials (conduit, raceways, wire, etc.) and make all of the line and low voltage wiring terminations for the furnished equipment to ensure the Unified Lighting Control System functions properly and in accordance with the specifications and drawings. The Electrical Contractor shall provide installation as-built drawings to the BAS Contractor.
      3. Reference Contractor Responsibility Matrix on plans, sheet **XX.XX** is for task details and specific low-voltage network and device cabling responsibilities.
   3. RELATED SECTIONS
      1. The General Conditions of the Contract, Supplementary Conditions, and General Requirements are part of this specification. They shall be used with this section as part of the contract documents.
      2. The following sections constitute related work:
         1. Section 23 09 23 – Direct Digital Control System for HVAC
         2. Section 25 00 00 – Integrated Automation
         3. Section 26 09 23 – Wiring Devices
         4. Section 26 09 43 – Network Lighting Controls
   4. QUALITY ASSURANCE
      1. BAS Contractor Qualifications:
         1. The contractor shall be an authorized Unified Lighting Control System dealer.
         2. The contractor shall have an established office with experienced engineering and service personnel within a fifty (50) mile radius of the project site.
         3. The contractor shall have completed the manufacturer's Technical Certification Training.
            1. Upon request, BAS Contractor shall present a record of completed training, including course outlines and a dated certificate.
         4. The contractor shall have at least five (5) years of experience integrating lighting control systems with BACnet Building Automation Systems.
         5. The manufacturer shall have an established lighting control business continuously operating for over fifteen (15) years.
         6. Manufacturer shall have at least five (5) years of experience designing and manufacturing BACnet native lighting controls.
         7. The manufacturer shall provide free software and firmware files via web download during the warranty period.
   5. CODES AND STANDARDS
      1. Work, materials, and equipment shall comply with the most restrictive local, state, and federal authorities' codes and ordinances or these plans and specifications. As a minimum, the installation shall comply with current editions in effect 30 days before receipt of bids of the following codes/certifications:
         1. BACnet Testing Lab (BTL)
         2. California Title 24 Energy Code
         3. ASHRAE 90.1
         4. National Electric Code (NEC)
         5. International Building Code (IBC)
         6. International Energy Conservation Code (IECC)
         7. National Electrical Manufacturer Association (NEMA)
         8. ANSI/ASHRAE 135-2010 Rev 12: Data Communication Protocol for Building Automation and Control Systems (BACNET)
         9. Underwriters Laboratory (UL) – UL916 Energy Management, UL508A Industrial Control Panels, and UL924 Emergency Lighting and Power Equipment.
   6. CONTRACTOR PROVIDED SUBMITTALS
      1. The BAS Contractor shall provide submittal drawings, including the following:
         1. Bill of Material (BOM) list with item references
         2. Product data sheet for each item listed on the Bill of Material
         3. The communications riser diagram shall indicate the MAC address and BACnet Device ID for each BACnet native lighting control module in the Unified Lighting Control System. It will also include the location and part number of each BACnet native lighting controller and each BAS BACnet router.
         4. Panel, Interior, and Kit schedules shall indicate the circuit number, area description, and control sequence designation for each output.
         5. Written Sequence of Operation and BACnet Points List for each required Sequence of Operation
         6. Point-to-point wiring details for all I/O modules shall indicate the wiring and terminations.
         7. An addressable CANbus network diagram containing all I/O modules and stations. The network diagram shall indicate the device's physical address, part number, and location designation. The location designation shall include the lighting control module BACnet Device ID, room number, switch box designation, and gang position.
