Proposal Information Template for:
Power Supplies for Luminous Outlines, Text and Channel Letters for Indoor Use

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Proposal Information Template – Power Supplies for Luminous Outlines, Text and Channel Letters for Indoor Use

2008 Appliance Efficiency Standards

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Purpose

This document is a report template to be used by researchers who are evaluating proposed changes to the California Energy Commission's (Commission) appliance efficiency regulations (Title 20, Cal. Code Regs. §§ 1601 – 1608). This report specifically covers Power Supplies for Luminous Outlines, Text and Channel Letters for Indoor Use[1]. Note that this is a draft, preliminary report – research is still being conducted on this subject and so the estimates given here will be adjusted in subsequent drafts.

Background

Power supplies for luminous "outlines", text and channel letters are appliance components commonly used in signage-type luminous systems by retail establishments and other indoor venues where visual communication with customers and clients is essential for successful business. Like other forms of signage, luminous messages and decorative elements are a form of free speech and artistic expression. Signs and outlines—particularly those using hand-formed neon—are historically an important and valued feature of commerce and culture in California, as in the rest of the United States. More recently luminous outlines, text and channel letters incorporate light emitting diodes (LEDs) as an alternative to neon. In our field observations and review of product offerings, we identified many hardwired and plug-in luminous systems using inefficient or unidentified power supplies. We also noted an increasing number of component suppliers offering high efficiency power supplies for neon and LED systems.

The power supply for each type of commonly used light source in outlines, text and channel letters is somewhat different, but serves the purpose of conditioning the mains power so that it will properly operate the light source. In the field, the common names for each are:

[1] This proposal addresses power supplies for luminous, linear tubing; these appliances may not be generally identified as "signs" or "signage." Signage for outdoor and indoor use is regulated by Title 24, Subchapter 5, Section 148, "Requirements for Signs," which addresses signage via one of two options: a) signage that has a surface area by regulating a maximum W/sf, or, but allowing alternate light sources. (Note that surface area is not a metric customarily applied to lengths of tubing.) Or, b) signage using alternate lighting sources. It is not clear how this option would necessarily apply to all types of luminous outlines that we observed in the field.

- Transformer (also referred to as, “luminous tube transformer” or “gaseous tube transformer”): for neon lighting systems (or “neon skeleton systems”).
- Circuit driver: for LED and electroluminescent systems (replace inefficient drivers with high efficiency drivers)

We propose standards that effectively require the replacement of ferromagnetic transformers with electronic transformers in neon systems, and inefficient circuit drivers with high efficiency circuit drivers in LED systems. Note that incandescent linear lighting systems typically do not require a separate power supply, and so they are not addressed in this recommendation. An accompanying proposal, “Decorative String Lights” applies to incandescent linear systems. We did not observe fluorescent lamps in use for outlining applications, but in any new installations it is likely that such systems would have to comply with federal and state regulations regarding fluorescent lamps and ballasts. Thus, we do not address ballasts for fluorescent systems in this report.

Power supplies with efficient solid-state components offer significant energy savings and peak demand reduction potentials relative to baseline ferromagnetic transformers and circuit drivers. Improved solid-state power supplies can also offer some non-energy benefits such as dimming and other dynamic effects, when coupled with appropriate controls. The proposed component regulation should speed the uptake of new power supply technology and immediately deliver energy and environmental benefits to California.

Overview
The market is already taking advantage of newer lighting technologies that enable visually equivalent or better luminous products, including high efficiency power supplies. The sign industry is generally aware of options for energy efficiency improvements, and although historically averse to government intervention, this industry is eager to continue its recent overall growth trend (up to 14% per year) and to better serve its customers who require efficient alternatives. The sign industry’s recent participation in Title 24 activities could pave the way for collaboration on this measure, too.

Energy savings opportunities are significant, although perhaps less substantial than those offered by our accompanying proposal for plug-in signs. Present stock primarily utilizes neon with conventional transformers, neon with more advanced transformers and LEDs with circuit drivers of varying efficiency. Without intervention, we expect future stock to remain consistent with the above options. Current market trends favor increased use of LED systems to replace channel letter neon, but we expect neon to persist in outlines and custom-formed text applications.

