SECTION 25 09 43
NETWORK LIGHTING CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Digital-Network Lighting Controls - 26 09 43.13
   2. Addressable Fixture Lighting Control – 26 09 43.16

B. RELATED DOCUMENTS
   1. [Wiring Devices – 26 27 26]
   2. [Lighting Control Devices – 26 09 23]
   3. [Interior Lighting Fixtures – 26 51 00]
   4. [Monitoring and Control of Electrical Equipment – 25 56 00]
   5. [Integrated Automation - 25 00 00]
   6. [Integrated Automation Definitions - 25 06 11]
   7. [Client-Server Information Database Integration - 25 12 23]
   8. [Graphics - 25 15 23]

1.2 REFERENCES

A. National Fire Protection Association (NFPA)

B. UL Listing/Certification
   1. Certified as Energy Management Equipment (UL 916)
   2. Certified as Emergency Lighting Equipment (UL 924)
   3. Meet Heat and Smoke Release for Air-Handling Spaces (UL 2043)

C. Federal Communications Commission (FCC) / Industry Canada (IC)

D. California Energy Commission (CEC)

E. Local Building Codes

1.3 SYSTEM DESIGN PROCESS

A. Lighting Design Kick-off Meeting: The Stanford Project Manager will initiate and facilitate a pre-design kick-off meeting between the lighting designer, Stanford Zone Manager, Stanford FAC Program Manager and LBRE IT. The intent of this meeting is to review the project and to determine the appropriate design approach for the lighting control system.

   1). If the project is for an existing building, the lighting designer shall review field conditions for existing lighting control systems. A preliminary approach and preferred Lighting Control System manufacturer shall than be discussed at the meeting.

   2). This meeting shall also determine who will provide the Lighting Control System (i.e., the Electrical Contractor or the Building Automation and Control System Contractor), and how the work will be identified in the construction documents.
1.4 SYSTEM HARDWARE & SOFTWARE DESCRIPTION AND REQUIREMENTS

A. Lighting Control System architecture shall facilitate remote configuration, monitoring, and reporting via a computer software interface. System shall include the following types of control components:

1. Lighting Control Network
   a. All lighting control hardware shall be networked together and shall be capable of remote programming, configuring, testing, and executing the control sequence of operations.
   b. The hardware to be networked will depend on the scope of the project. At minimum, all lighting control devices, including occupancy sensors, photosensors, relays, power packs, and low-voltage switches shall be networked.
      1) Individual luminaires do not necessarily require network connectivity, unless specifically called for in the sequence of operations or other design documents.

2. Lighting Control Protocols
   a. BACnet IP and BACnet MS/TP are acceptable lighting system communication protocols.
   b. Proprietary communication protocols are generally not acceptable. Any proprietary communication protocols must have FAC approval.

3. The system architecture shall be capable of distributed intelligence, wherein stand-alone groups of devices shall function according to local automatic sensing or manual control capacity, even if network connectivity to the system is lost.

4. Connected Devices:
   a. Drivers/Ballasts: Shall be industry standard, non-proprietary devices and use a 0-10V dimming protocol.
   b. Occupancy/Photosensors:
      1) Shall be low voltage devices, generally 24 VDC, and selected to suit the individual, space-specific application in which they are to be used.
      2) Wireless connections to Occupancy/Photosensors are not acceptable. This specification allows wired sensors only. Wireless sensors are acceptable only in the following scenarios, as approved by Owner:
         a) A ceiling that is known to contain Asbestos.
         b) A hard ceiling in an historical building that would be irreparably damaged by hard-wired Occupancy/Photosensors.
         c) Wireless communication protocols between gateways and sensors, only if approved by Owner in scenarios listed above, must conform to IEEE 802.15.4 standard.
         d) WiFi communication based on IEEE 802.11 is not allowed

B. Networked Lighting Controls or Unified Lighting Controls

1. A Networked or Unified Lighting Control System incorporates proprietary Building Automation Control System hardware and software. All lighting control devices shall be integrated with the Building Automation Control System and shall be capable of wired or hybrid wired architectures.

