LUTRON ELECTRONICS CO., INC.

DR. S. PEKKA HAKKARAINEN, MA, PhD
Vice President

California Energy Commission
DOCKETED
15-BSTD-01
TN # 75424
MAR 17 2015

March 17, 2015

Submitted via email: docket@energy.ca.gov

Mr. Andrew McAllister
Commissioner
California Energy Commission
1516 Ninth Street
Sacramento, California 95814

Re: Docket No. 15-BSTD-01

Lutron Electronics Co., Inc. comments on the 2016 Title 24 Part 6 45-Day Language for the residential and nonresidential building energy efficiency standards and associated documents

Dear Commissioner McAllister,

Thank you for the opportunity to review and provide comments on the 2016 Title 24 Part 6 45-Day Language. These comments are submitted on behalf of Lutron Electronics Co., Inc.

As you may know, Lutron was founded in 1961 and is headquartered in Coopersburg, Pennsylvania. From dimmers for the home, to lighting management systems for entire buildings, the company offers more than 17,000 energy-saving products, sold in more than 100 countries around the world. In the U.S. alone, Lutron products save an estimated 10 billion kWh of electricity, or approximately $1 billion in utility costs per year. The company's early inventions— including the first solid-state dimmer invented by Lutron's founder, Joel Spira—are now at the Smithsonian's National Museum of American History in Washington, DC.

Please find our detailed comments below. We look forward to working with you further on this important project. Please contact Michael Jouaneh at 610-282-5350 or mjouaneh@lutron.com if you have questions or would like more information on these comments. Thanks again for your consideration.

Respectfully submitted,

Pekka Hakkarainen, PhD
Vice President
Lutron Electronics Co., Inc.

7200 SUTER ROAD
COOPERSBURG, PA 18036-1299
USA

TELEPHONE 610 282-6766
FAX 610 282-7477

The comments and suggested edits to the proposal are shown below as deleted text in ~~strikeout~~, and suggested new text in <u>underline</u>. The edits are shown in order of importance:

1. **141.0(b)2 Additions and Alterations.** We are concerned with the current proposed language on lighting alterations which takes the Standard back to pre-2005 levels. In 2005, all lighting alternations of 50% or more of luminaires had to comply with the control requirements (area control, daylight control, shutoff control, and multi-level lighting). These requirements have persisted through the 2013 Standard. Now the proposed <u>modified 45-Day language</u> eliminates control requirements from most lighting alternations. This is not only backsliding from the 2013 Standard, it also puts Title 24 well behind ASHRAE 90.1 and IECC.

   Lighting controls and dimming ballasts/drivers save energy cost effectively. Even more so now than they did before as prices have come down significantly over the years. Plus the growth of wireless lighting controls from several manufactures has decreased the installation costs considerably. See the Table 1 below. It shows that the new LPD of fixture-only retrofits have to be 60% lower for occupancy sensing not to be cost effective and 25% lower for dimming not to be cost effective.

Table 1: LPD Reduction for Fixture-only Retrofits to Save the Same Energy as the Controls would have Saved

Office Building			
Allowable LPD of 0.8 for office buildings per T24 2013 and 2016			
	Occ sensor only	**Full dimming**	
Annual lighting hours of use	5000	5000	Hrs
LPD at which ltg ctrls have a 7 year payback or better	0.32	0.6	W/sq.ft
% savings from lighting controls	35%	55%	See references below
Energy savings	0.56	1.65	kWh/sq.ft/yr
Electricity cost	0.13	0.13	$/kWh
Annual $ savings	0.07	0.21	$/sq.ft/yr
Installed cost	0.5	1.5	$/sq.ft
Simple payback	6.9	7.0	Years
% reduction from LPD requirements in T24 2013/2016 to achieve a 7 year payback or better	60%	25%	

Notes:

1. For a lighting fixture-only retrofit (without using controls) to have the same energy savings as one that uses occupancy sensing system with a 7 year payback or better, the new LPD of the fixture-only retrofit must be 60% lower than the allowed LPD in Title 24 2013 2016.

2. For a non-dim lighting fixture-only retrofit to have the same energy savings as one utilizing a dimming system with a 7 year payback, the new LPD the fixture-nly retrofit needs to be 25% lower than the allowed LPD in Title 24 2013 and 2016.

