Proposal Summary

CALIFORNIA ENERGY CODES & STANDARDS
A STATEWIDE UTILITY PROGRAM

2022 California Energy Code (Title 24, Part 6)

Nonresidential Grid Integration – Demand Responsive Indoor Lighting

Updated: February 14, 2020

Prepared by: David Jagger, Energy Solutions

Introduction

The document summarizes proposed revisions to the California Energy Code (Title 24, Part 6) that will be discussed during Round 2 of the utility-sponsored stakeholder meetings on March 5, 2020. The Statewide Utility Codes and Standards Enhancement (CASE) Team is seeking input and feedback. Please share comments by email to info@title24stakeholders.com.

Measure Description

The existing demand management control requirements for lighting systems were adopted in the California Energy Code before lighting power density requirements were based on solid state lighting technology. To reflect this shift to solid state lighting, the exemption threshold in the 2019 Title 24, Part 6 Standards of 10,000 square feet is being reevaluated. Additionally, multiple updates are under consideration to simplify and clarify code requirements and acceptance testing. The following submeasures are currently being proposed:

1. Tie the current 0.5 watts per square foot space exemption to the multi-level lighting controls watts per square foot threshold of Section 130.1(b) of the California Energy Code. This link would highlight the demand responsive limiting factor for spaces less than or equal to 0.5 watts per square foot, and the lack of multi-level controls. If the multi-level control threshold is updated in future code revisions, this would automatically update the same exemption for demand responsive lighting.
2. Reevaluate the 2019 Title 24, Part 6 10,000 square foot demand responsive lighting threshold and replace with a current cost-effective total designed wattage equivalent as defined by Table C in the Indoor Lighting Certificate of Compliance NRCC-LTI-E.
3. Clarify the dimming requirements of the acceptance test by removing the current acceptance test requirement that spaces cannot reduce the illuminance of a space from electric and daylighting to less than 50 percent of the designed illuminance. As well as introducing a third verification method that operates at the whole building level for buildings that have their circuits disaggregated by end-use.

Draft Code Language

The proposed changes to the Standards and Reference Appendices are provided below. Changes to the 2019 documents are marked with red underlining (new language) and ~~strikethroughs~~ (deletions).

Standards

SECTION 110.12 – MANDATORY REQUIREMENTS FOR DEMAND MANAGEMENT

Buildings, other than healthcare facilities, shall comply with the applicable demand responsive control requirements of Sections 110.12(a) through 110.12(d)

(c) Demand Responsive Lighting Controls. Lighting controls in nonresidential buildings with total designed wattage greater than or equal to 4,000 watts, as defined by Table C of the Indoor Lighting Certificate of Compliance NRCC-LTI-E, ~~larger than 10,000 square feet~~ shall be capable of automatically reducing lighting power in response to a Demand Response Signal. General lighting shall be reduced in a manner consistent with the uniform level of illumination requirements in TABLE 130.1-A.

1. For compliance testing, the lighting controls shall demonstrate a lighting power reduction in controlled spaces of a minimum of 15 percent below the total installed lighting power. The controls may provide additional demand responsive functions or abilities.

EXCEPTION 1 to 110.12(c): Spaces with a lighting power density less than or equal to that specified for exemption for multi-level lighting controls in Section 130.1(b) ~~of 0.5 watts per square foot or less~~ are not required to install demand responsive controls and do not count toward the ~~10,000 square foot~~ 4,000-watt threshold.

EXCEPTION 2 to 110.12(c): Spaces where a health or life safety statute, ordinance, or regulation does not permit the lighting to be reduced are not required to install demand responsive controls and do not count toward the ~~10,000 square foot~~ 4,000-watt threshold.

SECTION 140.6 – PRESCRIPTIVE REQUIREMENTS FOR INDOOR LIGHTING

(a)2.K. To qualify for the PAF for a Demand Responsive Control in TABLE 140.6-A, a Demand Responsive Control shall meet all the following requirements:

i. The building shall have less than 4,000 watts of total designed wattage as defined by Section 110.12(c) ~~be 10,000 square feet or smaller~~; and

ii. The controlled lighting shall be capable of being automatically reduced in response to a demand response signal; and

iii. Lighting shall be reduced in a manner consistent with uniform level of illumination requirements in TABLE 130.1-A; and

iv. Spaces that are non-habitable shall not be used to comply with this requirement, and spaces with a lighting power density of less than or equal to that specified for exemption for multi-level lighting controls in Section 130.1(b) ~~0.5 watts per square foot~~ shall not be counted toward the building's total designed wattage~~lighting power~~.