2. A Networked or Unified Lighting Control System shall be provided by the Building Automation Control System contractor.

C. A Networked or Unified Lighting Control System is suitable for use in the design of new buildings and major renovations.
A. General Submittal Requirements are listed in DIV 250000.

B. List all software features that can be performed in Native Lighting Control Software but that cannot be performed through Niagara Integrated Automation System.

C. List all reports that can be generated in Native Lighting Control Software but that cannot be replicated in Niagara Integrated Automation System

D. Shop and Wiring Drawings: Submit shop drawings detailing control system, as supplied, including:
   1. Schedule of lighting control system components
   2. Typical room wiring diagrams
   3. System backbone
   4. Network riser diagram
   5. Sequence of operations
   6. Lighting plan by floor
   7. Interconnection diagrams showing field-installed wiring
   8. Wire counts
   9. Coverage patterns

E. Coordination Drawings: Submit evidence that lighting controls are compatible with connected monitoring and control devices and systems specified in other DIV 25 Sections.
   1. Show interconnecting signal and control wiring and interfacing devices that prove compatibility of inputs and outputs.
   2. For networked controls, list network protocols and provide statements from manufacturers that input and output devices meet interoperability requirements of the network protocol.
1.6 QUALITY ASSURANCE

A. Installer Qualifications: Installer shall be CALCTP Certified and experienced in performing the work of this section, and who has specialized in installation of work similar to that required for this project.

B. Contractor shall ensure that lighting system control devices and assemblies are fully compatible and can be integrated into a system that operates as described in the lighting control notes on drawings and as described within this specification. Any incompatibilities between devices, assemblies, and controllers shall be resolved between the contractor and the system provider, as required to ensure proper system operation and maintainability.

C. 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.

D. Code Requirements
   1. All system components shall be UL listed and certified.
   2. All system components shall be FCC /IC compliant.
   3. System electrical components shall be listed or recognized by a qualified testing agency (UL, ETC) and shall be labeled with required markings as applicable.
   4. All components and the manufacturing facility where the product was manufactured must be RoHS compliant.
   5. All system components shall be installed in compliance with National Electrical Codes.
   6. Building Codes: All units shall be installed in compliance with applicable local building codes.

E. ISO Certification: System components shall be manufactured at ISO-9000 certified plants.

F. Coordination
   1. Coordinate lighting control components to form an integrated interconnection of compatible components.
      a. Match components and interconnections for optimum performance of lighting control functions.
      b. Coordinate Sequence of Operations, Controls Matrix, and Task Tuning Table with Stanford University Project Manager. Provide all required sequence of operations requirements on lighting plans. Lighting controls data used for HVAC sequences will be specified in Division 253528.

1.7 PROJECT CONDITIONS

A. System devices shall meet the following environmental conditions:
   1. Operating Temperature Range: 14 deg F (-10 deg C) to 90 deg F (+32 deg C).
   2. Relative Humidity: 0% to 100% RH condensing rated for damp locations. Less than 90% non-condensing rated for indoor locations.

1.8 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 packaging 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.

1.9 WARRANTY

A. Refer to Section 250000

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Refer to Section 251400 for general requirements.

B. All lighting control sensors, switches, and ancillary control devices shall be Acuity nLight devices or Distech subnet-native devices.

2.2 SYSTEM REQUIREMENTS

A. WALL STATIONS

1. Description: The system shall connect with the wall stations. All wall stations shall at minimum meet the following general specifications.

2. General
   a. Individual button for each zone
   b. Ability to adjust dimming level for each zone

3. Multi-button scene controller shall be provided in the following spaces and as noted on: Conference Rooms, Lecture Halls, Auditorium, Theater, Multi-use Dining Hall/Multipurpose Rooms.

