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CA IOU Comments on LED Lamps and Small Diameter Directional Lamps

Additional submitted attachment is included below.

LED Lamps and Small Diameter Directional Lamps

Codes and Standards Enhancement (CASE) Initiative
For PY 2016: Title 20 Standards Development

RESPONSE TO CEC'S EXPRESS TERMS 15-DAY LANGUAGE PROPOSALS

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1 Overview

The Pacific Gas and Electric Company (PG&E), Southern California Edison (SCE), Southern California Gas (SoCal Gas), San Diego Gas & Electric (SDG&E) Codes and Standards Enhancement (CASE) Initiative Program seeks to address energy efficiency opportunities through development of new and updated Title 20 standards.

This document outlines the California Investor-Owned Utilities' (IOUs) CASE team response to the California Energy Commission's (CEC) Express Terms published on January 7, 2015, "Notice of Commission Adoption Hearing, Availability of Revised 15-Day Language" (herein referred to as the 15-Day Language). The comments in this document focus on the proposed standards for state-regulated light emitting diode (LED) lamps and small diameter directional lamps (SDDL).

For the reasons provided in our previous written comments on the 45-day language, we remain supportive of the CEC's proposals to set minimum efficacy, performance and quality requirements for LED lamps. These new requirements provide an optimal combination of key performance attributes, such as luminous efficacy, color rendering, light distribution, and longevity, and they ensure that LEDs will provide a level of quality and amenity that is similar to or better than the incandescent technology they are intended to replace. We commend the CEC for being innovative in its approach to setting effective color rendering requirements – requiring a minimum level of performance in each individual color score (R1 – R8) in the CRI system, rather than solely using the average color rendering value, "Ra" (in which very poor performance in certain colors can be masked by better performance in other color areas). We were disappointed to see the delay in the standards effective dates, since we believe there is a sufficient supply of compliant and cost-effective products available now. We believe that these standards will have maximum impact the sooner they take effect; it would be ideal to have only high quality, high efficacy LED lamps on the market, in greater quantities and with significant market competition, well before the January 1, 2018 effective date for California's 45 lumen per watt (lpW) halogen ban. That said, the requirements as proposed will still provide very clear guidance and a timeline to the industry, and help ensure maximum product availability by 2018, if not sooner.

We are also supportive of the proposed standards for small diameter directional lamps, which are designed to push the lamp market to high efficiency options such as LED. There are a number of compliant products already available, and given the ongoing expected efficacy improvements forecasted between now and 2018, we expect many more will be available by the standards effective date. We also support the change made in the 15 day language to clarify that the standards apply to any SDDL lamps that are capable of operation at 12V, 24V, or 120V. This is important given that products rated just off of these voltages could easily be operated at these voltages, with minimal impacts to light levels or lamp life. For example, 12.5V or 11.5V products can be operated on 12V transformers, so the proposed change is a critical improvement to the scope of the standards to prevent gaming and loophole products.

2 Supporting Comments and Data

2.1 Standby Mode Power

We support the CEC's proposal to require LED lamps to have a standby mode power of 0.2 watts or less. In the residential sector, lamps are only on for about 10% of the year, which means they

spend the vast majority of their time in the off or standby state. It is therefore critical that we limit standby power draw; high standby power draw can effectively negate the efficacy gains LED technology has experienced in recent years. For example, a 10W LED lamp with 1W standby power draw will likely use as much energy in the "standby" state in a year as it will in the "on" state, assuming typical residential hours of operation. In other words, left unchecked, residential LED lighting energy use could double if connected lamps proliferate.

The CA IOU team has completed an initial round of testing of the standby power of connected LED lamps, using the test procedure proposed by the CEC for use in Title 20.[1] This testing has shown the 0.2W level to be feasible for products on the market today. Despite relatively few internet-connected lamps on the market, our testing has found that there are already at least three products that have standby mode power of less than 0.2 watts. These lamps also have functionalities of leading smart products, including color tunability, remote on/off control, remote dimming, light level scheduling, and geo-fencing.[2] Similarly, these three products all use different common communication protocols, demonstrating that the proposed standby mode power draw does not limit the way connected lamps communicate. Table 1 below summarizes the capabilities, communication protocol, and standby power of the three lamps tested to have standby mode power below 0.2 watts.

