Proposal Summary

Indoor Lighting Controls

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Measure Description

This measure proposes the following revisions to the mandatory control requirement section in the code (Section 130.1) and the associated acceptance test (NA 7.6 in the Reference Appendices). The proposed changes include both updates in the requirements and code language clean-up. Many of the proposed measures also bring the requirements in Title 24, Part 6 in better alignment with the national standards (ASHRAE 90.1) and other model codes (IECC).

1) **Require nighttime dimming in parking garage daylight adaptation zones.** This measure ensures proper visual adaptation for drivers entering parking garages at night by requiring lighting in the daylight adaptation zones to reduce the light level to that of the general parking zone from sunset to sunrise.
2) **Require partial or full OFF occupant sensing controls in more spaces.** The space types currently being considered include lounges, breakrooms, waiting areas, auditorium areas, hotel function areas, financial transaction areas, lobbies in certain building types, museum exhibition/display areas, and rooms that houses server racks in data centers. Additionally, the requirement would trigger occupied standby controls in spaces where ventilation is allowed to be shut off and temperature set back when no occupant is detected. This would result in energy savings from HVAC systems.
3) **Reduce occupant sensing control time delay to 15 minutes.** This measure would reduce the time delay for occupant sensing controls from the current 20 minutes to 15 minutes.
4) **Clarify the definition and reduce the threshold for requiring multilevel lighting controls.** This code change would improve the definition of multilevel lighting controls to clarify their relationship with continuous dimming and other mandatory control requirements. Additionally, the measure proposes lowering the current 0.5 watts per square foot threshold for requiring multilevel lighting

controls. The tentative new threshold is 0.4 watts per square foot, but the final value will be determined based on a more careful cost-effectiveness analysis.

5) **Require continuous dimming for daylight responsive controls regardless of the lighting code Section 130.1(b) multilevel lighting controls exception.** This proposed measure aims to resolve confusion and additional complexity between two interrelated mandatory control requirements and their exceptions, thereby enhancing code clarity and enforceability. This proposed change would require multilevel lighting controls as long as daylight responsive controls are required in a space.
6) **Require manual overrides of daylight responsive controls to be timed or reset at the next ON cycle.** The proposed measure would require overrides to daylight responsive controls to either have a set time limit or be canceled the next time the lights are turned on again after being turned off by manual switching, time-based controls, or occupant sensing controls.
7) **Make the Alternate Partial Daylight Test the only test method for the Daylight Responsive Control Acceptance Test**. This proposed measure would remove the Partial Daylight Test method and make the Alternate Partial Daylight Test the only test method. This simplify the acceptance test procedure and promote better compliance with the daylight responsive controls requirements.
8) **Improve the lighting controls acceptance test methods for luminaire-level lighting controls (LLLC).** The proposed measure would improve the acceptance test methods by providing instructions for testing LLLCs when they are used as the control solution to meet the mandatory lighting controls requirements. The improved test method would reduce test burden and increase effectiveness for the Acceptance Test Technicians.

Table 1 summarizes the scope of the proposed code change.

Table 1: Scope of Proposed Code Change

An “X” indicates the proposed code change is relevant.

Building Type(s)		single family	**Construction Type(s)**	X	new construction
	X	multifamily		X	additions
	X	nonresidential		X	alterations
Type of Change	X	mandatory	**Updates to Compliance Software**		no updates
		prescriptive		X	update existing feature
		performance		X	add new feature
Third Party Verification		no changes to third party verification			

	X	update existing verification requirements
	X	add new verification requirements

Justification for Proposed Change

Several of the proposed revisions to the mandatory control requirements would bring Title 24 into alignment with ASHRAE 90.1 lighting requirements and increase energy savings. The nighttime adaptation compensation controls for the parking garage daylight adaptation zone are an existing requirement in ASHRAE 90.1, and such controls are considered a best practice to increase safety from an illuminating engineering standpoint. ASHRAE 90.1 also requires more spaces to implement partial or full OFF occupant sensing controls, and some of those spaces are currently either not required to have occupant sensing controls or not included as an area category in Title 24. Reducing the occupant sensing control time delay to 15 minutes is also currently being proposed as part of the 2025 code update cycle for ASHRAE 90.1, which provides a good opportunity for Title 24 to adopt the same requirements.

