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SECTION 16500
LIGHTING
(ENERGY MANAGEMENT AND FLUORESCENT DIMMING SYSTEM)

GENERAL

1.01 SUMMARY

- A. Section covers all system components including Energy Control Units, I/O Modules, Dimming Electronic Ballasts, Occupancy Sensors, Photo Sensors, Wall Controllers (“PCH”), Relay Control Panels, Communication Wiring, and energy and lighting control software.

1.02 SYSTEM DESCRIPTION

- A. Performance Requirements: Provide all System components that have been manufactured, assembled, and installed to maintain performance criteria stated by manufacturer without defects, damage, or failure.
- B. Performance Testing Requirements
 - 1. Manufacturer shall 100% test all equipment prior to shipment. Sample testing is not acceptable.
- C. Code Requirements
 - 1. All System components shall be UL listed and CSA/cUL certified, where applicable.
 - 2. All System components shall be FCC compliant, where applicable.
 - 3. All System components shall be installed in compliance with national electrical codes, where applicable.
 - 4. Building Codes: All units shall be installed in compliance with applicable, local building codes.

1.03 SUBMITTALS

- A. General: Submit listed submittals in accordance with conditions of the contract.
- B. Bill of Materials: Complete list of all parts needed to fully install selected System components.
- C. Product Data: Submit product data for specified products.
- D. Shop and Wiring Drawings: Submit shop drawings detailing all mechanical and electrical equipment, as supplied, including one-line diagrams, wire counts, coverage patterns, and physical dimensions of each item.
- E. Samples: Submit samples for finish, color, and texture.
- F. Installation Instructions: Manufacturer’s installation instructions.
- G. Closeout Submittals: Warranty documents specified herein.

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: Installer shall be one who is experienced in performing the work of this section, and who has specialized in installation of work similar to that required for this project.
- B. Source Limitations: No sourcing limitations shall be imposed when selected from Acceptable Manufacturers except where otherwise specified in this document.
- C. Manufacturer Requirements: The manufacturer shall be experienced in the manufacture of commercial lighting controls and shall provide phone support by qualified applications engineers.
- D. ISO Certification: Manufacturer shall be ISO-9000 certified.

1.05 DELIVERY, STORAGE & HANDLING

- A. Ordering: Comply with manufacturer’s ordering instructions and lead-time requirements to avoid construction

delays.

- B. Delivery: Deliver materials in manufacturer's original, unopened, undamaged packages with intact identification labels.
- C. Storage and Protection: Store materials away from exposure to harmful weather conditions and at temperature and humidity conditions recommended by manufacturer.

1.06 WARRANTY

- A. Manufacturer's Warranty: All equipment shall be warranted free of defects in materials and workmanship.
 - 1. Warranty Period: Excluding ballasts, all System components shall be warranted for at least two years from date of purchase.
 - 2. Owner Rights: Manufacturer's warranty is in addition to, not a limitation of, other rights the Owner may have under contract documents, or warranties of third party component manufacturers.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Controls: Encelium Technologies Inc.
- B. Sensors: Hubbell Building Automation, Inc., SensorSwitch, Inc., PLC Multipoint Inc., The Watt Stopper, Inc., Novitas, Inc. or equivalent.
- C. Ballasts: OSRAM Sylvania, Inc., Universal Lighting Technologies, Advance Transformer Co., Lutron Electronics Co. or equivalent.