         8. Dimensional drawings of all items listed on the Bill of Material.
         9. Specification compliance statement.
      2. The BAS Contractor shall provide as-built drawings including:
         1. Updated submittal drawings reflecting the actual installation of the system.
         2. Installation and user guides for each item listed on the Bill of Material.
         3. Operation and maintenance data.
   7. WARRANTY
      1. BAS Contractor shall provide a twenty-four (24) month labor and material warranty on the complete Unified Lighting Control System. The warranty shall include all panels, interiors, kits, modules, relays, and low-voltage field devices such as stations, occupancy sensors, wall switches, and light level sensors. If within twenty-four (24) months from the date of acceptance of the Unified Lighting Control System, upon written notice from the owner, it is found to be defective in operation, workmanship, or materials, it shall be replaced, repaired, or adjusted at the option of the BAS Contractor.
      2. The manufacturer shall provide a ten (10) year parts-only warranty on all relay I/O modules and a five (5) year parts-only warranty on all other components provided. The warranty period shall commence after the Manufacturer receives written owner acceptance and complete payment.
      3. If within the periods listed above from the date of acceptance of the Unified Lighting Control System, upon written notice from the BAS Contractor, it is found to be defective in operation, workmanship, or materials, it shall be replaced, repaired, or adjusted at the option of the Manufacturer.
2. PRODUCTS
   1. APPROVED PRODUCTS AND SUPPLIERS
      1. Basis of design is Unified Lighting Control System by Blue Ridge Technologies, Marietta, GA (800-241-9173), furnished by the BAS Contractor listed below:
      2. Approved Manufacturer and BAS Contractor:

|  |  |
| --- | --- |
| **Manufacturer** | **BAS Contractor** |
| Blue Ridge Technologies | <BAS Contractor> |
| Blue Ridge Technologies | <BAS Contractor> |
| Blue Ridge Technologies | <BAS Contractor> |

* + 1. All proposed substitutions must be submitted in writing for approval by the design professional at least ten (10) working days before the bid date. Submitted substitutions must be accompanied by a review of the specification noting compliance on a line-by-line basis.
    2. BAS Contractor utilizing substitutions accepts full responsibility for any associated costs directly related to substitution, including but not limited to required circuitry, devices, and wiring modifications.
  1. MATERIALS
     1. The manufacturer shall offer spare or equivalent parts for at least five years after the contract is completed. Spare parts include:
        1. Relays.
        2. Electronics.
        3. Transformers.
        4. Low-voltage field Devices, such as addressable stations, occupancy sensors, wall switches, and light level sensors.
     2. The manufacturer shall offer replacement parts for at least five years after shipment.
  2. OPERATOR INTERFACE
     1. Refer to Division 25 – Integrated Automation for details.
     2. The Operator Interface furnished under Division 25 shall be the primary operator interface for the Unified Lighting Control System.
        1. The Building Automation System operator workstations shall provide all necessary operator functions, including scheduling, reporting, monitoring, overriding, etc.
        2. Lighting floor plan graphics for switched lighting zones shall utilize grey to represent Off and white to represent On.
           1. Dimmed lighting zones shall also utilize a numerical value (percentage) to represent the lighting intensity.
  3. CONTROL PANELS, INTERIORS, AND KITS
     1. BAS Contractor shall provide control panels, interiors, and kits as detailed in the drawings.
        1. The Electrical Contractor under Division 26 shall install as detailed on the drawings and in accordance with the manufacturer’s recommendation.
     2. Control panels, Interiors, and kits shall include the BACnet native lighting control module, I/O modules, relays, power supplies, voltage barriers, and other panel components.
     3. Control panels and interiors shall be certified to meet the 2012 seismic testing requirements of the International Code Council Evaluation Services (ICC-ES) Acceptance Criteria 156 (AC156), Importance Factor 1.5.
     4. Enclosures shall be manufactured with a minimum of 18 gauge cold rolled steel (C.R.S.) that is treated to prevent corrosion and is powder coated. Plastic enclosures are not acceptable.
     5. Interiors shall be manufactured with a minimum of 18 gauge cold-rolled steel (C.R.S.) treated to prevent corrosion and powder-coated.
     6. Interior shall be removable to aid in the installation process.
     7. Control panel, interior, and kit shall have a power supply of 120VAC or 277VAC, a minimum of 200mA, and 50/60 Hz.
     8. Control panels and interiors must provide separate low-voltage and line-voltage compartments that allow the field installation of optional dead front covers.