4. Wireless connections to Wall Station are not acceptable, except in the following scenarios, as approved by Owner:
   a. A wall that is known to contain Asbestos.
   b. A stone wall with no interstitial space.
   c. A wall in an historical building that would be irreparably damaged by hard-wired Wall Station.

5. Electrical:
   a. Class 2 Low Voltage device
   b. Battery-powered Wall Stations are not acceptable, except in the following scenarios, as approved by Owner:
      1) A wall that is known to contain Asbestos.
      2) A stone wall with no interstitial space.
      3) A wall in an historical building that would be irreparably damaged by hard-wired Wall Station.

6. Mechanical:
   b. Color: Shall meet NEMA WD1 color specifications
   c. Mounts in standard size wall box (suitable for multi gang installation) or on mounting brackets for low voltage devices.
   d. Suitable for use with Decorator style wall plates.

7. Reliability:
   a. Maximum Operating Ambient Temperature: 122 deg F (60 deg C).
   b. Humidity: 5% to 90% RH non-condensing rated for indoor locations.

8. Regulatory:
   a. Safety: UL916 listed
b. Environmental protection: Rated for dry location; RoHS compliant
c. Radio Interference: FCC Part 15/ICES-003
d. Shall comply or exceed the following electromagnetic requirements:
   1) EN 61000-4-2
   2) EN 61000-4-4
   3) EN 61000-4-5

2.3 TIME OF DAY SCHEDULING

Increasingly, lighting control systems operate based on an operating state, typically an “expected occupancy” period and “expected vacancy” period. These periods do not necessarily indicate that the spaces are occupied, but rather that we want the lighting control system to behave differently.

In the simplest scenarios, during the “expected occupancy” period we want the lights on; however, to comply with Title 24, we also change the behavior of vacancy sensors. For example, a corridor will dim to 50% during business hours when the space is unoccupied and when occupied, raise to the task-tuned light level. After hours, when buildings are expected to be vacant, that same corridor would again raise to task-tuned level when occupied, but when vacant the lights would turn off completely to comply with Title 24. Similarly, after hours, we can also reduce the occupancy sensor delay-to-off period, or adjust area lighting controls from auto-on 50% to auto-on 20%, or similar.

A. The lighting control system schedules shall be programmable via the Niagara Integrated Automation System.

B. The time-of-day scheduling controls shall be capable of modifying the following lighting control variables as function of the time of day:
   1. On and Off command
   2. Vacancy sensor delay-to-off/dwell setting
   3. Auto-on dimming command
   4. Auto-off dimming command
   5. Manual switch behavior

C. Manual Switch Override: During a period when the time-of-day schedule indicates a space is vacant, any manual adjustment of a wall station or light switch shall temporarily override the local lighting control schedule and the space shall enter “occupied mode”.
   a. An override initiated in this manner shall not exceed 2 hours.

D. Central Interface Override: A qualified operator shall have the option of temporarily overriding the building schedule behavior for the whole building or individual floors. The override duration shall have a user-defined calendar and time-of-day duration.
   1. The override shall require an expiry date and time, after which the building will resume the normal operating schedule. This expiry date and time shall not exceed more than 96 hours after the initial event.
   2. Any central override issued in this manner shall be tracked and trended as a COV variable

E. Flicker Warning: The time-of-day scheduling controls shall be capable of issuing a flicker warning prior to changing to an unoccupied state.
   1. The flicker warning shall be configurable on an individual space-by-space basis.
   2. Each space shall have a unique flicker warning time period programmed via the Niagara Integrated Automation System, varying between 1 and 5 minutes with the capability of disabling the warning outright.
F. A flicker warning shall only occur in spaces without vacancy sensors and only in spaces where the lights are on prior to the change in scheduling status. System shall be capable of including scheduling of exterior luminaires via timeclock, if required.

2.4 OCCUPANCY & VACANCY SENSORS

A. The following parameters shall be centrally controlled via the Niagara Integrated Automation System front end for each sensor:
   1. Occupancy sensor sensitivity
   2. Occupancy sensor delay-to-off/dwell setting
   3. Enable/disable microphonics/ultrasonic

B. Microphonics occupant detection is generally unacceptable. Occupancy detection systems shall be designed to rely on Passive Infrared occupancy detection.

