Work Paper SCE13LG090

**Revision 2**

**Southern California Edison**

**Interior Induction Lighting**

**For Work Paper Reviewer Use Only**

**List all major comments that occurred during the review. This table may only be removed during management review.**

|  |  |  |  |
| --- | --- | --- | --- |
| **Major Comment** | **Reviewer Name** | **Date** | **Outcome/Resolution** |
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|  |  |  |  |

# At-a-Glance Summary

|  |  |
| --- | --- |
| **Measure Codes** | LT-51211, LT-26734, LT-80108, LT-34098, LT-69009 |
| **Measure Description** | Interior Induction Fixture |
| **Base Case Description** | Incandescent, mercury vapor, metal halide, high pressure sodium, pulse start metal halide |
| **Units** | Per fixture |
| **Energy Savings** | Refer to Excel Calculation Attachment |
| **Full Measure Cost ($/unit)** | Refer to Excel Calculation Attachment |
| **Incremental Measure Cost ($/unit)** | Refer to Excel Calculation Attachment |
| **Effective Useful Life** | Refer to Excel Calculation Attachment |
| **Measure Installation Type** | Replace on Burnout (ROB) |
| **Net-to-Gross Ratio** | 0.6 (DEER NTGR ID: Com-Default>2yrs, Ind-Default>2yrs, Ag-Default>2yrs) |
| **Important Comments** | This work paper has a complementary Ex Ante Database data set that will be provided in a separate submission to the California Public Utilities Commission (CPUC). |

# Revision History

|  |  |  |  |
| --- | --- | --- | --- |
| **Rev** | **Date** | **Author** | **Summary of Changes** |
| 0 | 04/02/12 | James Gowen/Matrix | Updated work paper to new template |
| 1 | 07/24/14 | David Pruitt/PL Energy | -New template for 2015 program year.  - Used measure Wattages from the ED lighting disposition table dated 30 May, 2014. |
| Jack Melnyk/SCE | -Updated Calc Templ to v4 2015  -Removed RET install type  -Modified some measure and base wattages from the ED disposition  -Work paper updated for reporting period, effective 7/1/2014-12/31/2014 |
| 2 | 08/20/15 | Yun Han/SCE | -New template for 2016 program year  -All savings from READI 2.3.0  -Removed DEER2008 base & labor costs, replaced w/WO17 |

# Commission Staff and Cal TF Comments

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Rev** | **Party** | **Submittal Date** | **Comment Date** | **Comments** | **WP Developer Response** |
| 2 | CS |  |  |  |  |

Cal TF website: <http://www.caltf.org/>

# Section 1. General Measure & Baseline Data

## 1.1 Measure Description & Background

This work paper documents the E3 Calculator input values for replacing an existing interior lighting fixture with a more efficient induction lighting fixture. Measures and Codes table below shows the 5 measure classifications that the existing base case wattage can fall into.

**Base, Standard, and Measure Cases**

|  |  |
| --- | --- |
| **Case** | **Description of Typical Scenario** |
| Measure | Interior Induction Fixture |
| Existing Condition | Metal Halide Fixture |
| Code/Standard | N/A |
| Industry Standard Practice | Pulse Start Metal Halide Fixture |

Measures and Codes

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Measure Codes** | | | | **Measure Name** |
| SCG | SDG&E | SCE | PG&E |
|  |  | LT-51211 |  | Up to 70 Watt Interior Fixture Induction replacing less than or equal to 100 Watt lamp base case |
|  |  | LT-26734 |  | Up to 120 Watt Interior Fixture Induction replacing 101 - 175 Watt lamp base case |
|  |  | LT-80108 |  | Up to 180 Watt Interior Fixture Induction replacing 176 - 399 Watt lamp base case |
|  |  | LT-34098 |  | Up to 250 Watt (Tier 1) Interior Fixture Induction replacing 400 Watt lamp base case |
|  |  | LT-69009 |  | Up to 360 Watt (Tier 2) Interior Fixture Induction replacing 400 Watt lamp base case |

The existing interior lights being replaced must be incandescent, mercury vapor, standard metal halide, or high pressure sodium. In all cases, the replacement induction fixture must be lower wattage than the existing base case and all base cases and measure cases must fall into the wattage classifications shown in Measures and Codes table.