The 0.5 watts per square foot threshold for requiring multilevel lighting controls has been in place since the pre-LED era and was based on traditional light sources. With LEDs' high efficacy and being continuously dimmable with no or minimal additional cost, it would be prudent to recalibrate and revise the threshold based on current technologies. Furthermore, the code language for multilevel lighting controls has been ambiguous as to whether it pertains to continuous dimming that other controls can utilize or a physical dimmer for manual dimming. Since several other mandatory control sections reference multilevel lighting controls, it is essential to clean up the multilevel lighting controls code language to ensure those references are consistent and coherent. The current exception for multilevel lighting controls also creates a conflict with daylight responsive controls when a space is exempted from multilevel lighting controls but is required to implement daylight responsive controls. Without continuous dimming provided by multilevel lighting controls, daylight responsive controls would not be effective, and the resulting behavior could be perceived negatively by the occupant. The proposal of requiring continuous dimming for daylight responsive controls regardless of the multilevel lighting controls exception aims to address this conflict.

Requiring manual overrides of daylight responsive controls to be timed or reset at the next ON cycle is a code cleanup effort to address ambiguity in the current code language that does not clearly specify whether daylight responsive controls can be

overridden by any user and how and when daylight responsive controls should resume when overridden.

The Alternate Partial Daylight Test was proposed and adopted in the 2022 T24 energy code as an alternative to the original Partial Daylight Test, as creating a proper test condition for performing the original Partial Daylight Test is often difficult. The intent was for the two test methods to coexist for a few code cycles, allowing Acceptance Test Technicians' (ATTs') to make a smooth transition to the Alternate Partial Daylight Test. It is time to formally remove the less effective Partial Daylight Test to improve acceptance test effectiveness and increase the compliance rate.

Current lighting controls acceptance test methods were designed for zone-based controls, where the lights in the entire zone, e.g., a daylit zone, are controlled by a single sensor. When luminaire-level lighting controls (LLLC) are used as the control solution to meet mandatory control requirements, the sampling rules in current test methods create a test burden, as too many controls would need to be tested. Additionally, the current test methods needs to consider the independentedness of each LLLC luminaire in responding to changing daylight conditions and provide specific instructions for correctly and effectively performing the Full Daylight Test.

Data Needs / Information Requests

The Statewide CASE Team is seeking the following information to inform the code change proposal. Data may be provided anonymously. To participate or provide information, please email Yao-Jung Wen at, ywen@energy-solution.com, directly and copy info@title24stakeholders.com.

- Require nighttime dimming in parking garage daylight adaptation zones
    - Data on the areas (square footage) of daylight adaption zones in relation to the overall parking structure area.
    - Information on the number of 24/7 and non-24/7 parking garages in California, and the typical operating hours for non-24/7 parking garages to help inform the energy savings estimate.
    - Cost of additional materials and labor to implement nighttime dimming in the daylight adaptation zones.
    - Examples of existing implementations of parking garage daylight adaptation zone nighttime dimming in California.
    - Determining the additional material required in equipment for nighttime dimming control.
- Require partial or full OFF occupant sensing controls in more spaces

