**Work Paper SCE13LG089**

**Revision 1**

**Southern California Edison Company**

**Interior Bi-Level Stairwell Lighting**

# At-a-Glance Summary

|  |  |
| --- | --- |
| ****Applicable Measure Codes:**** | *LT-48107, LT-69302* |
| **Measure Description:** | Bi-level or Dimming Stairwell Fixtures |
| **Base Case Description:** | Stairwell lights with no control |
| **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):** | EUL: 8yrs, RUL: 2.67yrs |
| **Measure Application Type:** | Retrofit (RET), Replace on Burnout (ROB) |
| **Net-to-Gross Ratios:** | NonRes downstream: 0.6, NonRes DI: 0.89, Res downstream: 0.55, Res DI: 0.85 |
| **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 |
| SCE13LG089.0 | No | 05/09/12 | Sara Richardson/EMCOR Energy Services | Revised to the 2013-2014 template. Updated base case, measure case costs and kW and kWh values. |
| SCE13LG089.1 | Yes | 4/17/14 | Yun Han/SCE | * New WP template * Work paper updated for reporting period, effective 7/1/2014-12/31/2014 * Code language update * Savings updated w/new 2nd baseline for code calculations * Added base cost * Added Mid-stream delivery method |

# Section 1. General Measure & Baseline Data

## 1.1 Measure Description & Background

This work paper details the replacement of a 4-foot T8 fixture (51W) with either a 4-foot 2-lamp T8 bi-level dimming fixture (62W/28W) or a 4-foot 2-lamp T8 and 2-foot 1-lamp T8 (67W/15W) bi-level on/off fixture. The new bi-level fixture will be controlled by an occupancy sensor which will dim the fixture or shut off the 4-foot lamps while the 2-foot emergency lamp stays lit.

Table 1 documents the applicable solution codes for this work paper.

Table 1 Measure Names

|  |  |
| --- | --- |
| Solution Code | Measure name |
| LT-48107 | Bi-Level On/Off Controls replacing (2) 48in T8 Linear Fluorescent |
| LT-69302 | Bi-Level Dimming Controls replacing (2) 48in T8 Linear Fluorescent |

The energy savings only applies to base case fixtures that are not equipped with automatic controls such as occupancy sensors, timers or photocells. The fixtures must be located in an interior stairwell. Table 2 lists the building types where this measure applies.

Table 2 Applicable Building Types for Implementation

|  |
| --- |
| Building Type |
| Assembly |
| Education - Primary School |
| Education - Secondary School |
| Education - Community College |
| Education - University |
| Health/Medical - Hospital |
| Health/Medical - Nursing Home |
| Health/Medical - Clinic |
| Lodging - Hotel |
| Lodging - Motel |
| Manufacturing - Bio/Tech |
| Manufacturing - Light Industrial |
| Industrial |
| Misc - Commercial |
| Office - Large |
| Office – Small |
| Retail - Multistory Large |
| Storage - Conditioned |
| Storage - Unconditioned |
| Transportation – Communication – Utilities |
| Warehouse - Refrigerated |
| Residential - Multi-Family |

This measure is approved for installation in all SCE climate zones. The customer may be required to present an invoice documenting installation of the measure case equipment

## 1.2 Technical Description

The measure case includes two types of bi-level fixtures.

1. A dimming fixture with two 4-foot T8 lamps with an electronic dimming ballast which at full level output consumes 62 Watts (0.062 kW) [410] per fixture and at low level output consumes 28 Watts (0.028 kW) [410] per fixture. The low level output wattage is based on a survey of market-available bi-level fixtures.
2. An on/off fixture which includes two 4-foot T8 lamps and one low wattage 2-foot T8 lamp equipped with electronic ballast. At full level output all three lamps are on and the fixture consumes 67 Watts (0.067 kW) [[[1]](#endnote-1)] per fixture and at low level output the 2-foot lamp is on and the fixture consumes 15 Watts (0.015 kW) [A] per fixture. The 2-foot lamp is always on.

Neither of the above measure cases is recommended for Refrigerated Warehouse applications because fluorescent relative light output drops about 2/3 at 32°F vs its 77°F rated temperature.

The base case includes a single type of fixture.

1. A fixture equipped with two 4-foot 30 W T8 lamps equipped with a premium instant start electronic ballast (F42WLL) consuming 51 Watts (0.051 kW) [382] per fixture.