2.02 SYSTEM REQUIREMENTS

- A. Lighting Control Software: The System shall offer two, separate levels of PC interface: (1) personal lighting control for the average building occupant to control and adjust basic lighting functions in their workspace, and (2) central energy control for the lighting administrator to perform energy management, configuration maintenance, monitoring operations, and providing support to building occupants.
 - 1. GUI: Shall provide a Windows graphical user interface.
 - 2. Central Control: Energy Control Software interface shall provide current status and enable configuration of all System zones including selected individual fixture availability, current light level, maximum light level, on/off status, occupancy status, emergency mode status.
 - 3. Reports: Energy performance reports shall be printable in a printer friendly format and downloadable for use in spreadsheet applications, etc.
 - 4. Personal Lighting Controls: The Personal Control Software interface shall provide current status and enable each user with the ability to dim and brighten lights, and turn them on and off by individual fixture. The Software shall offer user configurable light scenes, which may be programmed and then selected via the Software. Personal lighting control shall be available in open office environments.
- B. Daylight Harvesting (Light Regulation Averaging): In a photo sensor-equipped System, the Energy Control Unit shall rationalize changes to light levels when ambient (natural) light is available and shall maintain a steady light level when subjected to fluctuating ambient conditions. System shall utilize light level inputs from common and/or remote sensor locations to minimize the number of photo sensors required. The System shall operate with multiple users in harmony and not react adversely to manual override inputs. Daylight harvesting shall not impede personal lighting control and the ability to adjust light levels on a per fixture basis.
- C. Time Clock Scheduling: The System shall be programmable for scheduling lights on or off via the Energy Control Software interface.
 - 1. Override: Manual adjustments and occupancy sensor detection shall temporarily override off status imposed by time clock schedule.
 - 2. Response to Power Failure: In the event of a power failure, the time clock shall execute schedules that would still be in progress had they begun during the power outage.
 - 3. Flick warning: Five minutes prior to a scheduled lights-off event or expiry of a temporary override, the System shall provide two short light level drops as a warning to the affected occupants.

- D. Load Shed Mode: An automatic load shedding mode shall be available where, when activated through the System, the control unit will reduce its output to a programmable maximum electrical demand load. The System shall not shed more load than required and load shedding priority shall be centrally configurable by light fixture. The individual user shall retain the ability to override System light levels.
- E. Emergency Mode: There shall be a mode, when activated through the System, that will immediately adjust lights to full light output and retain that level until the mode is deactivated. This setting shall override all other inputs. The System shall interface with the building emergency monitoring system at a convenient point and not require multiple connections.
- F. Addressing: I/O Modules shall be centrally addressable, on a per fixture basis, through the Energy Control Software. To simplify installation and maintenance, the System shall not require manual recording of addresses for commissioning or reconfiguration.
- G. Programmable Task Tuning: Maximum light level programmability shall be available by individual fixture.
- H. Unoccupied State: The System shall provide two states when occupancy status is vacant as per an occupancy sensor: lights turn off or lights adjust to configurable light level.
- I. Occupied State: The System shall not isolate occupants by turning off lights that are still required for convenience and safety, such as a hallway path to exit the premises.
- J. LAN Operations: System shall operate independently of building's existing network infrastructure and shall not rely on tenant supplied PCs for operation. Network infrastructure shall only be utilized for Personal Control Software. Manufacturer must provide software to facilitate communications. Manufacturer shall provide connection from the PC running energy management and lighting control software to the System communication bus.
- K. Firewall Security: System firewall technology shall maintain network security.
- L. Low-Voltage Wiring: Wiring shall be topology independent and not require splicing or termination. Prefabricated, quick connecting wiring shall be utilized. The maximum connected length of wiring shall be no less than 425 metres (1,400 feet) per channel.
- M. Lamp Burn In: The System shall not permit dimming of new lamps prior to completion of manufacturer recommended `100 hour accumulated operation at full brightness.
- N. Reconfigurability: The assignment of individual fixtures to zones shall be centrally configurable by Energy Control Software such that physical rewiring will not be necessary when workspace reconfiguration is performed. Removal of covers, faceplates, ceiling tiles, etc. shall not be required.

2.03 I/O MODULE

A. General:

1. I/O Module shall be the common interface to a ballast or sensor.
2. Addressing: I/O Module shall be individually addressable via Energy Control Software.
3. Response to Power Failure: In the event of a power failure, I/O Modules connected to light fixtures shall default to the "on" state at full light output.