TABLE 140.6-A LIGHTING POWER ADJUSTMENT FACTORS (PAF)

TYPE OF CONTROL	TYPE OF AREA		FACTOR
a. To qualify for any of the Power Adjustment Factors in this table, the installation shall comply with the applicable requirements in Section 140.6(a)2 b. Only one PAF may be used for each qualifying luminaire unless combined below. c. Lighting controls that are required for compliance with Part 6 shall not be eligible for a PAF			
1. Daylight Dimming plus OFF Control	Luminaires in skylit daylit zone or primary sidelit daylit zone		0.10
2. Occupant Sensing Controls in Large Open Plan Offices	In open plan offices > 250 square feet: One sensor controlling an area that is:	No larger than 125 square feet	0.40
		From 126 to 250 square feet	0.30
		From 251 to 500 square feet	0.20
3.Institutional Tuning	Luminaires in non-daylit areas. Luminaires that qualify for other PAFs in this table may also qualify for this tuning PAF.		0.10
	Luminaires in daylit areas. Luminaires that qualify for other PAFs in this table may also qualify for this tuning PAF.		0.05
4. Demand Responsive Control	All building types of 4,000 total designed wattage of lighting as defined by Section 110.12(c)~~10,000 square feet~~ or smaller. Luminaires that qualify for other PAFs in this table may also qualify for this demand responsive control PAF		0.05
5. Clerestory Fenestration	Luminaires in daylit areas adjacent to the clerestory. Luminaires that qualify for daylight dimming plus OFF control may also qualify for this PAF.		0.05
6. Horizontal Slats	Luminaires in daylit areas adjacent to vertical fenestration with interior or exterior horizontal slats. Luminaires that qualify for daylight dimming plus OFF control may also qualify for this PAF.		0.05
7.Light Shelves	Luminaires in daylit areas adjacent to clerestory fenestration with interior or exterior light shelves. This PAF may be combined with the PAF for clerestory fenestration. Luminaires that qualify for daylight dimming plus OFF control may also qualify for this PAF		0.10

5.4.5 Demand Responsive Lighting Controls

§130.1(e); §110.12 (new for 2019)

Nonresidential buildings with a total designed wattage greater than or equal to 4,000 watts as defined in Section 110.12(c) ~~larger than 10,000 sq. ft.~~ must have lighting systems with demand responsive lighting controls.

Spaces with a lighting power density of 0.5 W/ft^2 or less do not count towards the 4,000-watt ~~10,000 sq ft.~~ threshold for triggering demand responsive lighting control requirements. Also, spaces not permitted by a health or life safety statute, ordinance, or regulation to be reduced, are exempted from the requirement.

See Appendix D of this compliance manual for guidance on compliance with the demand responsive control requirements.

5.6.2 Demand Responsive Lighting Controls

The adjusted indoor lighting power of all building areas is the total watts of all planned permanent and portable lighting systems in all areas of the proposed building.

Some adjustments are available to reduce the indoor lighting power that must be reported. These adjustments are discussed below.

A. Power Adjustment Factors (PAFs) or Reduction of Wattage Through Controls

The Energy Standards provide an option for a lighting power reduction credit when specific lighting controls are installed, provided those lighting controls are not required.

A power adjustment factor (PAF) is an adjustment to the installed lighting power in an area so that some of the installed lighting power is not counted toward the building's total installed lighting load.

In calculating adjusted indoor lighting power, the installed watts of a luminaire providing general lighting in a functional area listed in Table 140.6-C may be reduced by multiplying the watts controlled by the applicable power adjustment factor (PAF), per Table 140.6-A.

To qualify for a PAF, the following conditions are required to be met:

11. To qualify for the PAF for a demand responsive control in Table 140.6-A, a demand responsive control shall meet all of the following requirements:
    a. Because buildings with total designed wattage greater than or equal to 4,000 watts of lighting (as defined in Section 110.12(c) of the California Energy Code) ~~larger than 10,000 sq. ft.~~ are required to have demand responsive controls, to qualify for the PAF, the building shall have total designed watts less than 4,000 watts. ~~be 10,000 sq ft or smaller.~~
    b. The controlled lighting shall be capable of being automatically reduced in response to a demand response signal.
    c. Lighting shall be reduced in a manner consistent with the uniform level of illumination requirements in Table 130.1-A.
    d. Spaces that are non-habitable shall not be used to comply with this requirement, and spaces with a lighting power of less than 0.5 watts per square foot shall not be counted toward the building's total lighting power.