C. Occupancy sensors shall support at least two behaviors when unoccupied:
   1. Associated lighting zones turn off
   2. Associated lighting zones dim to a predefined light output
      a. This defined light output shall be adjustable from the Niagara Integrated Automation System front end.

D. Occupancy sensors shall be capable of being referenced across different lighting buses and control system subnets such that physically adjacent lighting zones may be brought on to an “adjacency” light output setting.

2.5 DAYLIGHTING SENSORS

A. Photosensor shall trigger changes to light levels when ambient (natural) light is available and shall maintain a steady light level when subjected to fluctuating ambient conditions by dimming ballasts and/or drivers.

B. Areas equipped with fixed output ballasts and/or drivers shall energize when natural light falls below foot-candle levels specified.

C. The system shall operate with multiple users in harmony and not react adversely to manual override inputs.

D. The following parameters shall be centrally controlled via the Niagara Integrated Automation System front end for each sensor:
   1. Primary Daylighting illuminance target.
   2. Secondary Daylighting illuminance target.
   3. Secondary Daylighting reading offset (if used).
   4. Daylighting minimum electric light output threshold.

The following options (§1.9, Switch Gang Lighting Controls and §1.10, Luminaire-level Lighting Controls) may be mutually exclusive depending on the specifics associated with the project.

2.6 SWITCH-GANG LIGHTING CONTROLS

A. The lighting system shall use switch-gang based lighting zones, as indicated in the associated electrical drawings.

B. Each switch gang shall share a 0-10V dimming signal to collectively reduce the light output on the switch gang.
C. The system shall have the ability to control (dim/switch) a group of luminaires with loads up to 20A.

D. Task Tuning:
   1. The lighting system shall be capable of setting task-tuning setpoints for each group of luminaires on the same switch gang.
   2. Each switch gang shall have a user programmable:
      a. Maximum dimming setpoint, which will be set in each space based on measured illuminance readings in the space and the design illuminance target.
      b. Minimum dimming setpoint, which should initially match the manufacturer-listed dimming output.

E. Step Dimming & A/B Ballast Switching: System shall have the ability to perform Step Dimming & A/B Ballast Switching.

2.7 LUMINAIRE-LEVEL LIGHTING CONTROLS

A. The lighting system shall use centrally addressable drivers on a per luminaire basis, as indicated in the associated electrical drawings.
   1. Acceptable addressable technologies include nLight Bus native drivers and luminaires or 0-10V drivers and luminaires with a field-installed dry contact control device.

B. The lighting system shall be capable of assigning new or replacement luminaires to a specific space or control group without manually entering a hardware address, MAC address, or serial number.

C. The lighting system shall be capable of assigning individual task-tuning setpoints to each luminaire or groups of luminaires.

D. Re-configurability: The assignment of individual luminaire to zones shall be centrally configurable by control software such that physical rewiring will not be necessary when workspace reconfiguration or re-zoning is performed. Removal of covers, faceplates, ceiling tiles, etc. shall not be required.

2.8 LOAD SHEDDING/DEMAND RESPONSE CONTROLS

A. The system shall support activation of system profiles from Demand Response Automation Servers via the OpenADR 2.0a protocol.

B. The lighting control system shall be capable of shedding lighting load based on an automated signal received from the Niagara Integrated Automation System.

C. Load shedding shall enable the following lighting control strategies:
   1. Lower the dimming command by reducing the maximum allowed dimming signal for individual zones.
   2. Shut-off and/or dim designated decorative lighting loads
   3. Temporarily reduce occupancy delay-to-off/dwell settings
   4. Reduce unoccupied minimum illuminance levels in corridors
      a. These light levels shall not be allowed to go below the fire code minimum egress illuminance levels or Cal-OSHA minimum require illuminance levels.
   5. Lower daylighting minimum electric light output
   6. Enable daylighting dim-to-off strategies

D. Each zone shall be capable of having three load shedding responses, in ascending order of severity.
1. Higher severity tiers shall not permit the shed to drop below the prior tier shed level.