    - Determining the space types that occupancy controls are frequently used (but not currently required by code), and the impact on occupants or call backs.
    - Updated, most recent, material and labor costs of adding occupant sensing controls vs. simple time-switch controls to spaces.
    - Cost of implementing occupied standby controls and cost of integrating lighting and HVAC controls for occupied standby.
    - Information on the practical challenges and issues in programming energy control and management systems (ECMS) for occupied standby.
    - Information on any integration issues between lighting and HVAC controls for implementing occupied standby controls.
    - Information around how occupied standby controls are implemented in practice to meet the current code requirements.
- Reduce occupant sensing control time delay to 15 minutes
    - Cost differential between occupancy sensors or control systems that do not provide a time delay setting for 15 minutes or less and those that do provide time delay settings for 15 minutes or less.
    - Cost of occupant sensing technologies that will not result in increased false offs if the time delay is reduced to 15 minutes.
    - Information on any possible prevalent false-offs in specific applications or space types.
    - Information on the fraction of practitioners' existing projects that already use a 15-minute or less time delay for occupant sensing controls.
- Clarify the definition and reduce the threshold for requiring multilevel lighting controls
    - Data on the fraction of the spaces that are currently exempted from the multilevel lighting controls requirement but will no longer meet the exception after the code change, i.e., spaces where the lighting power density is greater than 0.4 watts per square foot but less than or equal to 0.5 watts per square foot.
    - Cost of implementing multilevel lighting controls for different applications that would be affected, i.e. the cost of implementing multilevel lighting controls in spaces where the lighting power density is greater than 0.4 watts per square foot but less than or equal to 0.5 watts per square foot.
- Require continuous dimming for daylight responsive controls regardless of the lighting code Section 130.1(b) multilevel lighting controls exception

    - Practitioners' (lighting designers, electrical engineers, installers, commissioning agents, and ATTs) estimates, based on their projects, on the fraction of the spaces that meet the multilevel lighting control exception but are not exempted from the daylight responsive lighting controls exception.
    - Cost differential between on/off control and dimming control in daylight responsive control implementations.
    - Information on the fraction of practitioners' projects meeting the multilevel lighting control exceptions but not exempted from daylight responsive controls that already have continuous dimming.
    - Determining the additional material required in the equipment and wiring for continuous dimming
- Require manual overrides of daylight responsive controls to be timed or reset at the next ON cycle
    - Any additional cost to enable manual overrides to daylight responsive controls to be timed or reset at the next ON cycle.
    - Information on any technical or programming complexity of enabling manual overrides to daylight responsive controls to be timed or reset at the next ON cycle.
    - Information on the control companies and control solutions that can provide the required control override programming.
    - Information on the current programming of manual override for daylight responsive controls in practice.
- Make the Alternate Partial Daylight Test the only test method for the Daylight Responsive Control Acceptance Test
    - ATTs' estimate of the difference in time and effort between performing the Alternate Partial Daylight Test and performing the original Partial Daylight Test.
    - Determining the factors that currently prevent ATTs from using the Alternative Partial Daylight Test.
- Improve the lighting controls acceptance test methods for luminaire-level lighting controls (LLLC)
    - Information on ATTs' current practice in applying the sampling rules when conducting occupant sensing and daylight responsive controls acceptance tests on LLLC systems.
    - Information on ATT's current practice in conducting the Full Daylight Test on LLLC systems.

- The differences in time and effort when performing acceptance tests on LLLC systems vs. non-LLLC systems.

Draft Code Language

1.1 Guide to Marked Up Language

The proposed changes to the Standards and Reference Appendices are provided below. Changes to the 2025 documents are marked with blue underlining (new language) and ~~strikethroughs~~ (deletions).

1.2 Title 24, Part 1

There are no proposed changes to Title 24, Part 1.

1.3 Title 24, Part 6

SECTION 130.1 – MANDATORY INDOOR LIGHTING CONTROLS

(b) **Multilevel lighting controls.** The general lighting of any space with a size of 100 square feet or larger and with a connected lighting load greater than ~~0.5~~0.4 watts per square foot shall be provided with multilevel lighting controls. The multilevel lighting controls shall provide and enable continuous dimming from 100 percent to 10 percent or lower of lighting power for other controls, including manual dimmers, shut-off controls, daylight responsive controls, and demand responsive lighting controls.

…

(c) **Shut-OFF Controls.** All installed indoor lighting shall be equipped with controls able to automatically reduce lighting power when the space is typically unoccupied.

1. All installed indoor lighting shall be equipped with controls that meet the following requirements:

   A. Shall be controlled with an occupant sensing control set to no more than a ~~20~~15-minute time delay, automatic time-switch control, or other control capable of automatically shutting OFF all of the lighting when the space is typically unoccupied; and

   …

5. **Occupant sensing controls.** In offices 250 square feet or smaller, multipurpose rooms of less than 1,000 square feet, classrooms of any size, conference rooms, and restrooms, lighting shall be controlled with occupant sensing controls to automatically shut OFF all of the lighting in ~~20~~15 minutes or less after the control zone is unoccupied.