        1. Dead-front covers and line voltage compartments shall be appropriately marked.
        2. Dead-front covers will be provided in panels where indicated on plans.
     9. Control panels and interiors will support optional voltage barriers to separate regular and emergency-powered I/O Modules or to comply with other code requirements.
        1. Voltage barriers shall not reduce the relay capacity of the panel.
        2. Panels equipped for UL924 shall include voltage barriers, and the UL924 section shall be marked appropriately.
     10. Relays shall be SPST, dual coil, latching relay with temporary override lever that indicates relay status.
         1. Electrically held or electrically latched relays are not acceptable.
         2. HOA switch-on relays are not acceptable.
     11. Relay shall be rated for the following load ratings:
         1. Maximum of 20 amp Magnetic Ballast @ 277VAC
         2. Maximum of 16 amp Electronic Ballast @ 277VAC
         3. Maximum of 20 amp Tungsten @ 277VAC
         4. Maximum of 20 amp Resistive @ 277VAC
     12. Relay shall be rated for at least 300,000 on and off cycles at full load. Systems with published ratings of less than 300,000 cycles at full load shall provide spare equipment and labor equal to the difference in their published life span cycles.
     13. Load Status shall be provided for each relay, and the status will be determined by measuring voltage or current at the load side of the relay.
         1. Auxiliary contact-based status is not acceptable.
  4. BACnet Native Lighting Control Module (BNLCM)
     1. The BACnet Testing Lab (BTL) must actively certify BACnet Native Lighting Control Modules (BNLCM).
     2. BNLCM shall be BACnet Application Specific Controller (B-ASC) in accordance with BACnet Standardized Device Profile (Annex L) and shall comply with BACnet Protocol Revision 135-2010 Rev 13 or greater.
     3. BNLCM shall be provided with BACnet MS/TP network communications.
     4. BNLCM shall be provided with a micro-USB port for temporary connection to a laptop computer for product configuration.
        1. Connection shall support memory downloads, firmware upgrades, and troubleshooting operations.
        2. Controllers that require proprietary cables are not acceptable.
     5. BNLCM shall be able to read and write values to other BACnet controllers on the Building Automation System (BAS) BACnet MS/TP network.
        1. Control variables used to integrate control strategies across multiple BACnet controllers shall be readable by each BACnet controller on the network.
     6. BNLCM shall have a real-time clock and support the BACnet Time Synchronization and Universal Time Synchronization (configurable) service.
     7. BNLCM shall support all of the following BACnet Interoperability Building Blocks (BIBBs):
        1. Data Sharing – Read Property-B (DS-RP-B)
        2. Data Sharing – Read Property Multiple-A (DS-RPM-B)
        3. Data Sharing – Write Property-B (DS-WP-B)
        4. Data Management – Dynamic Device Binding (DM-DDB-B)
        5. Data Management – Dynamic Object Binding (DM-DOB-B)
        6. Data Management – Device Communication Control (DM-DCC-B)
        7. Data Management – Time Synchronization (DM-TS-B)
        8. Data Management – UTC Time Synchronization (DM-UTC-B)
     8. BNLCM shall support all of the following BACnet Objects, which must be at least visible and adjustable through the BAS front end.
        1. Controller Object, read and write
        2. Schedule Object, read, and write
        3. Channel or relay state, read and write
        4. Channel level, read and write
        5. Occupancy State read only.
        6. Occupancy Timer, read and write
        7. Day Light Harvesting Setpoint: read and write
     9. BNLCM shall provide a means to field select any one of the following BACnet baud rates: 9.6k, 19.2k, 38.4k, 76.8k, or 115.2K.
     10. BNLCM shall provide a means to field select the MAC address and shall have a range from 1 to 99.
     11. BNLCM shall automatically generate a BACnet Device ID based on the selected MAC address and the manufacturer’s BACnet Vendor ID.
