SECTION 260943.16 - ADDRESSABLE-LUMINAIRE LIGHTING CONTROLS

Revise this Section by deleting and inserting text to meet Project-specific requirements.

Verify that Section titles referenced in this Section are correct for this Project's Specifications; Section titles may have changed.

See "Sustainable Design Considerations" Article in the Evaluations for a discussion of sustainable design requirements that may impact the editing of this Section.

1. GENERAL
	* + 1. RELATED DOCUMENTS

Retain or delete this article in all Sections of Project Manual.

Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

* + - 1. SUMMARY
				1. Section includes lighting controls for addressable luminaires, based on DALI digital controls.
			2. DEFINITIONS

Retain terms that remain after this Section has been edited for a project.

* + - * 1. BAS: Building automation system.
				2. DALI: Digital addressable lighting interface.
				3. Data Bus: Two wires used to communicate with bus connected devices.
				4. DDC: Direct digital control.
				5. Device: A collective term for DALI-compliant bus connected devices, including fluorescent ballasts, incandescent luminaires, manual switches, switching relays, and similar. Sometimes also called "slave unit."
				6. Group: A set of devices that respond at the same time to messages on the data bus.
				7. IP: Internet protocol.
				8. IR: Infrared.
				9. LAN: Local area network.
				10. Monitoring: Acquisition, processing, communication, and display of equipment status data, metered electrical parameter values, power quality evaluation data, event and alarm signals, tabulated reports, and event logs.
				11. Scene: Digital light level associated with a preset; stored in the luminaire ballast.
				12. TCP/IP: Transmission control protocol/Internet protocol.
				13. VPN: Virtual private network.
			1. ACTION SUBMITTALS
				1. Submittals for this section are subject to the re-evaluation fee identified in Article 4 of the General Conditions.
				2. Manufacturer’s installation instructions shall be provided along with product data.
				3. Submittals shall be provided in the order in which they are specified and tabbed (for combined submittals).
				4. Product Data: For each type of product.

Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for control modules, power distribution components, relays, manual switches and plates, and conductors and cables.

Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

Sound data including results of operational tests of central dimming controls.

Operational documentation for software and firmware.

* + - * 1. Shop Drawings:

Floor Plans: Location, orientation, and coverage area of each sensor; group designations; and other specific design symbols and designations as required to define the installation, location, and configuration of all control devices.

Address Drawing: Reflected ceiling plan and floor plans, showing data-bus-connected devices, address for each device, and device groups. The plans shall be based on construction plans, using the same legend, symbols, and schedules.

Point List and Data Bus Load: Summary list of all control devices, sensors, ballasts, and other loads connected to each data bus and total connected load for each data bus. Include percentage of rated connected load and device addresses.

Wire Termination Diagrams and Schedules: Coordinate nomenclature and presentation with Drawings and block diagram. Differentiate between manufacturer-installed and field-installed wiring.

Retain "Block Diagram" Subparagraphsubparagraph below if this Section includes PC-based local area data bus or link to BAS.

Block Diagram: Show interconnections between components specified in this Section and devices furnished with power distribution system components. Indicate data communication paths and identify networks, data buses, data gateways, concentrators, and other devices used. Describe characteristics of network and other data communication lines.

Retain "Coordination Drawings" Paragraphparagraph below to require lighting controls to be connected to Section 230923 "Direct Digital Control (DDC) System for HVAC" or other integrated control system.

* + - * 1. Coordination Drawings: Submit evidence that lighting controls are compatible with connected monitoring and control devices and systems specified in [**Section 230923 "Direct Digital Control (DDC) System for HVAC."**] <**Insert Section number and title.**>

Show interconnecting signal and control wiring, and interface devices that show compatibility of inputs and outputs.

For control interfaces and adapters, list network protocols and provide statements from manufacturers that input and output devices comply with interoperability requirements of the protocol.

* + - * 1. Field quality-control reports.
				2. Sample Warranty: For manufacturer's special warranty.

Retain paragraph below for PC- and IP-based control systems.

* + - * 1. Software licenses and upgrades required by and installed for operation and programming of digital and analog devices.
				2. Submittals for this section are subject to the re-evaluation fee identified in Article 4 of the General Conditions.
			1. CLOSEOUT SUBMITTALS
				1. Operation and Maintenance Data: For lighting controls to include in emergency, operation, and maintenance manuals.

Retain "Software and Firmware Operational Documentation" Paragraphparagraph below for PC- and IP-based control systems.

* + - * 1. Software and Firmware Operational Documentation:

Software operating and upgrade manuals.

Program Software Backup: [**On USB drive.**] [**Username and password for manufacturer's support website.**]

Device address list.