…

6. **Full or partial-OFF occupant sensing controls.** For warehouse aisle ways, warehouse open areas, library book stack aisles, exercise/fitness centers, gymnasium areas, auditorium areas, lounge, breakrooms, waiting areas, hotel function areas, financial transaction areas, computer rooms, main entry lobbies, civic meeting place areas, religious worship areas, museum exhibition/display areas, corridors, stairwells, offices greater than 250 square feet, parking garages, parking areas, loading areas, and unloading areas, the installed lighting shall meet the following requirements:

…

D. In office spaces greater than 250 square feet, general lighting shall be controlled with occupant sensing controls that meet all of the following:

…

ii. In ~~20~~15 minutes or less after the control zone is unoccupied, the occupant sensing controls shall uniformly reduce lighting power in the control zone to no more than 20 percent of full power. Control functions that switch control zone lights completely off when the zone is vacant meet this requirement; and

iii. In ~~20~~15 minutes or less after the entire office space is unoccupied, the occupant sensing controls shall automatically turn off lighting in all control zones in the space; and

…

8. Hotel/motel guest rooms shall be controlled with one of the following controls such that, no longer than ~~20~~15 minutes after the guest room has been vacated, lighting power is switched off:

i. Captive card key controls; or

ii. Occupant sensing controls; or

iii. Other automatic controls.

(d) **Daylight Responsive Controls.**

…

2. All daylight responsive controls shall meet the following requirements:

…

C. The daylight responsive controls shall meet the following:

i. ~~For spaces where the installation of multilevel lighting controls is required under Section 130.1(b), allow the multilevel lighting controls to a~~Adjust the light level with continuous dimming;

…

F. ~~The automatic daylighting control shall permit the multilevel lighting control to adjust the level of lighting.~~In spaces where manual controls are required, the manual controls shall be capable of turning off or decreasing light levels below the light level set by the daylight responsive controls. When manual controls are capable of temporarily increasing electric lighting light levels above the light level set by the daylight responsive controls, the controls shall be configured to reset electric lighting controls back to the Section 130.1(d)2C defaults after electric lighting have been turned off or reduced by a manual control, occupancy sensor or timeclock.

(g) **Parking Garage Daylight Adaptation Zone Lighting Controls.** Parking garage daylight adaptation zone lighting shall be separately controlled to automatically reduce the lighting to no more than the general light level in the parking zone and ramps from sunset to sunrise.

Section 160.5 – MANDATORY LIGHTING REQUIREMENTS FOR INDOOR AND OUTDOOR SPACES

(b) **Common service area lighting.** Lighting systems and equipment in multifamily common services areas shall comply with the applicable provisions of Sections 160.5(b)1 through 160.5(b)4.

4. **Mandatory indoor lighting controls.** Multifamily common use areas shall comply with the applicable requirements of Sections 160.5(b)4A through 160.5(b)4~~F~~G, in addition to the applicable requirements of Section 110.9.

…

B. **Multilevel lighting controls.** The general lighting of any space with a size of 100 square feet or larger and with a connected lighting load greater than ~~0.5~~0.4 watts per square foot shall be provided with multilevel lighting controls. The multilevel lighting controls shall provide and enable continuous dimming

from 100 percent to 10 percent or lower of lighting power for other controls, including manual dimmers, shut-off controls, daylight responsive controls, and demand responsive lighting controls.

…

C. **Shut-OFF controls.** All installed indoor lighting shall be equipped with controls able to automatically reduce lighting power when the space is typically unoccupied.

…

i. All installed indoor lighting shall be equipped with controls that meet the following requirements:

a. Shall be controlled with an occupant sensing control set no more than a ~~20~~15-minute time delay, automatic time-switch control, or other control capable of automatically shutting OFF all of the lighting when the space is typically unoccupied; and

…

v. **Occupant sensing controls.** In offices 250 square feet or smaller, multipurpose rooms of less than 1,000 square feet, classrooms of any size, conference rooms, and restrooms, lighting shall be controlled with occupant sensing controls to automatically shut OFF all of the lighting in ~~20~~15 minutes or less after the control zone is unoccupied.