Two basic types of power supplies intended for use indoors are covered by this proposal:
- Transformers for neon systems.
- Circuit drivers and associated system components for LED, electroluminescent and other solid-state lighting technologies.

Figure 1. Power Supplies for Luminous Outlines.
Upper left shows a retail distributor using plug-in exposed neon "bare tube" text and graphics signs and green exposed neon "skeleton" window outlines. Upper right shows an open channel letter illuminated with exposed neon. Lower left shows a restaurant using a dynamic (blinking and color-changing) plug-in LED "open" sign, incandescent decorative string lights; and an exposed neon brand plug-in sign. Lower right shows a convenience store using green exposed neon window outlines and plug-in exposed neon text signs.

For 2008 we roughly estimate the following demand and use attributable to luminous outlines, text and channel letter sign systems indoors in the commercial sector of California.

- Estimated number of sign systems in use, statewide: approximately 2 million
- Total input power demand: approximately 1 GW
- Total input power demand at peak: approximately 1 GW
- Total daily use: over 1.4 GWh
- Total annual use: over 500 GWh

Luminous outlines, text and channel letters are used almost exclusively by commercial enterprises. From our preliminary assessment the major groups of commercial users for these systems are:

- **Food and beverage industry:** approximately 50% of units in use. (Restaurants, grocery stores, supermarkets, liquor stores, bars and pubs, restaurant equipment suppliers and beverage distributors).
- **Grooming and health services:** approximately 20% of units in use. (Hair care and treatment, manicures and pedicures, medical and dental retail services, and beauty and day spas).
- **Other retailers:** approximately 30%.

While the more efficient power supplies appear to be slightly more expensive on a first cost basis, the standard will result in positive net present values to these groups as a result of the lower operating costs to users.

Description of Standards Proposal	**Proposed requirements for all power supplies intended for use with luminous outlines, text and channel letters for indoor use only.** Harmonize with Title 24, Section 148, items b3, b5 and b7 (NOT b1, b2, or b4; and, no exceptions). Also, Title 20, Section 1605.3u, Non-Federally-Regulated Appliances, Power Supplies, Table U1 and U2, may pertain to LED installations, but not to transformers for neon tubing[2]. • Minimum power supply component efficiency (expressed as a percentage). Suggested minimum: ≥84% (to harmonize with T20, Table U-1). • Minimum power factor • Label
California Stock and Sales	Stock of signs installed in California in 2008: On the order of 2 million (rough estimate). Annual sales of sign units in California: TBD, but in the hundreds of thousands of units. Annual growth rate in the national sign industry was 5% to 14% for 2000 through 2006.

[2] Title 20, 1602, Definitions, "Single –voltage external AC to DC or AC to AC power supply" does not pertain to transformers for luminous (neon) tubes because it defines these devices as "designed to convert line voltage AC input into lower voltage DC or AC output." Transformers for neon outlines, text and channel letters convert line voltage into a higher voltage that is required to strike and maintain an arc in the gas-filled tubing.

Energy Savings and Demand Reduction	Energy use in California: 500+ GWh (rough estimate) Peak demand: 1 GW (rough estimate) Savings in energy use*: 50 to 75 GWh (approximately 10% to 15%) at entire stock replacement 2018. Peak demand savings*: 100 to 150 MW at entire stock replacement. * The proposed regulation will very slightly reduce thermal load in buildings; and thus reduce summer cooling loads; we have not quantified or incorporated this effect yet.
Economic Analysis	Life cycle cost per unit: TBD (Small incremental price relative to total lighting system cost.) Life cycle benefit: TBD. We note the cost effectiveness of the external power supply standard and expect better results will apply to these signage power supply applications because of the increased proportion of active mode operation. Benefit/cost ratio: TBD (>1). We expect benefits to substantially outweigh costs assuming a life of 10 to 15 years per system.
Non-Energy Benefits	Purchasers replacing neon with LED-based systems would not need a specially licensed neon installer, and so should save on labor and installation costs relative to purchasers who choose neon. The cost of power supplies for this application should decline as Title 24-stimulated demand for new power supplies increases.
Environmental Impacts	The proposal does not create any adverse environmental impacts. As a result of lower energy use, atmospheric emissions (including ozone depleting gases) should decrease. The more efficient power supplies weigh less and are smaller in some dimensions, so environmental and energy impacts associated with manufacturing, packaging, and shipping to the job site will be reduced relative to the base case. Solid-state power supplies are available in models that do not contain mercury, lead, iron or PCBs. Thus, precursor material supplies for manufacturing and also end-of-use for these products should entail fewer mining and material disposal issues.