E. Each zone load shed behavior shall be programmed in a manner consistent with the sequence of operations.

F. At minimum, the tier 1 load shedding shall be capable of shedding 15% of total connected lighting load in a manner consistent with the Title 24 requirements.

G. The load shedding event shall persist until the event expires or system operator manually cancels the event.

2.9 EMERGENCY RESPONSE MODE

A. The lighting control system shall respond to a discrete, single-command emergency mode initiated by the Niagara Integrated Automation system. This emergency response mode shall not require multiple connections between the Niagara Integrated Automation system and the lighting control system.

B. When operating in emergency mode, the lighting shall turn on to 100% output.
   1. In this state, the lighting control system shall override all lighting curtailment devices, including but not limited to manual switches, wall stations, occupancy sensors, daylighting controls, task-tuning controls, demand-response controls, and building operating schedules.
   2. When this mode is initiated, the event shall be tracked and trended as a COV variable.

2.10 IRED.LIGHTING CONTROL STRATEGIES

A. Control Software: Control software application is used to start-up, configure and manage the system. Every system parameter in a building (or campus of buildings) is configured for each individual user or space and baseline settings are established for each of the following (depending on the basis of design) system features:
   1. Daylight harvesting
   2. Occupancy control
   3. Smart time scheduling
   4. Task tuning
   5. Personal control
   6. Load shedding

2.11 AUDIO-VISUAL INTERFACE

A. General: Through the interface users can command (e.g. LCD Touch Screen Panel) various lighting scenarios depending on the audio & visual requirements of the room or building.
   1. The audio-visual interface hardware shall be coordinated with the audio-visual hardware vendor.
   2. The lighting control system shall be capable of integrating with the audio visual system via one of the following approaches:
      a. RS232
      b. BACnet IP
      c. Rest API’s
      d. Contact closure inputs
PART 3 - EXECUTION

3.1 EXAMINATION

A. Site Verification:
   1. 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.
   2. Verify that the ratings and configurations of the system components are consistent with indicated requirements.

B. Inspection: Inspect all material included in this contract prior to installation. Manufacturer shall be notified of unacceptable material prior to installation.

3.2 INSTALLATION

A. The Electrical Contractor, as part of the work of this section, shall coordinate, receive, mount, connect, and place into operation all line-voltage and 0-10V dimming equipment. The Electrical Contractor shall furnish all conduit, wire, connectors, hardware, and other incidental items necessary for a properly functioning lighting system, as described herein and shown on the plans (including but not limited to luminaires, drivers, ballasts, relays, and 0-10V dimming materials). The Electrical Contractor shall maintain performance criteria stated by manufacturer without defects, damage, or failure.

B. The System Integrator shall coordinate, receive, mount, connect, and place into operation all low-voltage control system devices. The System Integrator shall furnish all equipment, wire, connectors, hardware, and other incidental items necessary for a properly functioning lighting control system, as described herein and shown on the plans (including but not limited to lighting control sensors, networking hardware, and control software). The System Integrator shall maintain performance criteria stated by manufacturer without defects, damage, or failure.

C. Power: The Electrical 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.

D. Low-voltage, 0-10V dimming wires: The Electrical contractor shall test the continuity of the 0-10V dimming wires running from the lighting control relays to individual drivers prior to turning over the installation to the System Integrator.

E. Related Product Installation: Refer to other sections listed in Related Sections for related products’ installation.

3.3 SENSOR INSTALLATION

A. Proper judgement must be exercised in executing the work to ensure best possible installation in the available space and to overcome local difficulties due to space limitations or interference of structural components.