Appendix D - Demand Responsive Controls

Table D-1: Summary of DR Control Requirements for Newly Constructed Nonresidential Buildings

Application		Required DR Controls	Response Tested for Title 24 Compliance	Acceptance Test
HVAC	Direct Digital Control (DDC) to the Zone level[1]	Must have DR Controls that are compliant with Sections 110.12(a) and (b)	• During DR Period, in non-critical zones: ○ In cooling mode, increase the operating cooling temperature 4°F or more ○ In heating mode, decrease the operating heating temperature 4°F or more • Upon conclusion of the DR Period, reset the temperature set points to their original settings. • Provide an adjustable rate of change for the temperature.	NA7.5.10: Automatic Demand Shed Control Acceptance
	Single-zone air conditioner and heat pump system (without DDC to the Zone Level)[1,2]	Must have thermostatic controls that are compliant with Joint Appendix 5.	Defined in Joint Appendix 5.	Not applicable
Lighting	Lighting in buildings with installed general lighting greater than 4,000 watts ~~larger than 10,000 square feet~~[3]	Must have DR controls that are compliant with Sections 110.12(a) and (c)	Reduce lighting power by a minimum of 15 percent below the design full output level for the duration of the Demand Response Period. [3,4]	NA7.6.3 Demand Responsive Controls Acceptance
Sign Lighting	Electronic Message Centers (EMCs) having a new connected lighting power load greater than 15 kW[4]	Must have DR controls that are compliant with Sections 110.12(a) and (d)	Reduce lighting power by a minimum of 30 percent for the duration of the Demand Response Period.	Not applicable
Electrical Power System	Circuit-level controls installed as part of the electrical power distribution system[5]	Must have DR controls that are compliant with Sections 110.12(a)	Not applicable	Not applicable

1. Systems serving exempt process loads that must have constant temperatures to prevent degradation of materials, a process, plants, or animals are exempt.
2. Package terminal air conditioners, package terminal heat pumps, room air conditioners, and room air-conditioner heat pumps are exempt.
3. Spaces with a lighting power density of 0.5 watts per square foot or less and spaces in which lighting power or illuminance is not permitted to be reduced in accordance with health or life safety statues, ordinances, or regulations: 1) are not required to be capable of automatically reducing lighting power when a DR Signal is received; and 2) shall not be included in calculations of the design full output level or the reduced lighting power level.
4. Lighting for EMCs where lighting power or illuminance is not permitted to be reduced by 30 percent in accordance with a health or life safety statute, ordinance, or regulation is exempt.
5. Circuit-level controls installed to control HVAC, lighting, or sign lighting equipment must comply with the requirements for that application.

4. DR Controls for Lighting Systems

§110.12(c)

Buildings with a total designed wattage greater than or equal to 4,000 watts of lighting ~~larger than 10,000 square feet (ft^2)~~ must be equipped with DR controls for indoor lighting systems that comply with §110.12(a) and (c). There are two exceptions that impact the calculation of the total designed wattage ~~10,000 ft^2~~ threshold and impact where DR controls can must be installed. Specifically, spaces that fall into these two categories do not need to have DR lighting controls and do not need to be included in the calculation of the 4,000 total designed wattage ~~10,000 ft^2~~ threshold:

1. Spaces with a lighting power density of 0.5 W/ ft^2 or less; and
2. Spaces where health or life safety statute, ordinance, or regulation does not permit lighting to be reduced.

2019 Reference Appendices

7.6.3 Demand Responsive Controls Acceptance Tests

7.6.3.1 Construction Inspection

Prior to Functional testing, verify and document the following:

(a) That the demand responsive control is capable of receiving a demand response signal directly or indirectly through another device and that it complies with the requirements in Section 130.1(e).

(b) If the demand response signal is received from another device (such as an EMCS), that system must itself be capable of receiving a demand response signal from a utility meter or other external source.

7.6.3.2 Functional testing

There are three methods to verify the reduction in lighting power due to the demand responsive lighting controls. For methods 1 and 2, buildings with up to seven (7) enclosed spaces requiring demand responsive lighting controls, all spaces shall be tested. For buildings with more than seven (7) enclosed spaces requiring demand responsive lighting controls, sampling may be done on additional spaces with similar lighting systems; sampling shall include a minimum of 1 enclosed space for each group of up to 7 additional enclosed spaces. If the first enclosed space with a demand responsive lighting control in the sample group passes the acceptance test, the remaining building spaces in the sample group also pass. If the first enclosed space with a demand responsive lighting control in the sample group fails the acceptance test the rest of the enclosed spaces in that group must be tested. If any tested demand responsive lighting control system fails it shall be repaired, replaced or adjusted until it passes the test. Method 3 tests the entire facility at once, does not require sampling, but requires the facility lighting to be disaggregated from other end-use loads.

Test the reduction in lighting power due to the demand responsive lighting control using one of the following two methods.

