**Work Paper SCE13LG070**

**Revision 1**

**Southern California Edison Company**

**Replace Neon Open Sign with LED Open Sign**

# At-a-Glance Summary

|  |  |
| --- | --- |
| ****Applicable Measure Codes:**** | *LT-19583* |
| **Measure Description:** | LED OPEN Sign |
| **Base Case Description:** | Neon OPEN Sign |
| **Energy Impact Common Units:** | Fixture |
| **Energy Savings :** | Refer to Excel Calculation Attachment |
| **Gross Measure Cost ($/unit)** | Refer to Excel Calculation Attachment |
| **Measure Incremental Cost ($/unit):** | Refer to Excel Calculation Attachment |
| **Effective Useful Life (years):** | 16 |
| **Measure Application Type:** | Replace on Burnout (ROB) |
| **Net-to-Gross Ratios:** | See Table 3 |
| **Important Comments:** | This work paper document does not contain a data set in conformance with the 4/1/14 CPUC Ex Ante Database Specification; SCE will provide that data set separately. |

# Document Revision History

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Workpaper and Revision # | Tech. Revision | MM/DD/YY | Author/Affiliation | Summary of Changes |
| SCE13LG070.0 | No | 03/28/14 | James Gowen/Matrix | Updated work paper to new template |
| SCE13LG070.1 | No | 05/12/14 | Yun Han/SCE | * New WP template w/updated IE & OpHrs. * WP updated for reporting period, effective 7/1/14-12/31/14 * Added Mid-Stream program * Updated Title 24 code language to 2013 * Added all Non-Res BTs to DI Program * Updated NTGs |

# Section 1. General Measure & Baseline Data

## 1.1 Measure Description & Background

This work paper details the replacement of a neon OPEN sign, consuming 46 Watts per sign when “on” and 0 Watts when “off”, with a light emitting diode (LED) OPEN sign, consuming 14.9 Watts when “on” and 0.7 Watts when “off”.

Table 1 Measure Names

|  |  |
| --- | --- |
| Solution Code | Measure name |
| LT-19583 | LED OPEN Sign |

The existing OPEN sign must be a neon OPEN sign for interior application. The measure in this work paper applies to all commercial building types in all climate zones.

## 1.2 Technical Description

LED OPEN signs use LED technology as an alternative to traditional neon technology. Instead of a neon transformer and gas-filled neon tubes that have been bent and shaped to form the word, “OPEN,” the LED signs use an LED driver and various colored LEDs that are arranged to form the word, “OPEN.”

## 1.3 Measure Application Type

The delivery method is Financial Support - Direct Install and Midstream Programs – Mid-Stream Incentive.

The program/install type is Replace-on-Burnout (ROB).

## 1.4 Measure and Base Case Cost Effectiveness Data

### 1.4.1 DEER Measure and Base Case Analysis

Table 2 DEER Difference Summary

|  |  |
| --- | --- |
| DEER Difference Summary Table | |
| Modified DEER Methodology | No |
| Scaled DEER Measure | No |
| DEER Building Prototypes Used | No |
| Deviation from DEER | DEER does not contain this type of measure. |
| DEER Version | N/A |
| DEER Run ID and Measure Name (Sample) | N/A |

**Net to Gross**

The NTG value was obtained from the “DEER2011\_NTGR\_2012-05-16.xls” on the DEER website as required by Version 5 of the California Public Utilities Commission (CPUC) Energy Efficiency Policy Manual [351]. The relevant NTGR for this measure is shown in Table 3 below.

Table 3 Net-to-Gross Ratio

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| NTGR\_ID\* | Description\* | Sector\* | BldgType\* | ProgDelivID | NTG\* |
| ET-Default | Emerging Technologies approved by ED through work paper review | All | Any | All | 0.85 |
| Com-Default>2yrs | All other EEMs with no evaluated NTGR; existing EEM in programs with same delivery mechanism for more than 2 years | Com | Any | Any | 0.60 |
| Ind-Default>2yrs | All other EEMs with no evaluated NTGR; existing EEM in programs with same delivery mechanism for more than 2 years | Ind | Any | Any | 0.60 |
| Agric-Default>2yrs | All other EEMs with no evaluated NTGR; existing EEM in programs with same delivery mechanism for more than 2 years | Ag | Any | Any | 0.60 |
| Com-Default-HTR-di | All other EEM with no evaluated NTGR; direct install to hard-to-reach only. | Com | Any | DirInstall | 0.85 |
| Ind-Default-HTR-di | All other EEM with no evaluated NTGR; direct install to hard-to-reach only. | Ind | Any | DirInstall | 0.85 |
| Agricult-Default-HTR-di | All other EEM with no evaluated NTGR; direct install to hard-to-reach only. | Ag | Any | DirInstall | 0.85 |