B. Occupancy and Vacancy Sensors: Sensor detection sensitivity shall be adjusted for good occupant detection, minimal false-occupancy, and minimal false vacancy.
   1. The sensors shall not respond to transient occupancy of spaces outside the area for which they are intended to control. Occupancy sensors shall not be installed with line of sight beyond the room they are intended to control.
   2. The sensor sensitivity shall be adjusted such that an occupant, when standing still in the room, is able to wave their arm at chest level and trigger the sensor.
   3. Sufficient occupancy sensors shall be provided in each room to provide 100% coverage of the room.
4. Under no circumstances shall emergency or egress lighting be controlled by occupancy sensing controls.

5. Sensors shall be ceiling mount.

6. Occupancy sensors shall be installed such that they are more than four feet away from supply air diffusers and other sources of vibration.

7. Occupancy sensors shall be installed such that the oscillation of a ceiling fan does not interfere with the detection of occupants in the space.

8. Position and adjust sensors to minimize nuisance shut-offs. Each cubicle, office or work space shall be covered such that the lights will stay on in an area surrounding the worker even if he/she is the only person in the area.

9. The occupancy sensors connected to the lighting control system shall have a time delay as defined in the sequence of operations, below. Time delays shall be controlled via control software. Any time delays physically set on the device shall be set to the minimum time delay possible.

C. Photocells and Daylight Sensors

1. All daylight control devices shall be field adjusted and maintain horizontal illuminance levels as defined in the sequence of operations, below.

   a. Where no illuminance criteria are provided by the Owner, the Contractor shall adjust the daylighting controls to maintain the horizontal illuminance levels on at the designated workplane height for the dominant task type appropriate for each space per the latest edition of the Illuminating Engineering Society’s Lighting Handbook.

2. Sensors shall be furnished for each room as specified in the reflected ceiling plan.

3. Sensors shall be installed in a manner consistent with the manufacturer’s instructions.

3.4 WIRING INSTALLATION

A. Wiring Method: Comply with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size shall be 3/4 inch.

B. Wiring within Enclosures: Comply with NEC & CEC. Separate power-limited and non power-limited conductors according to conductor manufacturer’s written instructions.

C. Size conductors according to lighting control device manufacturer’s written instructions, unless otherwise indicated.

D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.5 ROUGH-IN

A. Provisions shall be made for a rough-in to be done before the first visit from a building inspector.

   1. The electrical contractor shall run line voltage wires from service panels to various endpoints.

   2. The rough-in work shall be neat and done to specifications, implying no changes will be made.

   3. In the event that the inspector should order modification, the work shall be accessible to make those changes.

B. Include mud rings if necessary.

3.6 SOFTWARE INSTALLATION

A. Please refer Part 4 for detailed requirements around sequence of operations.
B. Graphics shall not be created on the Native Lighting Control System. All Lighting graphics shall be programmed in the Niagara Integrated Automation System

3.7 3.8 COMMISSIONING, TESTING, AND ACCEPTANCE

A. Commissioning, testing, and acceptance requirements are specified in DIV 250000

3.8 FIELD QUALITY CONTROL

A. Manufacturer’s Field Service: System Integration shall engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Perform the following field tests and inspections with the assistance of a factory-authorized service representative:
   1. Operational Test: After installing wall stations and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
   2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Lighting control devices will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.
## PART 4 - SEQUENCE OF OPERATIONS

The following table should be updated by the lighting designer to reflect the specific needs of the occupant group and the design needs.