Printout of software application and graphic screens.

Adjustments of scene preset controls, adjustable fade rates, and fade overrides.

Operation of adjustable zone controls.

Testing and adjusting of panic and emergency power features.

* + - 1. MAINTENANCE MATERIAL SUBMITTALS
				1. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

Bus Power Supplies: Equal to [**two**] <**Insert number**> percent of amount installed, but no fewer than [**two**] <**Insert number**>.

Controller/Gateways: Equal to [**two**] <**Insert number**> percent of amount installed, but no fewer than [**two**] <**Insert number**>.

Incandescent Switching and Dimming Modules: Equal to [**two**] <**Insert number**> percent of amount installed, but no fewer than [**two**] <**Insert number**>.

Fluorescent Ballasts: Equal to [**two**] <**Insert number**> percent of amount installed, but no fewer than [**two**] <**Insert number**>.

Lighting Control Relays: Equal to [**two**] <**Insert number**> percent of amount installed, but no fewer than [**two**] <**Insert number**>.

* + - 1. WARRANTY

When warranties are required, verify with Owner's counselDirector’s Representative that warranties stated in this article are not less than remedies available to Director’s Representative Owner under prevailing local laws.

* + - * 1. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of lighting controls that fail in materials or workmanship within specified warranty period.

Failures include, but are not limited to, the following:

Software: Failure of input and output to execute switching or dimming commands.

Failure of modular relays to operate under manual or software commands.

Ballast failure.

Damage of electronic components due to transient voltage surges.

Verify available warranties and warranty periods for units and components.

Warranty Periods:

For DALI Ballasts: [**Three**] <**Insert number**> years from date of Substantial Completion.

For Control Components That Are Not Part of Ballasts: [**Three**] <**Insert number**> years from date of Substantial Completion.

1. PRODUCTS

Manufacturers and products listed in SpecAgent and Masterworks Paragraph Builder are neither recommended nor endorsed by the AIA or AVITRU. Before inserting names, verify that manufacturers and products listed there comply with requirements retained or revised in descriptions and are both available and suitable for the intended applications. For definitions of terms and requirements for Contractor's product selection, see Section 016000 "Product Requirements."

* + - 1. SYSTEM DESCRIPTION
				1. DALI:

Components: Individually addressable devices (such as ballasts, relays, dimmers, and switches) that are operated from digital signals received through a DALI-compliant bus, from data-entry and -retrieval devices (such as computers, Internet portals, hand-held IR programming devices, wired Ethernet hubs, wireless IEEE 802.11 hubs[**,and**] <**Insert digital communications device**>). Devices also report status to data-entry and -retrieval devices though the bus.

Digital Control: Use peer-to-peer communication and distributed logic, where the failure of any single component shall be automatically isolated and not affect global system functions.

Retain "Ethernet LAN" Paragraphparagraph below if controller/gateways are not connected to HVAC DDC system.

* + - * 1. Ethernet LAN:

Provide an Ethernet LAN to connect controller/gateways to a PC running a Microsoft Windows operating system. Comply with requirements in Section 271513 "Communications Copper Horizontal Cabling."

Ethernet Protocols: Comply with and be compatible with 10/100 BaseT TCP/IP routers and networks.

TCP/IP Modem: Capable of maintaining a secure Internet connection using VPN or equivalent protocol.

Coordinate with Section 230923 "Direct Digital Control (DDC) System for HVAC" or other integrated control system.

* + - * 1. Interface with HVAC DDC System: Hardware and software shall interface with HVAC DDC system to monitor, control, display, and record data for use in processing reports. Comply with requirements in Section 230923 "Direct Digital Control (DDC) System for HVAC."

Retain "Hardwired Points" or "Communication Interface" Subparagraphsubparagraph below. Retain first subparagraph if interface with HVAC DDC system is through hardwired points and minimal interface is required. Retain second if extensive interface with HVAC DDC system is required and is beyond what hardwired points can provide. Requirement may exclude some manufacturers. Coordinate with Section 230923 "Direct Digital Control (DDC) System for HVAC" or other integrated control system.

Hardwired Points:

Monitoring: On-off status, <**Insert monitoring point**>.

Control: On-off operation, <**Insert control point**>.

Communication Interface: Comply with [**ASHRAE 135**] <**Insert type of interface**>. Communication shall interface with HVAC DDC system to remotely control and monitor lighting from HVAC DDC system operator workstation. Control features and monitoring points displayed locally at lighting panel shall be available through DDC system for HVAC. Comply with requirements in Section 230923 "Direct Digital Control (DDC) System for HVAC."