\*Denotes that the column is taken from the DEER NTG Table.

Note that for the direct install delivery mechanism, a distinction between hard to reach and non-hard to reach markets will be made on a project by project basis. This work paper shows the NTG associated with a hard to reach direct install delivery mechanism and the non-residential defaulted NTG value, where in fact, a measure offered through direct install and is not “hard to reach” will receive a default NTG value.

**Installation Rate**

The installation rate (IR) is identified in the calculation attachment. This value is obtained from the support table available in READi. Currently there is no versioning on the installation rate table. To address appropriate selection of the installation rate the date of the workpaper will serve as the last date checked for updated IR values. The installation rate varies by end use, sector, technology, application, and delivery method. The relevant IR values for this measure are shown in Table 4 below.

Table 4 Installation Rate

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| GSIA\_ID\* | Description\* | Sector\* | BldgType\* | ProgDelivID | GSIAValue\* |
| Def-GSIA | Default GSIA values | Any | Any | Any | 1 |

**Spillage Rate**

Spillage rate will also be applied to measures however the values will not be tracked in the workpapers. The spillage rate will be tracked in an external table to be supplied to the Energy Division.

**READi Technology Fields**

To support the development of the ED ex ante tables, select fields from the ex ante database will be identified in the workpaper. For a full set of values associated with the measures in the workpaper refer the Excel calculation template.

Table 5 READi Tech IDs

|  |  |
| --- | --- |
| READi Field Name | Values included in this workpaper |
| Measure Case UseCategory | Lighting |
| Measure Case UseSubCats | Non-DEER |
| Measure Case TechGroups | Ltg\_Wired |
| Measure Case TechTypes | LED Fixture |
| Base Case TechGroups | Ltg\_Wired |
| Base Case TechTypes | Fixture |

### 1.4.2 Codes and Standards Analysis

Title 24 2013 [355] Section 130.3 and 140.8 contains requirements for signs.

**Section 130.3**

1. **Controls for Sign Lighting.** All sign lighting shall meet the requirements below as applicable:
   1. **Indoor Signs.** All indoor sign lighting shall be controlled with an automatic time-switch control or astronomical time-switch control.
   2. **Outdoor Signs.** Outdoor sign lighting shall meet the following requirements as applicable:
      1. All outdoor sign lighting shall be controlled with a photocontrol in addition to an automatic time-switch control, or an astronomical time-switch control.

**EXCEPTION to Section 130.3(a)2A:** Outdoor signs in tunnels, and signs in large permanently covered outdoor areas that are intended to be continuously lit, 24 hours per day and 365 days per year.

* + 1. All outdoor sign lighting that is ON both day and night shall be controlled with a dimmer that provides the ability to automatically reduce sign lighting power by a minimum of 65 percent during nighttime hours. Signs that are illuminated at night and for more than 1 hour during daylight hours shall be considered ON both day and night.

**EXCEPTION to Section 130.3(a)2B:** Outdoor signs in tunnels and large covered areas that are intended to be illuminated both day and night.

* 1. **Demand Responsive Electronic Message Center Control.** An Electronic Message Center (EMC) having a new connected lighting power load greater than 15 kW shall have a control installed that is capable of reducing the lighting power by a minimum of 30 percent when receiving a demand response signal.