<table>
<thead>
<tr>
<th>Schedule Number</th>
<th>Zone/Application Description</th>
<th>Dimmability</th>
<th>Occupancy Sensors</th>
<th>Operating Schedule</th>
<th>On/Off Behavior</th>
<th>After-hours Manual Override Behavior</th>
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</thead>
<tbody>
<tr>
<td>CN-1</td>
<td>CLASSROOMS</td>
<td>Yes</td>
<td>Yes</td>
<td>Normal Occupancy</td>
<td>Auto-ON 50% of TTLL</td>
<td>After 20 minutes of vacancy, turn OFF</td>
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<td>CN-1</td>
<td>CONFERENCE ROOMS</td>
<td>Yes</td>
<td>Yes</td>
<td>Normal Occupancy</td>
<td>Auto-ON 50% of TTLL</td>
<td>After 20 minutes of vacancy, turn OFF</td>
</tr>
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<td>CO-2</td>
<td>OFFICE CORRIDORS / VESTIBULES / ELEVATOR LOBBY</td>
<td>Yes</td>
<td>No</td>
<td>Normal Occupancy</td>
<td>Auto-ON 50% of TTLL</td>
<td>After 20 minutes of vacancy, turn OFF</td>
</tr>
<tr>
<td>LB-1</td>
<td>OFFICES, OPEN PLAN</td>
<td>Yes</td>
<td>Yes</td>
<td>Normal Occupancy</td>
<td>Auto-ON 50% of TTLL</td>
<td>After 20 minutes of vacancy, turn OFF</td>
</tr>
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<td>GA-1</td>
<td>LOADING DOCK</td>
<td>Yes</td>
<td>No</td>
<td>Normal Occupancy</td>
<td>Auto-ON 50% of TTLL</td>
<td>After 20 minutes of vacancy, turn OFF</td>
</tr>
<tr>
<td>Schedule Number</td>
<td>Zone/Application Description</td>
<td>Dimmability</td>
<td>NLCs Interface</td>
<td>Switch Type</td>
<td>Manual Switch</td>
<td>Demand Response</td>
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<td>----------------</td>
<td>-------------</td>
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<td>LO-4</td>
<td>LOBBY</td>
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<td>Yes</td>
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<td>OF-1</td>
<td>OFFICES, PRIVATE &amp; SHARED</td>
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<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<td>ST-1</td>
<td>STAIRS</td>
<td>Yes</td>
<td>Yes</td>
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<td>No</td>
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<td>UT-1</td>
<td>UTILITIES/STORAGE</td>
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<td>No</td>
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<td>Schedule Number</td>
<td>Zone/Application Description</td>
<td>Dimmability</td>
<td>Design Made</td>
<td>Daylighting</td>
<td>Operating Schedule</td>
<td>On/Off Behavior</td>
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<tr>
<td>-----------------</td>
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</tr>
<tr>
<td>UT-2</td>
<td>ELECTRICAL / MECHANICAL / TELECOMMUNICATIONS / SMALL UTILITIES</td>
<td>Yes Yes Yes No Yes</td>
<td>Determined by Lighting Designer</td>
<td>Not applicable</td>
<td>Determined by Lighting Designer</td>
<td>Manual On, Manual Off</td>
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<td>UT-3</td>
<td>SHOP, MAIN ELECTRICAL ROOM, MAIN EMERGENCY UTILITY AREAS</td>
<td>Yes Yes Yes No Yes</td>
<td>Determined by Lighting Designer</td>
<td>Not applicable</td>
<td>Determined by Lighting Designer</td>
<td>Manual On, Manual Off</td>
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<td>UT-4</td>
<td>RESTROOMS</td>
<td>Yes Yes No No Yes</td>
<td>Determined by Lighting Designer</td>
<td>Not applicable</td>
<td>Determined by Lighting Designer</td>
<td>Auto ON, Auto OFF</td>
</tr>
</tbody>
</table>

Daylighting Behavior: Daylight Sensor Reading is 200% of TTLL, Allow On 70%

Operating Schedule On/Off Behavior: After 20 minutes of vacancy, turn OFF
The following table describes the notation and terms used in the preceding SOO table.