## 1.3 Measure Application Type

The delivery methods that are available for these measures are:

* Financial Support / Down-Stream Incentive – Deemed
* Financial Support – Direct Install
* Midstream Programs – Mid-Stream Incentive

The program/install type for Down-Stream and Direct Install is:

* Retrofit (RET)

The program/install type for Mid-Stream Incentive is:

* Replace on Burnout (ROB)

## 1.4 Measure and Base Case Cost Effectiveness Data

### 1.4.1 DEER Measure and Base Case Analysis

Table 3 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 4 below.

Table 4 Net-to-Gross Ratio

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| NTGR\_ID\* | Description\* | Sector\* | BldgType\* | ProgDelivID | NTG\* |
| NonRes-sAll-mLtgCtrl-htr | Lighting controls | Com | Any | DirInstall | 0.89 |
| 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 |
| Res-Default>2 | All other EEM with no evaluated NTGR; existing EEM with same delivery mechanism for more than 2 years | Res | Any | All | 0.55 |
| Res-Default-HTR-di | All other EEM with no evaluated NTGR; direct install hard-to-reach only. | Res | 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/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 5 below.

Table 5 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 6 READi Tech IDs

|  |  |
| --- | --- |
| READi Field Name | Values included in this workpaper |
| Measue Case UseCategory | Lighting |
| Measure Case UseSubCats | Indoor Lighting |
| Measure Case TechGroups | Lighting – Hard-wired fixtures |
| Measure Case TechTypes | Linear Fluorescent Fixture |
| Base Case TechGroups | Lighting – Hard-wired fixtures |
| Base Case TechTypes | Linear Fluorescent Fixture |

### 1.4.2 Codes and Standards Analysis

Title 24 2013 [355] Section 130.1(c)6 & 7 states:

**Areas where partial ON/OFF occupant sensing controls are required** in addition to complying with Section 130.1(c)1.

1. Lighting installed in corridors and stairwells shall be controlled by occupant sensing controls that separately reduce the lighting power in each space by at least 50 percent when the space is unoccupied. The occupant sensing controls shall be capable of automatically turning the lighting fully ON only in the separately controlled space, and shall be automatically activated from all designed paths of egress.

**Areas where partial ON/OFF occupant sensing controls are required** instead of complying with Section

130.1(c)1.

1. Lighting in stairwells and common area corridors which provide access to guestrooms and dwelling units of high-rise residential buildings and hotel/motels shall be controlled with occupant sensing controls that automatically reduce lighting power by at least 50 percent when the areas are unoccupied. The occupant sensing controls shall be capable of automatically turning the lighting fully ON only in the separately controlled space, and shall be automatically activated from all designed paths of egress.

**EXCEPTION to Section 130.1(c)7A:** In corridors and stairwells in which the installed lighting power is 80 percent or less of the value allowed under the Area Category Method, occupant sensing controls shall reduce power by at least 40 percent.

Table 7 Code Summary

|  |  |  |
| --- | --- | --- |
| Code | Applicable Code Reference | Effective Dates |
| Title 24 (2013) | 2013 Non-Residential Compliance manual, Section 130.1(c)6 & 7 | July 1, 2014 |

### All building types covered in this work paper will have dual baselines as the code baseline will require 50% dimming when the space is unoccupied.

### 1.4.3 Non-DEER Study Review

Bi-level Stairwell Fixture Performance report was used as a basis for the occupancy rates in this work paper [410].

### 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 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 8 below identifies the value/methodology used for the measures in this work paper.

EUL for Occupancy Sensors was used for the measures in this work paper. Linear Fluorescent EUL recommends 70,000 hours divided by the 8,760 operating hours which is also 8 years. The RUL is of a Linear Fluorescent Fixture with EUL of 16 years divided by 3.

Table 8 DEER14 EUL Value/Methodology

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| READi EUL ID | Market | Enduse | Measure | EUL (Years) | RUL (Years) |
| ILtg-OccSens | Non-Residential | Lighting | Occupancy Sensors | 8 | 5.3 |

# Section 2. Energy Savings & Demand Reduction Calculations

The measure assumes that an existing fixture equipped with two 4-foot 30 W T8 lamps and a premium instant start electronic ballast consuming 51 Watts [382] per fixture will be replaced.

For the T8 bi-level dimming fixture measure, the fixture consists of two 4-foot T8 lamps with an electronic dimming ballast which at full level output consumes 62 Watts per fixture and at low level output consumes 28 Watts per fixture [410].