**EXCEPTION to Section 130.3(a)3:** Lighting for EMCs that is not permitted by a health or life safety statute, or regulation to be reduced by 30 percent

**Section 140.8**

1. **Maximum Allowed Lighting Power.**
   1. For internally illuminated signs, the maximum allowed lighting power shall not exceed the product of the illuminated sign area and 12 watts per square foot. For double-faced signs, only the area of a single face shall be used to determine the allowed lighting power.
   2. For externally illuminated signs, the maximum allowed lighting power shall not exceed the product of the illuminated sign area and 2.3 watts per square foot. Only areas of an externally lighted sign that are illuminated without obstruction or interference, by one or more luminaires, shall be used.
   3. Lighting for unfiltered light emitting diodes (LEDs) and unfiltered neon shall comply with Section 140.8(b).
2. **Alternate Lighting Sources.** The sign shall comply if it is equipped only with one or more of the following light sources:
   1. High pressure sodium lamps; or
   2. Metal halide lamps that are:
      1. Pulse start or ceramic served by a ballast that has a minimum efficiency of 88 percent or greater; or
      2. Pulse start that are 320 watts or smaller, are not 250 watt or 175 watt lamps, and are served by a ballast that has a minimum efficiency of 80 percent. Ballast efficiency is the measured output wattage to the lamp divided by the measured operating input wattage when tested according to ANSI C82.6-2005.
   3. Neon or cold cathode lamps with transformer or power supply efficiency greater than or equal to following:
      1. A minimum efficiency of 75 percent when the transformer or power supply rated output current is less than 50 mA; or
      2. A minimum efficiency of 68 percent when the transformer or power supply rated output current is 50 mA or greater.

The ratio of the output wattage to the input wattage is at 100 percent tubing load.

* 1. Fluorescent lighting systems meeting one of the following requirements:
     1. Use only lamps with a minimum color rendering index (CRI) of 80; or
     2. Use only electronic ballasts with a fundamental output frequency not less than 20 kHz.
  2. Light emitting diodes (LEDs) with a power supply having an efficiency of 80 percent or greater; or

**EXCEPTION to Section 140.8(b)5:** Single voltage external power supplies that are designed to convert 120 volt AC input into lower voltage DC or AC output, and have a nameplate output power less than or equal to 250 watts, shall comply with the applicable requirements of the Appliance Efficiency Regulations (Title 20).

* 1. Compact fluorescent lamps that do not contain a medium screw base sockets (E24/E26). **EXCEPTION 1 to Section 140.8:** Unfiltered incandescent lamps that are not part of an electronic message center (EMC), an internally illuminated sign, or an externally illuminated sign.

**EXCEPTION 2 to Section 140.8:** Exit signs. Exit signs shall meet the requirements of the Appliance Efficiency Regulations.

**EXCEPTION 3 to Section 140.8:** Traffic Signs. Traffic signs shall meet the requirements of the Appliance

For this measure, the LED OPEN signs will require controls to comply with Title 24. These signs already comply with the Sign Lighting Power Requirements because LEDs are specified as an efficient lighting source.

This measure claims full customer savings as the code does not force the consumer to LED signs and the choice to install an LED sign is a discretionary decision.

Table 6 Code Summary

|  |  |  |
| --- | --- | --- |
| Code | Applicable Code Reference | Effective Dates |
| Title 24 (2013) | 2013 Non-Residential Compliance manual, Section 130.3 & 140.8 | July 1, 2014 |

### 1.4.3 Non-DEER Study Review

ET06.16 – LED OPEN Signs project [421] was used to qualify the measure in this work paper.

### 1.4.4 Measure and Base Case Effective Useful Life

DEER14 update documentation provides EUL and RUL information to be used for the 2015 program cycle extension on [www.deeresources.com](http://www.deeresources.com). The DEER documentation “Summary of EUL-RUL Analysis for the April 2008 Update to DEER” provides the RUL value as a flat 1/3 of the EUL value. The RUL value will only be applied to the first baseline period for retrofit measures that have applicable code that will affect the energy savings. In all other installation types and retrofit with no applicable code that affects the energy savings, the RUL is not applicable to either the first or second baseline period.

To obtain the EUL value the DEER14 update documentation, EUL\_Summary\_10-1-08.xls [213], was consulted. Table 7 below identifies the value/methodology used for the measures in this work paper.