<table>
<thead>
<tr>
<th>Schedule Number</th>
<th>Short hand reference for where these sequence applies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone/Application Description</td>
<td>General description of where this sequence applies</td>
</tr>
</tbody>
</table>

**Dimmability**

<table>
<thead>
<tr>
<th>Fixtures</th>
<th>Does the lighting in this zone require dimmable drivers capable of receiving a standards-based dimming signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>LCS Interface</td>
<td>Does the lighting in this zone require control components capable of controlling the luminaire light output from the lighting control system network interface</td>
</tr>
<tr>
<td>Local Switch</td>
<td>Does the zone require user-adjustable dimming controls at the local switch in the zone</td>
</tr>
</tbody>
</table>

**Provide Local Manual Switch**

| Does the zone require a local manual (ON/OFF) controls in the zone |

**Demand Response Tier**

| Primarily, will this zone lighting load be shed during a demand response event. If the answer is yes, what is the shed behavior? |

**Lumen Maintenance Strategy**

| The lumen maintenance strategy will use the end-of-life lumen maintenance to establish the initial task tuning setpoint associated with the luminaire. This initial task tuning setpoint will be adjusted to account for furniture and light fixture luminous flux. The task tuning setpoint shall be based on the accumulated run hours as fraction of the expected luminaire life after furniture move-in. For example, if a luminaire has an LM-80/TM-21 rated life of 80,000 hours, the lighting zone will be dimmed to 80% of full power and may be dimmed further. The suggested dimming setpoint associated with the luminaire life shall be the “lumen maintenance light level” (LMLL). If the light levels in the space after this dimming setting are still higher than the design light levels, the lighting zone shall be dimmed until the design light levels are achieved. This final dimming setpoint shall be the "task-tuned light level" (TTLL). Over time, the LMLL shall rise as a fraction of the accumulated run hours of the lighting system and an expected lumen maintenance curve. Minimally, this shall be a linear reset (e.g. at 50% life, the difference between full output and the LMLL shall decrease by 50%), although a piecewise or polynomial reset may be used if it achieves greater efficiency. At the end of life (based on accumulated run hours), the difference between full output and the LMLL shall be 0; however, the TTLL must be maintained. |

**Design Maintained Illuminance (Task Tuned Light Level, TTLL)**

| What is the maintained illuminance level (ftc or lux) and at what workplane height (typically 30” AFF or 0” AFF). This illuminance threshold shall be used for setting daylighting setpoints and task-tuning the light levels in the space. |

**Daylighting Behavior**

| A plain description of how the daylighting system shall respond to measured daylight availability in the space. |

**Sensor Type**

| A discussion of what type of sensor is expected (open loop, closed loop, hybrid, no-preference). The type of sensor selected will ultimately dictate the required programming, start-up, and commissioning procedure. |

**Operating Schedule**

| Specific day-of-week, time-of-day this schedule will be active. |

**On/Off Behavior**

| What device causes the lighting to turn ON in the space. |
| How shall that on-device be configured/specified/programmed to respond when the device is called to turn ON. |
| What device causes the lighting to turn OFF in the space. |
| How shall that on-device be configured/specified/programmed to respond when the device is called to turn OFF. |

**After-hours Manual Override Behavior**

| A discussion of what local devices (if any) will be able to force the zone from one operating schedule to another, outside of direct manipulation of the lighting control system software. The after-hours manual override is intended to shift the zone(s) into a “normal occupancy” mode for no more than 2-hours. This strategy is generally limited areas with fixed time-of-day/day-of-week schedules that dictate behavior, where there may be periodic, non-routine after-hours use of the space. |

**Remarks**

1. WHEN PRESENT, EMERGENCY LIGHTING SHALL BE CONTROLLED VIA A UL 924 DEVICE TO OVERRIDE LIGHTS ON TO FULL BRIGHTNESS IN THE CASE OF AN EMERGENCY.
2. MULTI-ZONE, MULTI-SCENE CONTROLLER SHALL BE USED WHEN SHOWN ON THE DRAWINGS.
3. PHOTOCELL SHALL DIM LIGHTS TO 50% WHEN ENOUGH DAYLIGHTING IS AVAILABLE.
4. OCCUPANCY SENSORS SHALL BE INSTALLED IN THESE AREAS, BUT SHALL NOT BE USED FOR DIRECT CONTROL OF THE LIGHTING SYSTEMS.

END OF SECTION