3. The 7 year payback is achieved without the help of rebates. Rebates such as from the city of LA ($0.1/kWh saved) or from SoCal Edison ($50/occupancy sensor) reduce installed cost significantly

4. Even conservative calculations place the cost of fixture only retrofits at a 5 year payback even with a 50% wattage reduction

References:

1. VonNieda B, Maniccia D, & Tweed A. 2000. An analysis of the energy and cost savings potential of occupancy sensors for commercial lighting systems. Proceedings of the Illuminating Engineering Society. Paper #43.
*Source 1 numbers based on 15 minute timeouts. Higher savings is possible with lower time out periods

2. Galasiu AD, et al. 2007. Energy saving lighting control systems for open-plan offices: A field study. Leukos. 4(1) pg 7-29

3. Williams A, et al. 2012. Lighting Controls in Commercial Buildings. Leukos. 8(3) pg 161-180.

4. Reinhart CF. 2002. Effects of interior design on the daylight availability in open plan offices. Study of the American Commission for an Energy Efficient Environment (ACE) Conference Proceedings. To achieve maximum lighting savings, automated shades are utilized.

The current exception for one-for-one replacements to be 20% lower than existing lighting power is headed in the right direction but it's not enforceable. Once the old fixtures are removed an inspector can't verify the previous lighting load. They can, however, verify the new lighting load and they know what the LPD allowances are per the Standard. Thus, we strongly suggest the following changes:

EXCEPTION 2 to Section 141.0(b)2I. One for one replacement of luminaires where the new lighting power density is ~~luminaires have~~ at least 25~~0~~ percent lower ~~power~~ than allowed per Section 140.6. ~~consumption compared to the original luminaires.~~

J. Luminaire Component Alterations. Where 40 or more existing luminaires are modified as specified in i through iii-below on any single floor of a building, the modifications shall not cause the lighting power allowance in Section 140.6 to be exceeded, shall comply with Table 141.0-E~~Subsections 130.1(a)1, 2, and 3~~, and shall not prevent or disable the operation of any multi-level, shut-off, or daylighting controls installed to control the luminaires:

i. Replacing the ballasts or drivers and the associated lamps in the luminaire; or

ii. Permanently changing the light source of the luminaire; or

iii. Changing the optical system of the luminaire.

Lamp replacements alone and ballast replacements alone shall not be considered a modification of the luminaire provided that the replacement lamps or ballasts can be installed and powered without modifying the luminaire.

EXCEPTION 1 to Section 141.0(b)2J. Modification of portable luminaires, luminaires affixed to moveable partitions, or lighting excluded in accordance to Section 140.6(a)3.

~~**EXCEPTION 2 to Section 141.0(b)2J.** Replacement of luminaire components where the modified luminaires have at least 20 percent lower power compared to the original luminaires.~~

K. **Lighting Wiring Alterations.** For each enclosed space, the following wiring alterations serving permanently installed lighting shall not cause the lighting power allowance in Section 140.6 to be exceeded and the altered circuits and luminaires served by them shall meet the applicable requirements in Table 141.0-E ~~Sections 130.1(a), (b), (c), and (d)~~:

TABLE 141.0-E Control Requirements for Lighting System Alterations

Control requirements that shall be met when 20% or more of existing luminaires are altered	Resulting lighting power, compared to the lighting power allowance specified in Section 140.6(c)2	
	Lighting power is ≤ ~~8~~75% of allowance	Lighting power is > ~~8~~75% to 100% of allowance

Section 130.1(a)1, 2, and 3 Area Controls	Yes	Yes
Section 130.1(b) Multi-Level Lighting Controls – only for alterations to general lighting of enclosed spaces 100 square feet or larger with a connected lighting load that exceeds 0.5 watts per square foot	~~For each luminaireenclosed space, minimum one step between 30-70 percent regardless of luminaire type, or meet Section 130.1(b)~~ Not Required	Yes
Section 130.1(c) Shut-Off Controls	Yes	Yes
Section 130.1(d) Automatic Daylight Controls	Not Required	Yes
Section 130.1(e) Demand Responsive Controls – only for alterations > 10,000 ft^2 in a single building, and where the alteration changes the area of the space, or occupancy type of the space, or increases the lighting power	Not Required	Yes

2. **Appendix JA10 – Test Method for Measuring Flicker of Lighting Systems and Reporting.**
We would like the language to be clear on who is responsible for the testing. And make it clear in section 10.2 on equipment combinations that only one dimmer from any dimmer manufacturer must be tested for each "dimmer type" (reverse phase-cut controls, 0-10 VDC controls, digital controls, powerline carrier controls, and wireless controls...) compatibility is claimed. This needs to be clarified so that unnecessary combinations of dimmer/lamp/driver testing and reporting are not onerous and endless. Lastly, JA10 makes section 1605.3(I)(2)(F)2 of the 2012 Title 20 Appliance Efficiency Regulations obsolete so 1605.3(I)(2)(F)2 should be stricken from next version of Title 20.