Method 1: Illuminance Measurement. Measure the reduction in illuminance in enclosed spaces required to meet Section ~~130.1(b)~~ 130.1(e), as follows:

(a) In each space, select one location for illuminance measurement. The chosen location must not be in a skylit or primary sidelit area. When placed at the location, the illuminance meter must not have a direct view of a window or skylight. If this is not possible, perform the test at a time and location at which daylight illuminance provides less than half of the design illuminance. Mark each location to ensure that the illuminance meter can be accurately located.

(b) Full output test

1. Using the manual switches/dimmers in each space, set the lighting system to full output. Note that the lighting in areas with photocontrols or occupancy/vacancy sensors may be at less than full output, or may be off.
2. Take one illuminance measurement at each location, using an illuminance meter.
3. Simulate a demand response condition using the demand responsive control.
4. Take one illuminance measurement at each location with the electric lighting system in the demand response condition.
5. Calculate the area-weighted average reduction in illuminance in the demand response condition, compared with the full output condition. The area-weighted reduction must be at least 15% ~~but must not reduce the combined illuminance from electric light and daylight to less than 50% of the design illuminance in any individual space~~.

(c) Minimum output test

1. Using the manual switches/dimmers in each space, set the lighting system to minimum output (but not off). Note that the lighting in areas with photocontrols or occupancy/vacancy sensors may be at more than minimum output, or may be off.
2. Take one illuminance measurement at each location, using an illuminance meter.
3. Simulate a demand response condition using the demand responsive control.
4. Take one illuminance measurement at each location with the electric lighting system in the demand response condition.
5. In each space, the illuminance in the demand response condition must not be less than the illuminance in the minimum output ~~condition or 50% of the design illuminance, whichever is less~~.

   EXCEPTION: In daylit spaces, the illuminance in the demand response condition may reduce below the minimum output condition~~, but in the demand response condition the combined illuminance from daylight and electric light must be at least 50% of the design illuminance~~.

Method 2: Current measurement. Measure the reduction in electrical current in spaces required to meet Section ~~130.1(b)~~ 130.1(e), as follows:

(a) At the lighting circuit panel, select at least one lighting circuit that serves spaces required to meet Section 130.1(e).

(b) Full output test

1. Using the manual switches/dimmers in each space, set the lighting system to full output. Note that the lighting in areas with photocontrols or occupancy/vacancy sensors may be at less than full output, or may be off.

2. Take one electric current measurement for each selected circuit.
3. Simulate a demand response condition using the demand responsive control.
4. Take one illuminance measurement at each location with the electric lighting system in the demand response condition.
5. Add together all the circuit currents, and calculate the reduction in current in the demand response condition, compared with the full output condition. The combined reduction must be at least 15% ~~but must not reduce the output of any individual circuit by more than 50%~~.

(c) Minimum output test

1. Using the manual switches/dimmers in each space, set the lighting system to minimum output (but not off). Note that the lighting in areas with photocontrols or occupancy/vacancy sensors may be at more than minimum output, or may be off.
2. Take one electric current measurement for each selected circuit.
3. Simulate a demand response condition using the demand responsive control.
4. Take one electric current measurement for each selected circuit with the electric lighting system in the demand response condition.
5. In each space, the electric current in the demand response condition must not be less than ~~50% or~~ the electric current in the minimum output condition~~, whichever is less~~.

   EXCEPTION: Circuits that supply power to the daylit portion of enclosed spaces as long as lighting in non-daylit portions of the enclosed space.

Method 3: Full facility current measurement. Measure the reduction in electrical current of the full facility on the lighting end-use disaggregated circuit for spaces that are required to meet Section 130.1(e), as follows:

(a) At the circuit panel, select the circuit that serves the lighting load of the entire facility.

(b) Full output test

1. Using the facility lighting controls, set the lighting system to full output. Note that the lighting in areas with photocontrols or occupancy/vacancy sensors may be at less than full output, or may be off.
2. Take one electric current measurement on the circuit. This is your pre-event current.
3. Simulate a demand response condition using the demand responsive control.
4. Take one electric current measurement on the circuit. This is your post-event current.
5. Calculate the difference between the pre-event current and the post-event current to determine your wattage reduction.
6. Divide the wattage reduction by the total design wattage for the lighting required to meet Section 130.1(e). The percent reduction in wattage must be at least 15%.

(c) Minimum output test

1. Using the facility controls, set the lighting system to minimum output (but not off). Note that the lighting in areas with photocontrols or occupancy/vacancy sensors may be at more than minimum output, or may be off.
2. Take one electric current measurement on the circuit. This is your pre-event current.

3. Simulate a demand response condition using the demand responsive control.
4. Take one electric current measurement on the circuit. This is your post-event current.
5. The post-event current must not be less than the pre-event current in the minimum output condition.