For the T8 bi-level on/off measure, the fixture consists of two 4-foot T8 lamps and one low wattage 2-foot T8 lamp equipped with electronic ballast. At full level output all three lamps are on and the fixture consumes 67 Watts per fixture. At low level output the 2-foot lamp is on and the fixture consumes 15 Watts per fixture [A]. This measure is named on/off because the 2-foot linear fluorescent lamp constantly stays on while the two 4’ T8 lamps turn on and off when the space is occupied.

**Occupancy Rates:**

Based on a the Final Report of Bi-level Stairwell Fixture Performance from the CEC Lighting Research Project [410], the percentage of time in the low output mode ranged from 62% to 82% on weekdays and 85% to 97% on weekends. When the fixture is in low output mode the space is assumed to be unoccupied. From a weighted average calculation using the conservative time saving estimates, the average weekly unoccupied and occupied rates are as follows:

**Interactive Effects:**

Fixtures are assumed to be in an unconditioned space so interactive effects are assumed to be not applicable. These measures have been applied to all building types that are likely to have unconditioned stairwells.

**Peak Demand Reduction (1st Baseline):**

The following calculations are an example of the T8 bi-level dimming fixture measure replacing a T8 fixture. The calculations for both measures in applicable building types can be found in the attachments section [[[2]](#endnote-2)].

∆Watts/unit:

The demand difference (watts per unit) between the electric demand of the base unit and the electric demand of the energy efficient unit is as follows:

Note: The Energy Efficient Unit Watts are calculated by a time-weighted average using the occupancy rates as follows:

Therefore,

**Peak Demand Reduction (2nd Baseline):**

The 2nd baseline uses the code baseline that would dim the lighting to 50%. Utilizing the same measure that draws 62W, the unoccupied W dimmed results in 31W.

**Energy Savings (1st Baseline):**

**Energy Savings (2nd Baseline):**

The calculations for energy savings and demand reduction can be found in the attachment [[[3]](#endnote-3)]. The list of savings for all climate zones in applicable building types can be found in the attachment [B].

# 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 Occupancy Sensor 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 |
| Assembly | Misc.\_Commercial | Occupancy Sensor |
| Education - Primary School | K\_thru\_12\_School | Occupancy Sensor |
| Education - Secondary School | K\_thru\_12\_School | Occupancy Sensor |
| Education - Community College | K\_thru\_12\_School | Occupancy Sensor |
| Education - University | K\_thru\_12\_School | Occupancy Sensor |
| Health/Medical - Hospital | Misc.\_Commercial | Occupancy Sensor |
| Health/Medical - Nursing Home | Misc.\_Commercial | Occupancy Sensor |
| Health/Medical - Clinic | Small\_Office | Occupancy Sensor |
| Lodging - Hotel | Hotel\_Motel | Occupancy Sensor |
| Lodging - Motel | Hotel\_Motel | Occupancy Sensor |
| Manufacturing - Bio/Tech | Industrial | Occupancy Sensor |
| Manufacturing - Light Industrial | Industrial | Occupancy Sensor |
| Industrial | Industrial | Occupancy Sensor |
| Misc - Commercial | Misc.\_Commercial | Occupancy Sensor |
| Office - Large | Large\_Office | Occupancy Sensor |
| Office - Small | Small\_Office | Occupancy Sensor |
| Retail - Multistory Large | Large\_Retail\_Store | Occupancy Sensor |
| Storage - Conditioned | Misc.\_Commercial | Occupancy Sensor |
| Storage - Unconditioned | Misc.\_Commercial | Occupancy Sensor |
| Transportation - Communication - Utilities | Trans\_Comm\_Util | Occupancy Sensor |
| Warehouse - Refrigerated | Misc.\_Commercial | Occupancy Sensor |
| Residential Multi-family | Misc.\_Commercial | Occupancy Sensor |

# Section 4. Base Case & Measure Costs

## 4.1 Base Case Cost

For Retrofit install type, the Base Case Cost is 0 since this is a discretionary choice by the consumer to replace their existing measure before the end of its useful life.

For Replace on Burnout install type, the Measure Case Cost of the bi-level stairwell lighting is shown in Table 10. Once the existing stairwell lighting burns out, the customer would have had to follow code and install a bi-level stairwell lighting. The same cost is used since the only difference would be the dimming level which would not have much effect on cost.