3. **130.1(c)5 Areas where Occupant Sensing Controls are required to shut OFF All Lighting.** The requirements have changed to allow either partial-ON sensors or vacancy sensors. We support these changes but want to ensure that occupancy sensors that are programmed to operate as partial-on or vacancy sensors can comply. Occupant sensing devices under Title 20 Appliance Efficiency Regulations does not allow for a vacancy sensor to be converted to automatic functionality. This makes sense for the Title 24 Part 6 residential control requirements since only vacancy sensors are allowed to comply. But on the commercial side since a space can use either vacancy sensors or partial-on occupancy sensors, occupancy sensors that are set to operate as vacancy sensors or partial-on sensor should comply. Thus, we suggest the following change:

> In offices 250 square feet or smaller, multipurpose rooms of less than 1,000 square feet, classrooms of any size, and conference rooms of any size, lighting shall be controlled with occupant sensing controls to automatically shut OFF all of the lighting when the room is unoccupied. The occupant sensing controls shall function either as a:

A. Partial-ON Occupant Sensor capable of automatically activating between 50-70 percent of controlled lighting power, or

B. Vacancy Sensor, where all lighting responds to a manual ON input only.

In addition, controls shall be provided that allow the lights to be manually shut-OFF in accordance with Section 130.1(a) regardless of the sensor status. Occupancy sensors that are set to operate as vacancy sensors or partial-on occupant sensors shall be permitted to comply.

4. **150.0(k)2J.** The next standard should require all luminaires in these non-living spaces to be on an energy-saving control, not just one luminaire in those spaces, especially if by 2020 new residential spaces are supposed to be Net Zero Energy. If anything, it should be written the other way around so that only one luminaire, in a room with multiple luminaires, can be uncontrolled. Additionally, the standard should allow a dimmer to be one of the complaint controls in a bathroom especially since JA-8 complaint light sources will be dimmable dimmers. Different light levels are needed (e.g. low level at night, higher level for grooming, etc.). Table 9 in the January 2014 CEE Residential Lighting Controls Market Characterization (http://library.cee1.org/content/cee-residential-lighting-controls-market-characterization) shows a 51% to 82% (depending on light source) reduction in wattage in bathrooms from using dimmers. Also, a partial-ON occupant sensor should be allowed as they have been proven to save even more energy than vacancy sensors because occupants are usually satisfied with 50% of the lighting ON (see http://lightingcontrolsassociation.org/cltc-study-demonstrates-major-energy-savings-for-bilevel-occupancy-sensors/). We suggest the following changes:

   J. In Bathrooms, Garages, Laundry Rooms, and Utility Rooms, ~~at least one~~ all luminaires in each of these spaces shall be controlled by a dimmer, vacancy sensor, or partial-on occupant sensor.

5. **150.0(k)2K.** Hallways are a key space where lighting should be controlled beyond a standard switch. Many people use dimmers in hallways especially during the nighttime where folks prefer a very low light level to not disturb other occupants that may be sleeping in the adjunct bedrooms. What's more is that there is significant energy savings for using dimmers or vacancy sensors in hallways as evidenced in the January 2014 CEE Residential Lighting Controls Market Characterization (http://library.cee1.org/content/cee-residential-lighting-controls-market-characterization). Table 7 in the CEE study shows a 53% reduction in ON hours in the hallway with vacancy sensors. And Table 9 shows a 51% to 82% (depending on light source) reduction in wattage in hallways. We suggest the following changes:

   K. Dimmers, partial-on occupancy sensor, or vacancy sensors shall control all luminaires required to have light sources compliant with Reference Joint Appendix JA8.

   EXCEPTION 1 to Section 150.0(k)2K: Luminaires in closets less than 70 square feet.
   ~~EXCEPTION 2 to Section 150.0(k)2K: Luminaires in hallways.~~

6. **130.1(d) Automatic Daylighting Controls and 140.6(d) Automatic Daylight Controls in Secondary Daylight Zones.** We would like add some clarification language to the Standard so that electrical contractors know that one daylight sensor can be used to control lighting separately in skylit daylit zone, primary sidelit daylight zone, and secondary daylit zone. We have had several think that the language in the Standard

specifies a different daylight sensor for each daylight zone. While we have gotten emails from the CEC which stated that one sensor is acceptable, this issue keeps coming up. Thus, we suggest the following changes:

> **130.1(d)2 B.** Luminaires in the Skylit Daylit Zone shall be controlled separately from those in the Primary Sidelit Daylit Zones. <u>One daylight sensor shall be permitted to control the luminaires in the Skylit Daylit Zone and Primary Sidelit Daylit Zone provided that the luminaires in the zones can adjust lighting levels differently based on daylight conditions.</u>
>
> **140.6(d) Automatic Daylighting Controls in Secondary Daylit Zones.** All luminaires providing general lighting that is in, or partially in a Secondary Sidelit Daylit Zone as defined in Section 130.1(d)1C, and that is not in a Primary Sidelit Daylit Zone shall:
>
> 1. Be controlled independently from all other luminaires by automatic daylighting controls that meet the applicable requirements of Section 110.9. <u>One daylight sensor shall be permitted to control the luminaires in the Primary Sidelit Daylit Zone and Secondary Daylight Zone provided that the luminaires in the zones can adjust lighting levels differently based on daylight conditions</u>; and