B. Electrical Specifications

1. Ratings: Shall be low voltage input.
2. Voltage Compatibility: Universal voltage control capability to 347 VAC maximum.
3. Primary Relay Rating: 6.5A/120-277V, 4.5A/347-480V with up to 2 ballasts
4. Ballast Compatibility: Suitable for use with electronic dimming ballasts using a 0 to 10 VDC dimming signal, such as Advance Mark VII 0-10V, OSRAM Sylvania Quicktronic Helios, or equivalent.
5. Power:
 - Shall supply 12-24 VDC, 40 mA maximum for occupancy sensor,
 - Shall supply 10 VDC, 25 mA for photo sensor.

6. Control Signal: Shall supply 0-10 VDC, 25 mA maximum dimming signal to attached ballast or receive control signal from attached sensor.

7. Memory: Retains all system settings in non-volatile memory.

C. Mechanical Specifications

1. Wiring: I/O Module shall not require wiring connections to the System apart from prefabricated, quick connecting low voltage wiring.

D. Environmental Specifications

1. Operating Temperature Range: 0°C to +40°C

2. Relative Humidity: 20% to 90% non-condensing

2.04 WALL CONTROLLERS

A. General

1. Addressing: All controllers shall be individually addressable via Energy Control Software.

B. Electrical Specifications

1. Ratings: Shall be low voltage input.

C. Mechanical Specifications

1. Operations: Localized on/off switching, dimming up/down, and programmable scene selection for dimming loads shall be provided, as required.

2. LED's: All controllers shall feature LED's to indicate light on and light off status, as required.

D. Environmental Specifications

1. Operating Temperature Range: 0°C to 55°C

2. Relative Humidity: 20% to 90% non-condensing

E. Aesthetic Requirements

1. Style: All controllers shall feature Decorator styling.

2. Color: All controllers shall be available in white, with an optional colour insert kit for changing color without reinstalling switch.

3. Accessories: Matching wallplate shall be available.

2.05 PHOTO SENSOR

A. General

1. A sensor that measures ambient light in a finite area shall be available.

2. Specifications: The sensor shall measure light from any source in the visible spectrum within at least a 60° cone. It shall measure light between 0 and minimum 75 foot-candles.

B. Electrical:

1. Rating: Maximum 10VDC, 25mA.

C. Mechanical:

1. Mounting: The sensor shall be flush mounted on or recessed inside ceiling tile.

D. Environmental Specifications

1. Operating Temperature Range: 0°C to 55°C

2. Relative Humidity: 20% to 90% non-condensing

2.06 OCCUPANCY SENSORS

A. General:

1. Sensors using passive infrared, ultrasonic, acoustic, and multi-technology adaptive technology shall be

available.

2. Sensor timeouts shall be configurable by System software.

B. Electrical:

1. Rating: Maximum 24 VDC input voltage, 40 mA current draw.

C. Mechanical:

1. Mounting: Sensors for mounting on ceilings and walls, including corners, must be available.

D. Environmental:

1. Operating Temperature Range: 0°C to 55°C
2. Relative Humidity: 20% to 90% non-condensing

2.07 BALLASTS

A. Quality Assurance

1. Source Limitations: All dimming ballasts, per particular lamp and fixture type, must be manufactured by the same company in order to assure consistent dimming.
2. Manufacturer Requirements: Manufacturer must have a demonstrated history of designing and manufacturing dimming electronic ballasts.
3. Ballast must be manufactured in a facility certified to ISO Quality System Standards.

B. Code Requirements

1. Ballast shall meet ANSI C82.11 limits for Total Harmonic Distortion.
2. Ballast shall meet FCC Part 18 non-consumer standards for electrical equipment (Class A).
3. Ballast shall meet ANSI 62.41 Category A standards for Transient Voltage protection.
4. Ballast shall meet UL 935 standards and be UL Listed and CSA Approved.
5. Ballast shall be UL Class P and Type 1 Outdoor.
6. Ballast shall contain no Polychlorinated Byphenols (PCBs) in accordance with U.S. law.
7. Ballast shall meet all U.S. state and federal efficacy laws and all Canadian provincial and federal efficacy laws.