* + - * 1. Surge Protective Device: Factory installed as an integral part of control components or field-mounted surge protective device complying with UL 1449, SPD Type 2.
				2. Operation: Input signal from digital signal sources switches or dims DALI devices associated with ballasts or luminaires, or switches field-deployed, DALI-compliant, control relays.

Each device and relay is connected to a digital data bus.

Each DALI device and relay has a digital address and can be operated by a digital signal.

Each device or relay can be assigned to any or all of 16 available groups connected to a single data bus.

Each dimming ballast may have as many as 16 preset lighting levels or scenes. Scenes can be programmed to ballasts and may be applied to groups.

* + - * 1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
				2. Comply with 47 CFR 15, Subparts A and B, for Class A digital devices.
				3. Comply with protocol described in IEC 60929, Annexes E and G, for DALI lighting control devices, wiring, and computer hardware and software.
				4. Comply with UL 916.
			1. BUS POWER SUPPLY

The power supply powers the Class 2 low-voltage communications bus to which DALI devices are connected. The controller supports the DALI commands, device settings, and device monitoring.

* + - * 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

Leviton Manufacturing Co., Inc.

Signify North America Corporation (formerly Philips Lighting).

Starfield Controls, Inc.

Or equal.

* + - * 1. Description: Supply power to data bus for 64 addressable devices, suitable for use with NFPA 70, Class 2 control circuit.

Primary Power: Field selectable, 120 and 277 V.

Power Supply: Regulated to maintain the operating voltage above 15-V dc under full load and rated for full charging load of 250 mA and a minimum maintained connected load of 190 mA.

Pilot Lights: Indicate data bus ground-fault and data bus traffic.

* + - 1. CONTROLLER/GATEWAYS
				1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

Leviton Manufacturing Co., Inc.

Signify North America Corporation (formerly Philips Lighting).

Starfield Controls, Inc.

Or equal.

* + - * 1. Description: DALI controller/gateways link the distributed data buses with an Ethernet network to provide computer configuration, control, analysis, and maintenance. Controller/gateways operate independently and continue to process local inputs and schedules when disconnected from the LAN. Controller/gateways shall provide local intelligence and features including the following:

Integrated real-time clock with automatic daylight savings adjustment and leap-year correction.

Integrated sunrise/sunset support based on the site location (latitude and longitude).

Automatic time schedules, to control groups for scheduled occupancy with support for holiday exceptions.

Two digital outputs for additional control and interlocking with external equipment such as fans, valves, and security panels.

Support [**one**] [**two**] data bus(es).

Computer Monitoring and Configuration: The controller/gateway shall allow configuration, monitoring, and analysis from PCs on the Ethernet LAN.

* + - * 1. Each data bus shall have the capacity to control 64 addressable devices, using NFPA 70, Class 2 control circuit.

Each data bus shall have the capacity to control up to 16 groups and scenes.

10 BaseT Ethernet port for DDC system for HVAC connection.

LED indicator lights for Ethernet status (link, send, and receive), power-on, and LAN failure.

Linking of switch and sensor inputs to relay and ballast outputs.

Viewing relay and ballast output status.

Controlling relay and ballast outputs.

Setting device addresses.

Assigning switch and sensor inputs and relay and ballast output modes.

Retain applicable DALI-compliant addressable devices in first paragraph below. Verify that listed devices are available from manufacturers listed in subsequent articles.

* + - * 1. Allow connection of the following DALI-compliant addressable devices:

Fluorescent luminaire switching and dimming, for linear and compact lamps.

Incandescent luminaire switching and dimming.

HID and HPS luminaire switching and dimming.

LED luminaire switching and dimming.

Occupancy and photoelectric sensors.

Emergency lighting interface complying with UL 924.

* + - * 1. Stores system programming in nonvolatile memory.

Switch to enable or disable software programming.

If controller/gateways are not connected to DDC system for HVAC, retain "User Interface" and "Lighting Control System Management Software" articles below as alternatives. Delete both articles if Owner will program controller/gateways with a laptop PC running Microsoft Windows.

* + - 1. USER INTERFACE
				1. Workstations: A laptop PC, with Microsoft Windows operating system and lighting control system management software installed. With automatic backup.

Include documentation, storage media, and licensing for a minimum of five concurrent users.