Table 7 DEER14 EUL Value/Methodology

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| READi EUL ID | Market | Enduse | Measure | EUL (Years) | RUL (Years) |
| LED-sign | Non-Residential | Lighting | LED Open Signs | 16 | 5.3 |

# Section 2. Energy Savings & Demand Reduction Calculations

This work paper details the replacement of neon signs with LED open signs. The base case and measure case wattage values were obtained from the LED Open Sign Project [421]. The demand of 10 different LED and 10 neon signs were averaged in both the “on” and “off” states.

Unlike high voltage neon signs, LED open signs can be turned off while leaving the driver powered on, which results in slight energy consumption. Also, neon signs can internally disconnect power to part of the transformer, causing energy consumption in the off state. Some LED signs, like neon signs, disconnect power to the entire system, resulting in zero energy consumption.

The average demand for LED and neon signs in the “on” and “off” state are from the LED Open Signs Report [421] and are shown in Table 8. They are also shown in the Calculation Template [[[1]](#endnote-1)].

Table 8 Measured Average Demand Data

|  |  |  |  |
| --- | --- | --- | --- |
| **State** | **LED Wattage** | **Neon Wattage** | **Wattage Difference** |
| Off | 0.7 W | 0.0 W | -0.7 W |
| On | 14.9 W | 46.0 W | 31.1 W |

The ΔWatts is the difference in wattage from the base case to the measure case. The ΔWatts for the “on” state accounts for the higher demand scenario as shown below.

ΔWatts = *Base Case Wattage - Measure Wattage* = 46 – 14.9 = 31.1 Watts

The energy savings estimates are calculated as shown in Equation 1.

Equation 1



The annual energy savings are based on wattage difference per fixture, DEER annual hours, and interactive effects by building type.

The following is a sample energy savings calculation for the measure in an Agricultural building type in Climate Zone 6. The LED’s “Off” wattage is subtracted from the energy savings for the remainder of the time the OPEN Sign is not being operated.

Equation 2



The demand reduction is calculated as shown in Equation 3.

Equation 3



The following is a sample demand reduction calculation for the measure in an Agricultural building type in Climate Zone 6.

Equation 4



For a full list of savings, refer to the attachment [A]. There are no second baseline calculations because there is no applicable code that affects energy or demand savings calculations.

# Section 3. Load Shapes

The difference between the base case load shape and the measure load shape would be the most appropriate load shape; however, only end-use profiles are available. Therefore, the closest load shape chosen for this measure is the DEER:Indoor\_Non-CFL\_Ltg load shape. See Table 9 for a list of all Building Types and Load Shapes. See the KEMA report [31] for a more thorough discussion regarding the load shapes for this measure.