Table 10 Base Case Cost

|  |  |  |  |
| --- | --- | --- | --- |
| Measure Name | Base Equipment Cost | Labor Cost | Total Cost |
| Bi-Level On/Off Controls replacing (2) 48in T8 Linear Fluorescent | $211.90 | $50.50 | $262.40 |
| Bi-Level Dimming Controls replacing (2) 48in T8 Linear Fluorescent | $285.00 | $50.50 | $335.50 |

## 4.2 Measure Case Cost

The measure case costs are shown in Table 11. The measure and labor are from manufacturer’s websites and RS Means as referenced in the table.

Table 11 Measure Case Cost

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Measure Description** | **Reference Resource** | **Measure Case Material Cost** | **Measure Case Labor Cost** | **Measure Case Cost** |
| T8 Bi-level Dimming | Manufacturer Website [[[4]](#endnote-4)] | $285.00 | - | - |
| RS Means 2011, Sec 26 61 13.50 Reference 2310 (Installation of 4’ 2L T8 Fixture) | - | $50.50 | - |
| **Totals** | **$285.00** | **$50.50** | **$335.50** |
| T8 Bi-level on/off | RS Means 2011, Sec 26 61 23.10 Reference 0176 (For one 2’ Lamp) | $5.00 | - | - |
| RS Means 2011, Sec 26 61 23.10 Reference 0180 (For two 4’ Lamps) | $6.40 | - | - |
| RS Means 2011, Sec 26 51 13.50 Reference 7520 (Ballast only) | $25.50 | - | - |
| RS Means 2011, Sec 26 61 13.50 Reference 2310 (Installation of 4’ 2L T8 Fixture) | - | $50.50 | - |
| Manufacturer [[[5]](#endnote-5)] Bi-level fixture only (not including lamps, ballast or installation) | $175.00 | - | - |
| **Totals** | **$211.90** | **$50.50** | **$262.40** |

## 4.3 Gross and Incremental Measure Cost

### 4.3.1 Gross Measure Cost

For Retrofit install type, GMC is represented by the equation below and shown in Table 12:

*GMC = Measure Equipment Cost + Measure Labor Cost*

Table 12 RET Gross Measure Cost

|  |  |  |  |
| --- | --- | --- | --- |
| Measure Name | Measure Equipment Cost | Labor Cost | Total Cost |
| Bi-Level On/Off Controls replacing (2) 48in T8 Linear Fluorescent | $211.90 | $50.50 | $262.40 |
| Bi-Level Dimming Controls replacing (2) 48in T8 Linear Fluorescent | $285.00 | $50.50 | $335.50 |

For Replace on Burnout install type, GMC is represented by the equation below and shown in Table 13:

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

Table 13 ROB Gross Measure Cost

|  |  |  |  |
| --- | --- | --- | --- |
| Measure Name | Measure Equipment Cost | Base Cost | Total Cost |
| Bi-Level On/Off Controls replacing (2) 48in T8 Linear Fluorescent | $211.90 | $211.90 | $0 |
| Bi-Level Dimming Controls replacing (2) 48in T8 Linear Fluorescent | $285.00 | $285.00 | $0 |

### 4.3.2 Incremental Measure Cost

The Incremental Measure Cost (IMC) is the premium cost to install an energy efficient measure over a standard efficiency measure or code baseline measure, represented by the equation below:

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

The IMC is the same as ROB GMC as shown in Table 13.

# Attachments

1. 2.  3. 4. 

# References



[31]

[213]

[351]

[355]

[382]

[410]

# 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 2 - RWS Cutsheet R1precision.pdf [↑](#endnote-ref-1)
2. Attachment 1 - Calculation Template 2015 v3.xlsm [↑](#endnote-ref-2)
3. Attachment 3 – 15LG089 Calculations.xlsx [↑](#endnote-ref-3)
4. Lamar 2012. VO Series Custom Luminaires, Voyager, “Lamar VO232E8U” Lamar Lighting Co, 2008. For measure case, accessed at (measure case): <http://www.goodmart.com/products/lamar-lighting-voyager-32w-2-lamp-occu-smart-bi-level-light-fixture-vo232e8upaas.htm> [↑](#endnote-ref-4)
5. Attachment 4 - Precision RWS Stairwell Fixture.pdf [↑](#endnote-ref-5)