Acceptance Issues	Luminous outlines, text and channel letters are ubiquitous in retail spaces. Whenever new tenants redesign or move into retail spaces they remove old systems and install new ones, so there is a steady demand for this application. The trend is toward increased use of luminous outlines and letters, bolstered by intense marketing by sign retailers, economic development programs and small business advocacy campaigns. Any perceived restrictions on design choices would be regarded negatively by users and retailers of signs. However, the trend in the market is already toward increased use of efficient power supplies, and increased use of LEDs as an alternative to neon. A label could increase purchaser awareness of the energy and environmental benefits of the new power supplies. Lighting Measure Availability and Cost: Electronic firms that manufacture transformers and circuit drivers include: Allanson International, ElectraLED Inc., France, Lecip USA, Lumination (GE), Philips Advance Transformer, Osram, SloanLED, Supertex, Transco, Ventex Technology Inc. and others. The proposed regulation requires technology that is available from some leading manufacturers, but more work needs to be done to increase the number of providers and products. California has a higher proportion of sign manufacturers, retailers and installers than does the rest of the USA. For example, of entities that are certified by one listing body to manufacture signs, California represents 15% of the total certified in the USA; similarly, California represents 17% of the total for skeletal neon signs; 48% of the total for changeable message signs, and 23% of the total for sign components. Many providers presently import their products from Asia; this is a widespread trend in the worldwide lighting industry. Should the recommendations be adopted, the power supply electronics industry has the capacity to supply new technologies in quantities sufficient for statewide compliance. We recommend that educational outreach to upstream providers be implemented to encourage them to prepare for more demand for high efficiency power supplies. The California and national sign industry associations and representatives are participating in the regulatory process for Title 24, for outdoor signage. Resistance to regulation that is perceived as economically burdensome may be counterbalanced by the industry's desire to be "green" and to increase sales and profits. Acceptance of this standard may be enhanced with highly targeted incentive programs such as education for and rebates to distributors, headquarter rebates to chain store procurement offices, or coupon and take-back programs for small, independent businesses. Programs encouraging change-out of neon systems should offer recycling or disposal options; neon systems contain mercury and other hazardous materials.

AB 1109 (California Lighting Efficiency and Toxics Reduction Act)	To the extent that the energy use of these signage products (especially the outlining applications) is counted in the AB1109 metrics, it will contribute substantively to the commercial lighting reduction goal of 25% savings by 2018.
Federal Preemption or other Regulatory or Legislative Considerations	The only federal program presently addressing energy efficiency in signs is in EPACT 2005; it applies only to exit signs. The proposed Title 24 2008 language regulates power supplies, but exempts most of the power supplies that are addressed by this proposal. The California and national sign industry associations and representatives are participating in the regulatory process for Title 24, for outdoor signage. They are already familiar with those power supply requirements. In a separate proposal we recommend regulating plug-in luminous signs for indoor use; this power supply proposal would apply to either hard-wired or plug-in systems, and thus would apply to exposed outline and text luminous plug-in signs.

Methodology

The authors found no comprehensive data on energy use of signage. Trend and market information was collected from trade articles from magazines such as *Signs of the Times*, *LEDs Magazine* and *Digital Signage Monthly*. To categorize the types and frequencies of signs indoors, we photographed, videotaped and counted plug-in signs in a wide variety of establishments in San Francisco, Oakland, Orange County, South San Francisco, Los Angeles, and San Diego. We made observations during daylight and evening hours. We also examined many websites of online retailers for all types of signs and sign components, compiling average data for size, input power demand and other factors.