7. **130.1(a) Area Controls**. Manual controls shouldn't be required in stairwells, corridors, and restrooms. It is a safety issue. And in the case of stairwells in multi-story buildings, where is the manual control supposed to be installed? On the first floor? If someone is on the 50th floor and the lights are manually turned off that is a safety issue. ASHRAE 90.1-2016 is addressing this by not requiring local control in these spaces and Title 24 Part 6 should do the same. Thus, we suggestion the following change:

   > **<u>EXCEPTION 2 to Section 130.1(a)1:</u>** <u>Lighting in stairwells, corridors, and restrooms.</u>

8. **130.1(c) Shut-OFF Controls.** Lighting in stairwells that is controlled with automatic partial-off occupant sensing controls per section 130.1(c)6 or 130.1(c)7 should not have to also be controlled with automatic full-off control because of safety issues. Thus, we suggest the following change:

   > **<u>EXCEPTION 6 130.1(c)1</u>**: <u>Lighting in stairwells that complies with Section 130.1(c)6 or 130.1(c)7</u>.

9. **130.1(c)8 Hotel guest room control.** The automatic shut-off timeout should match section 110.9(b)4F of 20 minutes. Also, captive card key controls are too easily defeated and they are not automatic. Most of the time hotel guests get more than one key, so one key is always in the captive key card slot all the time even when guest is not in the room. ASHRAE 189.1-2014 has recognized this fact and has language that prevents captive key card solutions from complying. Current hotel guestroom technologies are better at guest presence detection than captive key card controls. Additionally, use of occupancy sensors alone is not reliable especially when guests are sleeping they are not detected by the sensors. This requirement should be written in a way that is more technology-neutral to allow for better solutions while eliminating the poor ones. Thus, we suggest the following changes:

   > 8. Hotel motel guest rooms shall have ~~captive card key controls, occupancy sensing controls, or~~ automatic controls such that, no longer than ~~3~~<u>2</u>0 minutes after the guest room has been vacated, lighting power is switched off. <u>Captive key card controls shall not be used to comply.</u>

10. **130.5 Electrical Power Distribution Systems.** The 2016 Standard should focus more on energy monitoring over disaggregation of circuits. Disaggregation of circuits doesn't save energy or add value to the owner unless monitoring is done. Plus this aligns better with ASHRAE 90.1-2010 and 2013.

If projects use a utility meter to comply, the data should be made easily accessible to the owner so that corrective actions can be taken to resolve energy efficiency issues promptly. Owners should not have to wait for their energy bills to notice any issues as by that time it's too late. Our suggested changes are not substantive but more editorial to more prominently show monitoring over disaggregation by listing the monitoring alternatives first.

Thus, we suggest the following changes:

> **EXCEPTION to Section 130.5(a):** Service or feeder for which the utility company provides a metering system capable of electrical energy measurement in accordance with TABLE 130.5-A requirements provided that the data is readily accessible to the building owner.
>
> (b) **~~Disaggregation of Electrical Circuits / Electrical Energy Monitoring~~. Electrical Energy Monitoring/Disaggregation of Electrical Circuits.** Electrical power distribution systems shall allow installation of measurement devices for monitoring the electrical energy usage of load types...
>
> ~~3~~1. Buildings for which a complete metering and measurement system is provided that at a minimum measures and reports the loads called for in TABLE 130.5-B.

11. **150.0(k)3 Residential Outdoor Lighting.** Landscape lighting is still not addressed. All exterior lighting should be controlled, not just the exterior lighting that is attached to a building. We suggest the following changes:

> 150(k)3A. For single-family residential buildings, outdoor lighting ~~permanently mounted to a residential building or other buildings on the same lot~~ shall meet all of the following requirements in item (i) and the requirements in either item (ii) or item (iii):

12. **100.1 Definitions and Rules of Construction.** The thermostat definition should be changed to allow for multi-part thermostat systems. There are many multi-part thermostat systems such as this one (http://www.lutron.com/TechnicalDocumentLibrary/367-2020.pdf) where the temperature measure device is separate from the wall controls and separate from the HVAC controller/processor. It is a whole-system that works together. These systems are beneficial because the temperature measuring device and the wall controls can be in different locations which allows for better performance. Thus, we suggest the following change:

> **THERMOSTAT** is an automatic control device or system used to maintain temperature at a fixed or adjustable setpoint.