* + - * 1. Tablet Computer: Handheld, with custom graphical user-interface software, supplied by the controller/gateway supplier. The software shall provide for all DALI-protocol programming commands to be applied to the controller/gateway via a tethered connection.
				2. Web Interface: Internet portal, with [**one**] [**10**] <**Insert number**> unique username and password(s), and a custom graphical user interface, allowing DALI-protocol programming commands to be applied to the controller gateway via [**LAN**] [**the Internet**].
				3. IR Programming Assistant: Handheld, with custom graphical user-interface software, supplied by the controller/gateway supplier to program the manual switches.
			1. LIGHTING CONTROL SYSTEM MANAGEMENT SOFTWARE
				1. The software shall provide for programming, configuring, and monitoring all devices connected to all data buses of the lighting control system, using application-specific software with Microsoft Windows-based, user-friendly software with graphical user-interface designed screens.

The software shall be object oriented with pop-up menus and built-in help screens. All specified features of the data-bus-connected devices and those associated with controller/gateways shall be included in the software.

Retain "Luminaire Switching and Dimming Modules" Article below for luminaire switching and dimming applications that are not connected to a ballast. If connected to a ballast, retain "Ballast Switching and Dimming Modules" Article.

* + - 1. LUMINAIRE SWITCHING AND DIMMING MODULES
				1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

Leviton Manufacturing Co., Inc.

Signify North America Corporation (formerly Philips Lighting).

Starfield Controls, Inc.

Or equal.

* + - * 1. Description: Comply with DALI exponential dimming curve calibrated for the connected lamp type, group, and scene settings, and with DALI light-level and configuration commands. Dimmer rise time shall be not less than 15 microseconds.
			1. BALLAST SWITCHING AND DIMMING MODULES
				1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

Lutron Electronics Co., Inc.

OSRAM SYLVANIA.

Signify North America Corporation (formerly Philips Lighting).

Or equal.

* + - * 1. Each ballast or group shall be addressable and shall include on-off, fade, dimming, scene settings, and other standard DALI control functions and as required to meet the sequence of operation.
				2. Ballasts: Comply with requirements in [**Section 265116 "Fluorescent Interior Lighting" for ballasts for linear fluorescent lamps**] [**and**] [**Section 265123 "HID Interior Lighting" for ballasts for HID lamps**]; electronic programmed-start; and the following:

Starting Method: Programmed rapid start with antiflash (turns on at previously set light level).

Dimming ranges down to 1 and 3 percent of rated lumens are available for some fluorescent lamps.

Dimming Range: 100 to 10 percent of rated lumens unless otherwise indicated.

Ballast Factor: 1.0 at full output; 0.01 at full dim.

Input Voltage Range: 108 to 305 V.

* + - 1. SENSORS
				1. Comply with requirements in Section 260923 "Lighting Control Devices." All sensors shall be DALI-protocol compliant.
				2. Daylight Harvesting Switching and Dimming Controls:

Adjustments and Set Points: All adjustments with exception of sensor range shall be made via the communication network.

Remote Monitoring and Reporting: Sensor value shall be displayed when queried by lighting management software or shall automatically report based on a change of value or change of time period setting.

* + - * 1. Indoor Occupancy Sensors: May be powered directly from the lighting control network or with a standalone power supply. Units powered with a standalone power supply shall interface with the lighting control system through an electrically isolated digital input.
			1. RELAYS

Retain this article to require addressable switches for loads where DALI compliance is not built in.

* + - * 1. Relays: Electrically operated, mechanically held single-pole switch, rated at 20 A at 277 V. Short-circuit current rating shall be not less than 5 kA. Pilot light indicates when relay is closed and latched. Control shall be by DALI digital data bus. Relay status shall be displayed when queried by lighting management software.
				2. Relay Panel: A single enclosure with incoming lighting branch circuits, relays, and connection to the DALI digital control network.

Enclosure: NEMA 250, Type 1 unless otherwise indicated.

Barriers to separate low-voltage and line-voltage components.

Directory: Cover mounted, identifying each relay with its device address and naming the load controlled.

* + - * 1. Individually Mounted Relays:

Enclosure: Standard outlet box or NEMA 250, Type 1 unless otherwise indicated.

Directory: Cover mounted, identifying each relay with its device address.

* + - 1. MANUAL SWITCHES AND PLATES

Coordinate use of manual switches in this article with required control and override functions, with sensor applications where used, and with switch and wall-plate finish specified in Section 262726 "Wiring Devices."

"Connection Type" Paragraphparagraph below is NFPA 70, Class 2, connected to the DALI data bus. Other cabling methods are available, depending on manufacturer.

* + - * 1. Connection Type: RS-485 protocol, [**Category 5**] [**Category 5e**] UTP cable, using RJ-45 connectors. Power shall be from the control unit.
				2. Push-Button Switches: Modular, operating over the DALI digital data bus.

Each switch shall control the following functions, in coordination with programmed sequence of operation and related sensors:

On.

Off.

Dimming, increase light level.

Dimming, decrease light level.