         1. BNLC shall also be capable of being assigned a custom BACnet Device ID. The building automation system can assign the custom BACnet Device ID within the limits of the BACnet standard, with a maximum value of 4,194,303.
     12. BNLCM shall have a subnet port for optional Expanders and stations.
         1. Systems requiring option cards are not acceptable.
  5. LOW VOLTAGE INPUTS AND OUTPUTS
     1. Control and I/O modules shall support all the following:
        1. UI for direct connection to low voltage field devices such as dry contact switches, occupancy sensors, and light level sensors.
        2. UI shall be configurable as either a digital input or an analog input.
           1. Digital input shall be compatible with dry contact switches, occupancy sensors, or BAS/security system contact.
           2. Analog input shall be compatible with 0-5VDC, 0-10VDC, and 4-20mA.
        3. Analog Outputs (AO) shall be compatible with 0-10VDC dimming ballasts and drivers.
        4. Each AO shall be capable of sinking up to 100mA.
        5. AO shall be compatible with 0-10VDC dimming ballasts that comply with IEC 60929 Annex E, Section E.2.
        6. Digital output (DO) shall be capable of driving 1 amp load 24 AC or DC.
  6. LOW VOLTAGE Stations
     1. BAS Contractor shall provide stations as detailed in the drawings.
        1. The Electrical Contractor under Division 26 shall install all stations as detailed in the drawings and in accordance with the manufacturer’s recommendation.
           1. See Contractor Responsibility Matrix on plans, Sheet **XX.XX** for addressing responsibilities.
        2. BAS Contractor shall provide addressing and ganging information for all stations.
        3. The Electrical Contractor under Division 26 shall furnish and install all face plates with labeling or engraving as required. The BAS Contractor shall provide the text for labeling or engraving of all face plates.
     2. Stations shall be gang-able with other low voltage, decorator-style devices under a standard face plate.
     3. Stations shall reside on a four (4) wire daisy chain network (CL3P 22/4); two (2) for digital communication and two (2) for 24VDC power.
     4. Stations shall be available in the following configurations:
        1. Channel On/Off - one (1), two (2), three (3), four (4), or six (6) button
        2. Channel Raise/Lower - one (1) or two (2) channels
        3. Preset – three (3) presets with raise/lower, or six (6) presets
     5. Stations shall be provided with an LED indicator for status. The LED shall also serve as a locator light by operating at a low level, visible in a dark room, and capable of blinking to warn occupants of the channel transition to inactive or off.
     6. Stations shall utilize capacitive touch technology.
        1. Stations with mechanical switches or moving parts are not acceptable.
     7. Stations shall be available in white, black, grey, or light almond colors.
     8. Stations utilizing pre-manufactured cables or proprietary wiring to connect to controllers are unacceptable.
     9. Provide blink warning for wiring issues.
  7. Low Voltage Occupancy Sensors
     1. BAS Contractor shall provide Low Voltage Occupancy Sensors as detailed in the drawings.
        1. The Electrical Contractor under Division 26 shall install all Occupancy Sensors as detailed in the drawings and in accordance with the manufacturer’s recommendation.
        2. The Electrical Contractor under Division 26 shall set all timers to the minimum setting and document settings on the as-built documents provided to the BAS Contractor.
        3. Under Division 26, the electrical contractor shall furnish and install low-voltage occupancy sensors not part of the Unified Lighting Control System.
     2. Occupancy Sensors shall sense the presence of human activity within the space and provide a signal to the controller. The controller shall determine the on, off, or dimming signals required to perform the sequences of operation in Section 3.6 – Sequence of Operations for Unified Lighting Controls.
     3. Occupancy Sensors shall utilize passive infrared (PIR) technology to detect occupant motion.
     4. For applications where a second method of sensing is necessary to adequately detect or maintain occupancy (such as in rooms with obstructions), a sensor with an additional “dual” technology shall be used.