…

vi. **Full or partial-OFF occupant sensing controls.** For exercise/fitness centers, lounge, breakrooms, waiting areas, corridors, stairwells, and offices greater than 250 square feet, parking garages, parking areas, loading areas, and unloading areas, the installed lighting shall meet the following requirements:

…

b. In office spaces greater than 250 square feet, general lighting shall be controlled with occupancy sensing controls that meet all of the following:

…

II. In ~~20~~15 minutes or less after the control zone is unoccupied, the occupancy sensing controls shall uniformly reduce lighting power in

the control zone to no more than 20 percent of full power. Control functions that switch control zone lights completely off when the zone is vacant meet this requirement; and

III. In ~~20~~15 minutes or less after the entire office space is unoccupied, the occupancy sensing controls shall automatically turn off lighting in all control zones in the space; and

…

D. **Daylight Responsive Controls.**

…

viii. The daylight responsive controls shall meet the following:

a. ~~For spaces where the installation of multilevel lighting controls is required under Section 130.1(b), allow the multilevel lighting controls to a~~Adjust the light level with continuous dimming;

…

xi. Interaction with other lighting controls in space where manual controls are required, the manual controls shall be capable of turning off or decreasing light levels below the light level set by the daylight responsive controls. When manual controls are capable of temporarily increasing electric lighting light levels above the light level set by the daylight responsive controls, the controls shall be configured to reset electric lighting controls back to the Section 160.5(b)4Dviii defaults after electric lighting have been turned off or reduced by a manual control, occupancy sensor or timeclock.

…

G. **Parking garage daylight adaptation zone lighting controls.** Parking garage daylight adaptation zone lighting shall be separately controlled to automatically reduce the lighting to no more than the general light level in the parking zone and ramps from sunset to sunrise.

1.4 Reference Appendices

NA7.6 Indoor Lighting Controls Acceptance Tests

***NA7.6.1* Daylight Responsive Controls Acceptance Tests**

…

NA7.6.1.4 Continuous Dimming Control Systems Functional Testing

Continuous dimming control systems provide more than 10 levels of controlled light output per zone.

…

~~(d) **Partial Daylight Test**. Simulate or provide daylight conditions where illuminance provided only by daylight only at the Reference Location is between 60 and 95 percent of Reference Illuminance measured during the No Daylight Test. Verify and document the following:~~

1. ~~Measure that the combined daylight and controlled electric lighting illuminance at the Reference Location is no less than the reference illuminance measured at this location during the No Daylight Test.~~
2. ~~Verify that the combined daylight and controlled electric lighting illuminance at the Reference Location is no greater than 150 percent of the reference illuminance.~~
3. ~~Light output is stable with no visible flicker. (Note: only luminaires in daylit zones are affected by daylight control)~~

~~(e)~~(d) ~~**Alternate** **Partial Daylight Test**. When outdoor horizontal illuminance is at least 4,000 fc and where illuminance from daylight only at the Reference Location (Partial Daylight Illuminance) is no greater than 80 percent of Reference Illuminance measured at this location during the No Daylight Test. Measure the outdoor horizontal illuminance level and the daylight illuminance level, and do not proceed until the illuminance criteria are met.

Verify and document the following:

1. Measure the Partial Daylight Illuminance at the Reference Location. This can be measured by turning the electric lighting off. (Turn the electric lighting back on before proceeding to next step.)
2. Measure the combined daylight and controlled electric lighting at the Reference Location.
3. This alternate partial daylight test is passed if the measured illuminance value (from Step 2) is no less than the Reference Illuminance measured at this location during the no daylight test and no greater than Partial Daylight Combined Illuminance Maximum (PDCIM).

   In other words, the measured value must be within the following range in order to pass this test.

Reference Illuminance (from the no daylight test) ≤ measured illuminance value (from Step 2) ≤ PDCIM, where PDCIM = Reference Illuminance (from the no daylight test) + 0.40 x Daylight Illuminance (from Step 1)

4. Light output is stable with no visible flicker.
5. Only luminaires in daylit zones are affected by daylight control.