Table 9 Building Types and Load Shapes

|  |  |  |
| --- | --- | --- |
| Building Type | E3 Alt. Building Type | Load Shape |
| Agricultural | NON\_RES | DEER:Indoor\_Non-CFL\_Ltg |
| Assembly | NON\_RES | DEER:Indoor\_Non-CFL\_Ltg |
| Education - Primary School | NON\_RES | DEER:Indoor\_Non-CFL\_Ltg |
| Education - Secondary School | NON\_RES | DEER:Indoor\_Non-CFL\_Ltg |
| Education - Relocatable Classroom | NON\_RES | DEER:Indoor\_Non-CFL\_Ltg |
| Education - Community College | NON\_RES | DEER:Indoor\_Non-CFL\_Ltg |
| Education - University | NON\_RES | DEER:Indoor\_Non-CFL\_Ltg |
| Grocery | NON\_RES | DEER:Indoor\_Non-CFL\_Ltg |
| Food Store | NON\_RES | DEER:Indoor\_Non-CFL\_Ltg |
| Health/Medical - Hospital | NON\_RES | DEER:Indoor\_Non-CFL\_Ltg |
| Health/Medical - Nursing Home | NON\_RES | DEER:Indoor\_Non-CFL\_Ltg |
| Health/Medical - Clinic | NON\_RES | DEER:Indoor\_Non-CFL\_Ltg |
| Lodging - Hotel | NON\_RES | DEER:Indoor\_Non-CFL\_Ltg |
| Lodging - Guest Rooms | NON\_RES | DEER:Indoor\_Non-CFL\_Ltg |
| Lodging - Motel | NON\_RES | DEER:Indoor\_Non-CFL\_Ltg |
| Manufacturing - Bio/Tech | NON\_RES | DEER:Indoor\_Non-CFL\_Ltg |
| Manufacturing - Light Industrial | NON\_RES | DEER:Indoor\_Non-CFL\_Ltg |
| Industrial | NON\_RES | DEER:Indoor\_Non-CFL\_Ltg |
| Misc - Commercial | NON\_RES | DEER:Indoor\_Non-CFL\_Ltg |
| Office - Large | NON\_RES | DEER:Indoor\_Non-CFL\_Ltg |
| Office - Small | NON\_RES | DEER:Indoor\_Non-CFL\_Ltg |
| Restaurant - Fast-Food | NON\_RES | DEER:Indoor\_Non-CFL\_Ltg |
| Restaurant - Sit-Down | NON\_RES | DEER:Indoor\_Non-CFL\_Ltg |
| Retail - Multistory Large | NON\_RES | DEER:Indoor\_Non-CFL\_Ltg |
| Retail - Single-Story Large | NON\_RES | DEER:Indoor\_Non-CFL\_Ltg |
| Retail - Small | NON\_RES | DEER:Indoor\_Non-CFL\_Ltg |
| Storage - Conditioned | NON\_RES | DEER:Indoor\_Non-CFL\_Ltg |
| Storage - Unconditioned | NON\_RES | DEER:Indoor\_Non-CFL\_Ltg |
| Transportation - Communication - Utilities | NON\_RES | DEER:Indoor\_Non-CFL\_Ltg |
| Warehouse - Refrigerated | NON\_RES | DEER:Indoor\_Non-CFL\_Ltg |

# Section 4. Base Case & Measure Costs

## 4.1 Base Case Cost

**ROB**

The base case cost, shown in Table 10, is taken from the LED Open Sign project report [421].

Table 10 Base Case Cost

|  |  |
| --- | --- |
| Name | Base Case Cost |
| Neon Sign | $221.57 |

## 4.2 Measure Case Cost

The measure cost, shown in Table 11, is an estimated value based on the derivation in the LED OPEN Sign project [421].

Table 11 Measure Case Cost

|  |  |
| --- | --- |
| Name | Measure Case Cost |
| LED Sign | $191.68 |

## 4.3 Gross and Incremental Measure Cost

### 4.3.1 Gross Measure Cost

For ROB, GMC is represented by the equation below and shown in Table 12.

*GMC = Measure Equipment Cost – Base Case Equipment Cost*

Table 12 Gross Measure Cost

|  |  |  |  |
| --- | --- | --- | --- |
| Measure name | Base Cost | Measure Cost | GMC |
| LED OPEN Sign | $221.57 | $191.68 | -$29.89 |

The labor cost is assumed to be zero because a standard OPEN Sign can be installed by the user.

### 4.3.2 Incremental Measure Cost

The Incremental Measure Cost is the same as GMC as shown in Section 4.3.1.

# Attachments

1.

# References



[31]

[213]

[351]

[355]

[421]

# Appendix A – SCE/ED Application Types

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| SCE Program Type | ED Application Type | 1st Baseline Savings | 2nd Baseline Savings | 1st Baseline Cost | 2nd Baseline Cost | 1st Baseline Life | 2nd Baseline Life |
| New | New Construction (Nc) | Above Code/Standard | N/A | Incremental Cost | N/A | EUL | 0 |
| Replace on Burnout (ROB) | Replace on Burnout (Rob)/Normal Replacement (NR) | Above Code/Standard | N/A | Incremental Cost | N/A | EUL | 0 |
| Retrofit (RET) | Early Replacement (ER) | Above Cust. Existing | Above Code/Standard | Full Cost | Incremental Cost | RUL | EUL-RUL |
| Retrofit – First Baseline Only (REF) | Early Replacement RUL (ErRul) | Above Cust. Existing | N/A | Full Cost | N/A | EUL | 0 |
| Retrofit Add-on (REA) | N/A | Above Cust. Existing | N/A | Full Cost | N/A | EUL | 0 |

1. Attachment 1 – Calculation Template 2015 v3.xlsx [↑](#endnote-ref-1)