     5. Acceptable dual technology includes:
        1. PIR/HFD (also known as High Frequency Doppler)
        2. PIR/Ultrasonic
     6. All sensing technologies provided shall not interfere with other electronic devices within the space (such as electronic whiteboard readers or hearing aids). Microwave-based sensing technologies are not acceptable for use within the building envelope.
     7. Occupancy Sensors shall be 24VDC with three (3) wire (common, power, and signal) or four (4) wire (common, power, signal common, and signal) connections and shall be available for the following applications:
        1. Ceiling Mount Passive Infrared – BOS-515 or equal
        2. Ceiling Mount Passive Dual Tech – BDS-600 or equal
        3. Wall Mount Passive Infrared – OS-551 or equal
        4. Wall Mount Passive Dual Tech – OS-551DT or equal
        5. Hallway Passive Infrared – OS-551 or equal
        6. Wall Switch Passive Infrared – BBS-700 or equal
        7. Wall Switch Passive Dual Tech – BDS-700 or equal
     8. Occupancy Sensors with automatic time delay adjustments are not acceptable. The controller shall determine the occupancy sensor time delay, minimum on time, or other timing parameters.
     9. Occupancy sensors shall have a minimum timer value of 30 seconds or less.
     10. Occupancy sensor timers shall be writeable from BACnet. Occupancy sensor timers that are configured at each device location are not acceptable.
     11. Occupancy Sensor shall be factory calibrated for optimum performance for its installed PIR lens and shall not require initial or subsequent field adjustment of detection sensitivity.
     12. Occupancy Sensors with integral light sensors are not acceptable.
     13. Occupancy Sensors utilizing pre-manufactured cables or proprietary wiring to connect to the controller are unacceptable.
  8. Low Voltage Wall Switches
     1. BAS Contractor shall provide wall switches as detailed in the drawings.
        1. The Electrical Contractor under Division 26 shall install all wall switches as detailed in the drawings and in accordance with the manufacturer’s recommendation.
        2. The Electrical Contractor under Division 26 shall furnish and install all face plates with labeling or engraving as required. The BAS Contractor shall provide the text for labeling or engraving of all face plates.
        3. Under Division 26, the electrical contractor shall furnish and install low-voltage wall switches not part of the Unified Lighting Control System.
     2. Wall Switches shall be gang-able with other low voltage, decorator-style devices under a common face plate.
     3. Wall Switches utilizing pre-manufactured cables or proprietary wiring to connect to controllers are unacceptable.
  9. Low Voltage Light Level Sensors
     1. BAS Contractor shall provide low voltage Light Level Sensors as detailed in the drawings.
        1. The Electrical Contractor under Division 26 shall install all Light Level Sensors as detailed on the drawings and in accordance with the manufacturer’s recommendation.
     2. Light Level Sensors shall be a three-wire (standard, power, and signal) analog, linear photodiode and shall be available for the following applications:
        1. Indoor Closed Loop – BPD-500 or equal.
        2. Indoor Closed Loop – LS24OL or equal.
        3. Outdoor, Open Loop - BPD-500, LS24 or equal.
     3. Light Levels Sensors that require an interface box, manual set points, or external power source are unacceptable.
     4. Light Level Sensors requiring pre-manufactured cables or proprietary wiring to connect to controllers are unacceptable.
  10. LINE VOLTAGE OCCUPANCY
      1. BAS Contractor shall provide line voltage occupancy sensors directly connected to the Unified Lighting Control System.
         1. The Electrical Contractor under Division 26 shall install all line voltage occupancy sensors as detailed on the drawings and in accordance with the manufacturer’s recommendation.
      2. Under Division 26, the electrical contractor shall furnish and install line-voltage occupancy sensors not part of the Unified Lighting Control System.
  11. TECHNICIANS KIT
      1. BAS Contractor shall provide a Technicians Kit to the owner during training. The Technicians Kit shall include;
         1. Configuration software
         2. USB Cable
      2. BAS Contractors shall provide an electronic copy of all system files and firmware images for all BACnet Native Lighting Controllers (BNLC).