Return to preset light level.

LED Pilot Lights: On to indicate that the control is active, or when the manual control is operated.

Match color and style specified in Section 262726 "Wiring Devices."

Integral IR receiver for programming.

* + - * 1. Wall Plates: Single and multigang plates as specified in Section 262726 "Wiring Devices."
				2. Legend: Engraved or permanently silk-screened on wall plate where indicated. Use designations indicated on Drawings.
			1. CONDUCTORS AND CABLES
				1. Power Wiring to Supply Side of Class 2 Power Source: Not smaller than No. 12 AWG, complying with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

For Class 2 conductors in "Class 2 Control Cables" Paragraphparagraph below, retain wire size based on voltage drop, or use No. 18 AWG.

* + - * 1. Class 2 Control Cables: Multiconductor cable with copper conductors not smaller than [**No. 18**] [**No. 22**] [**No. 24**] AWG, complying with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
				2. Class 1 Control Cables: Multiconductor cable with copper conductors not smaller than [**No. 14**] [**No. 16**] [**No. 18**] AWG, complying with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
				3. Digital and Multiplexed Signal Cables: UTP cable with copper conductors, complying with [**Category 5e**] [**Category 6**] for horizontal copper cable. and with Section 271513 "Communications Copper Horizontal Cabling."
1. EXECUTION
	* + 1. WIRING INSTALLATION
				1. Comply with NECA 1.

Retain one of two "Wiring Method" paragraphs below and coordinate with Drawings. Delete both if wiring methods for system are indicated on Drawings.

* + - * 1. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters [**and except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used**]. Conceal raceway and cables except in unfinished spaces.

Retain first subparagraph below if retaining option in "Wiring Method" Paragraphparagraph above.

Install plenum cable in environmental airspaces, including plenum ceilings.

Comply with requirements for cable trays specified in Section 260536 "Cable Trays for Electrical Systems."

Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."

* + - * 1. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
				2. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.
			1. IDENTIFICATION
				1. Identify system components, wiring, cabling, boxes, cabinets, and terminals. Comply with identification requirements specified in Section 260553 "Identification for Electrical Systems."
				2. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with Section 260553 "Identification for Electrical Systems."
				3. Identify all ceiling-mounted controls with data bus number and device address.
				4. Label each device cable within 6 inches (152 mm) of connection to bus power supply or termination block.
			2. FIELD QUALITY CONTROL
				1. Acceptance Testing Preparation:

Test continuity of each circuit.

Retain "Perform the following tests and inspections" Paragraphparagraph below to require Contractor to perform tests and inspections.

* + - * 1. Perform the following tests and inspections [**with the assistance of a factory-authorized service representative Company Service Advisor**]:

Test each bus controller using local and remote controls.

Perform each visual and mechanical inspection and electrical test stated in NETA ATS. Certify compliance with test parameters.

Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

* + - * 1. Field Test Reports:

Printed list of all points created from actual queries of all addressed control points to include lamps, ballasts, manual controls, and sensors.

Event log verifying the performance of all devices generating event messages to include occupancy sensors, control buttons, alarm messages, and any other change of value messages.

* + - * 1. Lighting controls will be considered defective if they do not pass tests and inspections.
				2. Prepare test and inspection reports, including a certified report that identifies bus controllers included and describes query results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.
			1. STARTUP SERVICE
				1. [**Engage a Company Service Advisor to perform**] [**Perform**] startup service.

Complete installation and startup checks according to manufacturer's written instructions.

Activate luminaires and verify that all lamps are operating at 100 percent.

Burn-in fluorescent lamps at 100 percent for 100 hours.

Confirm correct communications wiring, initiate communications between DALI devices and controller/gateways, and program the lighting control system according to approved configuration schedules, time-of-day schedules, and input override assignments.

<**Insert startup steps if any**>.

* + - 1. ADJUSTING
				1. Occupancy Adjustments: When requested within [**12**] <**Insert number**> months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to [**two**] <**Insert number**> visits to Project during other-than-normal occupancy hours for this purpose.
			2. SOFTWARE SERVICE AGREEMENT

Services in this article may not be allowed for publicly funded projects.

* + - * 1. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for [**two**] <**Insert number**> years.
				2. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within [**two**] <**Insert number**> years from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.

Upgrade Notice: At least [**30**] <**Insert number**> days to allow Director’s Representative to schedule and access the system and to upgrade computer equipment if necessary.

* + - 1. DEMONSTRATION
				1. [**Engage a Company Service Advisor to train**] [**Train**] Director’s Representative's maintenance personnel to adjust, operate, and maintain the control unit and operator interface.

END OF SECTION 260943.16