From these observations and information, we made very general assumptions and, where possible, referenced figures developed by SCE or by the PG&E Title 24 team. We will complete a more in-depth analysis in the process of completing a CASE Report in the next weeks. In that process we will conduct more field work and discussions with manufacturers and/or their trade associations to refine the analysis and standards specifications.

Analysis and Results

We found ample cause to require newer, more efficient components and systems for signage. Savings impacts are estimated in the sections above, but are worthy of Commission attention. Many existing signs are in poor operating and visual condition. Although some establishments change signs frequently, some businesses continue to operate “vintage” or simply out-of-date equipment. Exposed neon signs have a distinctive visual impact; they may not be as easy to displace with other types of newer light sources.

Even so, the power supplies (transformers) for exposed neon signs offer energy efficiency opportunities.

Our preliminary assessment is consistent with the results of a recent study on signage conducted by Southern California Edison, which found that, “Over 70% of indoor neon signage is plug-in and operates during day. Indoor neon represents 28% of total linear feet, 20% of installed wattage, and 29% of annual kWh.” Assuming that the remaining indoor neon signage is outline, text or channel letter, we project that this proposal would regulate 8% of total linear feet, 6% of installed wattage, and 8% of annual kWh of all neon installed in California. SCE found that for replacement of neon open signs with LED open signs, “”Technology [is] currently available which allows replacement: Any color sign can be replaced; and, approximately 1/10th of energy and demand is [used].” (Higa 2008). LED replacements for neon outline, text and channel letters are also widely available. We understand that some users may prefer non-LED light sources for aesthetic reasons, so our CASE Report analyses will include a mix of alternative light sources with power supplies exceeding the efficiency of power supplies commonly in use in 2008.

In our research to date, we found many systems operating in full sunlight, at peak utility demand hours, when their visual impact was negligible. Many window outline systems operate all night, too. Most sign users did not ostensibly turn signs off during sunlight hours—many could not because the signs lacked accessible or automatic controls. We did not examine whether signs in storefront windows were plugged into a switchable electrical circuit, but we did observe potential fire and electrical shock hazards due to broken and/or multiple signs plugged into electrical outlets that were not designed to power numerous high-wattage devices. We also found in the industry a lack of consistent sign component and system definitions, product types, testing methods and labels. While we can adapt some elements from other documents, developing appropriate test methods for this standard will require further research and stakeholder input.

SCE suggests, “that there is a much greater energy impact produced from interior neon signs than was previously thought and that there are Energy Efficiency, Demand Reduction, and Demand Response potentials that need to be explored.” (SCE 2007). We will work with SCE and the sign industry to further define the standard options and analysis of savings for the CASE Report.

Recommendations

We recommend that power supplies for luminous outlines, text and channel letters comply with minimum power supply efficiency levels, and also utilize a minimum power factor. The minimum levels should be set for each light source technology according to technical feasibility, and these levels should be harmonized if possible with other Title 20 and Title 24 requirements. Power supplies should bear a label clearly stating input power demand and efficiency (at maximum usage setting) and power factor. Consumer education and incentive programs could accelerate the adoption of more energy-efficient signage in California.

Bibliography and Other Research

The authors consulted with PG&E's staff (Steve Blanc, Gary Fernstrom and Pat Eilert) and the PG&E Title 24 consultants who worked on sign component and system issues, including Michael Neils and HMG. The authors attended several industry trade shows (ISA 2007 in Las Vegas and LightFair 2007 in New York) where we met manufacturers and distributors. We participated in Underwriter Laboratories' LED workshop held in Chicago.

We will consult with SCE prior to submitting the final CASE report. Also, we may conduct tests of several samples of conventional and high efficiency power supplies for both neon and LED sources with a fixed load (length of light source), in order to better establish energy savings potentials. If we do conduct tests, we will incorporate test methods as available from sources such as: CEC Appliance Efficiency Regulations, CEC Building Efficiency Regulations, US DOE SSL CALIPER program, UL, NEMA, IEC and ANSI.

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