      3. Configuration software shall be capable of local communication with one or multiple BNLCs using USB (or optional Bluetooth). Upon local connection with one BNLC, the software shall be capable of communicating with any other BNLC on that BACnet MSTP segment / LAN.
      4. Configuration software shall be capable of remote communication with one or multiple BNLC using an IP connection through the BACnet IP / MSTP router (the BACnet router must support tunneling). Upon remote connection with one BNLC, the software shall be capable of communication with any other BNLC on that BACnet MSTP segment / LAN.
      5. Configuration software shall be capable of setting or changing all BNLC parameters.

1. EXECUTION

* 1. Installation
     1. The Electrical Contractor shall furnish the installation of Unified Lighting Control Systems under Division 26.
  2. PROGRAMMING AND CONFIGURATION
     1. BAS Contractor under this Section shall program and configure Unified Lighting Control System controllers to perform the functions in Section 3.6 – Sequence of Operations for Unified Lighting Controls.
     2. The BAS Contractor shall configure the Unified Lighting Control System to be an integral part of the Building Automation System so that the operator experiences one unified system for controlling, monitoring, scheduling, trending, alarming, etc.
     3. BAS Contractor shall provide an operator interface that includes the following graphics:
        1. Floor Plan Graphic: Each controlled zone shall be represented on a Floor Plan Graphic, which shall use color to represent the status.
           1. Grey shall represent Off.
           2. White shall represent On.
           3. Areas with dimming, multiple levels, or presets shall also have an adjacent numeric value showing the current percentage or active preset.
        2. Zone Detail Graphic. Each zone shall have a Zone Detail Graphic displaying the following:
           1. The status of the channel(s) associated with the Zone. The status shall be represented in color on the graphic.
           2. Status of channel timer values for override switches or occupancy sensors associated with the channel. The time-out value shall be represented in minutes and seconds.
           3. Status of channel runtime and cycle count. The runtime shall be represented in hours and minutes. The cycle count shall be represented as a numeric value.
     4. Provided that the operator has the appropriate access, each Zone shall be able to be commanded from the Floor Plan Graphic.
  3. Control System Checkout and Testing
     1. BAS Contractor shall complete startup testing to verify that the control system is operational before notifying the Owner of the system demonstration.
        1. Provide the Owner with a schedule for startup testing. The owner may have a representative present during any or all startup testing.
        2. Verify that the control wiring is connected correctly.
        3. Verify that the wiring installed by Division 26 is free of shorts and ground faults and that terminations are tight.
        4. Verify that the system performs the functions in Section 3.6 – Sequence of Operations for Unified Lighting Controls.
        5. Simulate and observe each operational mode by overriding and actuating inputs and schedules.
        6. Check each alarm with an appropriate signal at a value that will trip the alarm.
        7. Prepare a log documenting the startup testing of each input and output device, with the technician's initials certifying each device has been tested and calibrated.
  4. Control System Demonstration and Acceptance
     1. After tests described in this specification are performed to the satisfaction of both the Engineer and Owner, the Engineer will accept the control system as meeting completion requirements. Engineer may exempt tests from completion requirements that cannot be performed due to circumstances beyond Contractor's control. The engineer will provide a written statement of each exempted test.
     2. The system shall not be accepted until completed demonstration forms and checklists are submitted and approved.
  5. Training
     1. BAS Contractor shall provide two (2) four (4) hour sessions of on-site orientation by a system technician who is thoroughly knowledgeable of the specific installation details of the project. This orientation shall, at a minimum, consist of a review of the project as-built drawings, the Unified Lighting Control System software, layout, and naming conventions, and a walk-through of the facility with the facility manager to identify the Unified System components.
  6. Sequence of Operation for Unified Lighting Controls
     1. Add your sequences here

END Division 25