LUTRON ELECTRONICS CO., INC.

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

June 6, 2014

VIA EMAIL TO: docket@energy.ca.gov

Mr. Ken Rider, Mr. Harinder Singh
California Energy Commission
Dockets Office, MS-4
Re: Docket No. 14-AAER-1
1516 Ninth Street
Sacramento, CA 95814-5512

California Energy Commission's Draft Staff Report of Dimming Fluorescent Ballasts

Docket Number: 14-AAER-1

Dear Mssrs Rider and Singh,

Lutron Electronics Co., Inc. (Lutron) thanks you for the opportunity to provide the attached comments on the California Energy Commission's Draft Staff Report of Dimming Fluorescent Ballasts.

Lutron was founded in 1961 and is a manufacturer of lighting control systems and motorized window shade systems, headquartered in Coopersburg PA. Lutron has factories in Albertis PA, Allentown PA, Ashland VA, Humacao PR and four locations outside the United States.

Please find our detailed comments below. We look forward to working with you further on this important project. If you have any questions on these comments, please contact Pekka Hakkarainen at (610) 909-3267 or phakkarainen@lutron.com .

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1. Scope

The IOU CASE Report and CEC Draft Staff Report (CEC-400-2014-006-SD) are both based upon a dataset of ballasts for 4' T8 (F32T8) lamps. The scope is currently too broad, and covers all "Deep-dimming fluorescent ballasts". Ballasts are designed to drive specific lamps and these designs vary significantly from lamp to lamp. Applying the results of a 4' T8 study to ballasts for other types of lamps is not appropriate as lamp electrodes are significantly different for each type of lamp. Lutron proposes that following change to the regulatory language:

> Section 1604. Test Method for Specific Appliances.
>
> (j) (3) Deep-dimming fluorescent ballasts rated to operate four-foot, T8 lamps shall be tested…

2. Standby Power

The proposed Annual Energy Usage formula discourages the use of digital dimming ballasts. These ballasts have a number of energy-savings advantages, including the ability to respond to Demand Response (DR) events and to create independent occupancy-sensed and daylighting zones. These ballasts can also report the actual power used. These advantages require that digital ballasts have off-state power consumption. If the standby power is incorporated into an efficiency metric, these ballasts would need an even higher operating efficiency to comply when compared with their analogue counterparts. We believe that these ballasts should not be punished for their expanded utility, as the effect would be the loss of all associated system energy savings.

Lutron agrees with the IOU CASE Team report recommendation of a 1 Watt standby power limit separate from all other efficiency metrics.

3. Methodology

Both the IOU CASE report and the draft CEC Staff Report proposals are written around the concept of "cathode-cutout" technology. Inexpensive implementations of this technology are the subject of numerous U.S. Patents, including 5,623,184; 5,656,891; 5,703,441; 5,710,488; 5,920,155; 5,923,126; 5,973,455; 6,366,031; 6,433,490; 6,501,225; 6,531,831; 6,664,742; 6,750,619; 6,819,063; 6,933,684; 7,176,639; 7,187,132; 7,247,991; 7,586,268; 7,843,139; 8,288,956; 8,294,384; and 8,324,813. Adoptions of regulations that effectively require the use of this patented technology limits competition.

The methodology proposed by the CEC draft Staff report attempts to simplify the complicated field of dimming ballast operation into a single equation, presumably for the benefit of having a single limit. Unfortunately, this approach has the unintended consequence of favoring several single-lamp ballasts over multiple-lamp ballasts and ballasts for four-foot lamps over two-foot and three-foot counterparts.

Lutron supports the IOU methodology of setting efficiency limits at various operation points; however, there are some issues with the IOU proposal.

- We believe there is an error in the equations for the BLE limits at 80% and 50%. IOU data demonstrates that BLE decreases across all ballasts as the lamps are dimmed; however, the equations as stated require BLE to increase as the lamps are dimmed. We believe the numerator for the equations intended by the IOU should have been the dimmed arc power, not the arc power at 100% as written.

$$Min\ BLE_{80\%} = \frac{\cancel{Arc\ Power_{Full\ Output}}\ Arc\ Power_{80\%}}{Arc\ Power_{Full\ Output} * A + B * Arc\ Power_{80\%} + C}$$

$$Min\ BLE_{50\%} = \frac{\cancel{Arc\ Power_{Full\ Output}}\ Arc\ Power_{50\%}}{Arc\ Power_{Full\ Output} * A + B * Arc\ Power_{50\%} + C}$$

- Even after fixing this mistake, we are concerned that the limits are not tied to any physical parameter, but rather arbitrarily calculated to achieve the desired number of compliant ballasts. We can, and should, do better. We propose working together to develop a larger dataset which more accurately represents dimming ballasts available in the State of California today and to develop relevant limits based upon physical parameters.

4. Electrode Voltage

Figure 1 in NEMA LL-9-2011 shows the safe operating area for electrode voltage as a function of lamp current. What it does not show, however, is that each lamp manufacturer has a different "sweet spot" for best performance and lamp life somewhere between the upper and lower limit lines.

Driving cathode current towards the lower limit line will cause certain lamps to fail more quickly and perform worse than other lamps. As a lighting controls company, Lutron makes ballasts which perform well with all lamps, and as such, believes that it is of paramount importance to not limit electrode voltage too low. We recommend regulations which would allow ballasts to operate with electrode voltages within 60% of the window created between EV_{min} and EV_{max} values in NEMA LL-9. In other words,

$$EV \leq EV_{min} + 0.6 * (EV_{max} - EV_{min})$$

The power that is consumed by the electrode is not actually a ballast loss, as the power is consumed in the lamps and is generated for the purpose conditioning the electrode to allow the lamp to function. It would be best to remove this power completely from the ballast metric, and instead focus on a true ballast efficiency metric.

5. Selection of Lighting Control

   Lutron supports the Staff proposal for the selection of compatible lighting controls as it will allow for more consistent data.

6. Summary

   Lutron supports the CEC's overarching goal of energy savings, and wants to work together with Industry and the CEC

   a) Scope should be limited to ballasts for 4' T8 lamps only.
   b) Standby power should be regulated via a separate metric, and limited to 1 W.
   c) BLE limits should be the metric used to evaluate efficiency. Limits should be based upon physical parameters and discussed openly after the development of a larger dataset.
   d) Care must be used when trying to direct electrode voltage as lamp lifetime and performance will vary with lamp manufacturer. We recommend allowing 60% of the operating area of Electrode Voltage curves from NEMA LL-9-2011.
   e) The same manufacturer's lighting controls should be used with the ballast under test to help ensure consistent measurements.