Table 1. Capabilities, Communication Protocol, and Standby Mode Power of Three Currently Available Connected Lamps[3]

Lamp	"Smart" Capabilities					Communication Protocol	Standby Mode Power
	Color Tunable	Remote On / Off	Remote Dimming	Light Level Scheduling	Geo-Fencing		
A	✓	✓	✓	✓	✓	ZigBee Light Link[4]	0.197w
B	✓	✓	✓	✓		Wi-Fi[5]	0.189w
C		✓	✓	✓		6loWPAN[6]	0.172w

[1] Lamps were tested first at Underwriters Laboratory in late 2015, and have now been passed on to a second lab to complete "round robin" verification. The full results of the study will be published when testing is completed.
[2] A geofence is a virtual barrier. Programs that incorporate geo-fencing allow an administrator to set up triggers so when a device enters (or exits) the boundaries defined by the administrator, a text message or email alert is sent.
[3] Standby Mode power measurements were taken at the lamp for a duration of 60 minutes, beginning after the system had been stabilized in Standby Mode for at least 60 minutes.
[4] ZigBee is a low-power wireless mesh network standard designed for long battery life devices used in wireless control.
[5] Wi-Fi is a Wireless Local Area Network (WLAN) that connects products network via a wireless network access point.
[6] 6LoWPAN is an acronym for *IPv6 Low Power Wireless Personal Area Networks*; an Internet communication protocol designed for small devices.

The fact that these products already achieve the capabilities described above while drawing less than 0.2 watts during standby mode (despite the lack of any current mandatory or voluntary requirement to do so), suggests that the requirement will be even easier to meet by 2019 after several years of continued innovation and design work aimed at that requirement.

2.2 Flicker

We support the proposed requirements for low flicker operation for lamps that are designed and marketed as dimmable. The importance of controlling flicker has been widely documented[7] and due to the fast response of light emitting diodes (LEDs) to current, LEDs are now the subject of the standard IEEE PAR1789 "Recommended Practice for Modulating Current in High-Brightness LEDs for Mitigating Health Risks to Viewers."[8] Excessive flicker, even imperceptible flicker, can have deleterious health effects, and lesser amounts can impact satisfaction and productivity. The California reduced flicker operation definition is far less stringent than the recommended levels in IEEE PAR1789, but would impact approximately 50% of the LEDs that have been sold in the past. Once quantified by a repeatable test method, flicker can be substantially reduced through better design.[9]

We refer the CEC to the completed test report provided to the docket under separate cover. This report documents the recent testing funded by PG&E and completed at multiple private test labs, utilizing the CEC's own test procedure (from Title 24 Joint Appendix 10). This testing demonstrated that the proposed requirements are feasible. Overall, the results show that more than half of the products tested meet the California definition of "reduced flicker operation," including a wide variety of products with different lamp shapes and sizes. In fact, we have measured a number of LED designs that have even less flicker than incandescent lamps operating on AC current. The testing completed by PG&E also explored the relationship between measured flicker levels and rated power factor, and examples of many products that achieved both very low levels of flicker and very high power factor. This suggests that these two design factors need not be traded off against each other. Lastly, the flicker testing completed in that study demonstrated that the test method being used by CEC (from Joint Appendix 10) is repeatable and reliable.

[7] Miller and Lehman. FLICKER: Understanding the New IEEE Recommended Practice http://energy.gov/sites/prod/files/2015/05/f22/miller%2Blehman_flicker_lightfair2015.pdf
[8] http://standards.ieee.org/findstds/standard/1789-2015.html
[9] B. Lehman & A. Wilkins, "Designing to Mitigate the Effects of Flicker in LED Lighting," IEEE Power Electronics Magazine, Vol. 1, No. 3, September 2014.