C. Manufacturer's Warranty: All equipment shall be warranted free of defects in materials and workmanship.

1. Warranty Period: Ballasts shall be warranted for at least five years from date of manufacture.
2. Conditions: Warranty shall be valid at case temperatures of 70°C or less.

D. Electrical Requirements

1. Ballast THD shall be less than 10% for the main lamp design (as indicated on the datasheet).
2. Lamp Current Crest Factor shall not exceed 1.7 for the main lamp design.
3. Ballast Power Factor must be greater than 98% for the main lamp design.
4. Ballast must operate between $\pm 10\%$ of rated input voltage, 60Hz.
5. All Ballasts for Compact Fluorescent Lamps and T5 diameter lamps must contain a lamp end-of-life detection and shut down circuit in accordance with ANSI/IEC proposed standards. Compact Fluorescent and Long Twin Tube T5 lamps (BIAX, PL-L, DULUX-L) shall not be operated on an instant-start circuit.

E. Mechanical Requirements

1. Ballast shall be able to dim a fluorescent lamp from 100-20% of nominal light output. Dimming shall be available to 5% on some models.
2. Ballast shall be able to start the lamp at any level without having to start at the high level first.
3. Ballast input power (ANSI watts) shall be able to be reduced to less than 30% of nominal.

4. Ballast shall be controlled via a 0 to 10V signal transmitted over Class 1 or Class 2 low voltage leads.
- F. Lighting Performance Requirements
1. Ballast must have a ballast factor of .85 to .96 for a normal light output design.
 2. Ballast must have a maximum input wattage (ANSI) as indicated on the data sheet.
 3. Ballast must have a ballast efficacy factor of at least what is indicated on the data sheet.
 4. Ballast must be able to start and operate the specified lamps at an average temperature of 60° Fahrenheit.
 5. Ballast must be sound rated A.
 6. Ballast must be designed and UL Listed to operate the number and type of lamps as indicated on the data sheet.

2.08 LIGHTING CONTROL PANELS

A. General

1. Addressing: All lighting control panels shall be individually addressable via Energy Control Software.
2. Communication: All lighting control panels shall communicate via the same prefabricated, quick connecting low voltage wiring as all other devices.
3. Wiring: Relay control panels shall be interconnected with any other devices on the same wiring loop.

PART 3 EXECUTION

3.01 PREPARATION

- A. Site Verification: Verify that wiring conditions, which have been previously installed under other sections or at a previous time, are acceptable for product installation in accordance with manufacturer's instructions.
- B. Inspection: Inspect all material included in this contract prior to installation. Manufacturer shall be notified of unacceptable material prior to installation.

3.02 INSTALLATION

- A. The Electrical Contractor, as part of the work of this section, shall coordinate, receive, mount, connect, and place into operation all equipment. The Electrical Contractor shall furnish all conduit, wire, connectors, hardware, and other incidental items necessary for properly functioning lighting control as described herein and shown on the plans. The Electrical Contractor shall maintain performance criteria stated by manufacturer without defects, damage, or failure.
 1. Compliance: Contractor shall comply with manufacturer's product data, including shop drawings, technical bulletins, product catalog installation instructions, and product carton instructions for installation.
- B. Power: The contractor shall test that all branch load circuits are operational before connecting loads to sensor system load terminals, and then de-energize all circuits before installation.
- C. Related Product Installation: Refer to other sections listed in Related Sections for related products' installation.

3.03 TESTING

- A. Upon completion of all line, load and interconnection wiring, and after all fixtures are installed and lamped, a qualified factory representative shall completely configure and test the System.
- B. At the time of checkout and testing, the owner's representative shall be thoroughly instructed in the proper operation of the system.

3.04 PROTECTION

- A. Contractor shall protect installed product and finished surfaces from damage during all phases of installation including preparation, testing, and cleanup.

END OF SECTION