## 1.2 Technical Description

This work paper details the replacement of existing incandescent, mercury vapor, standard metal halide, or high pressure sodium interior lighting fixtures with more efficient linear induction fixtures.

## 1.3 Installation Types and Delivery Mechanisms

**Installation Type Descriptions**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Installation Type** | **Savings** | | **Life** | |
| 1st Baseline (BL) | 2nd BL | 1st BL | 2nd BL |
| Replace on Burnout (ROB) | Above Code or Standard | N/A | EUL | N/A |

A delivery mechanism is a delivery method paired with an incentive method. Delivery mechanisms are used by programs to obtain program participation and energy savings.

**Delivery Method Descriptions**

|  |  |
| --- | --- |
| **Delivery Method** | **Description** |
| Financial Support | The program motivates customers, through financial incentives such as rebates or low interest loans, to implement energy efficient measures or projects. |

**Incentive Method Descriptions**

|  |  |
| --- | --- |
| **Incentive Method** | **Description** |
| Down-Stream Incentive | The customer installs qualifying energy efficient equipment and submits an incentive application to the utility program. Upon application approval, the utility program pays an incentive to the customer. Such an incentive may be deemed or customized. |
| Mid-Stream Incentive | The program gives a financial incentive to a midstream market actor, such as a retailer or contractor, to encourage the promotion of efficient measures. The incentive may or may not be passed on to the end-use customer. |

## 1.4 Measure Parameters

### 1.4.1 DEER Data

DEER Difference Summary

|  |  |
| --- | --- |
| **DEER Item** | **Used for Workpaper?** |
| Modified DEER methodology | No |
| Scaled DEER measure | No |
| DEER Base Case | Yes |
| DEER Measure Case | Yes |
| DEER Building Types | Yes |
| DEER Operating Hours | Yes |
| DEER eQUEST Prototypes | No |
| DEER Version | DEER 2016, READI 2.3.0 |
| Reason for Deviation from DEER | N/A |
| DEER Measure IDs Used | C-In-Ind(110w)-dwP80-dwC75 |

**Net-to-Gross Ratio**

The NTG values were obtained using the DEER READI tool. The relevant NTG values for the measures in this work paper are in the table below.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **NTGR ID** | **Description** | **Sector** | **BldgType** | **Measure Delivery** | **NTGR** |
| 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 | All | 0.6 |
| 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 | All | 0.6 |
| 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 | All | 0.6 |

**Spillage Rate**

Spillage rates are not tracked in work papers; they are tracked in an external document which will be supplied to the Commission Staff.

**Installation Rate**

The IR values were obtained using the DEER READI tool. The relevant IR values for the measures in this work paper are in the table below.

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

**Effective and Remaining Useful Life**

The EUL and RUL values were obtained using the DEER READI tool. DEER defines the RUL as 1/3 of the EUL value. The RUL value is only applicable to the first baseline period for an RET measure with an applicable code baseline. The relevant EUL and RUL values for the measures in this work paper are in the table below.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **EUL ID** | **Description** | **Sector** | **UseCategory** | **EUL (Years)** | **RUL (Years)** |
| ILtg-Lfluor-Elec | Linear Fluorescent with Electronic Ballast | Com | Lighting | 70000/building operating hours, 15 max years | ILtg-MH: EUL/3 |

### 1.4.2 Codes and Standards Analysis

Title 24 2013 [355] Section 141.0(b)2 contains codes related to Nonresidential lighting as shown below. The measures in this work paper do replace luminaires which triggers Lighting System Alterations. Triggering Alteration requires mandatory control provisions in Section 130.1(a)(b)(c)(d) for each enclosed space that includes Area, Shut-off, Multi-level, and if applicable, Daylighting Controls.

**Lighting System Alterations** shall meet the applicable requirements in TABLE 141.0-E and the following:

1. Lighting System Alterations include alterations where an existing lighting system is modified, luminaires are replaced, or luminaires are disconnected from the circuit, removed and reinstalled, whether in the same location or installed elsewhere.

**EXCEPTION 1 to Section 141.0(b)2Iii:** Alterations that qualify as a Luminaire Modification-in-

Place.

**EXCEPTION 2 to Section 141.0(b)2Iii:** Portable luminaires, luminaires affixed to moveable partitions, and lighting excluded in accordance to Section 140.6(a)3.

**Luminaire Modifications-in-Place** shall meet the applicable requirements in TABLE 141.0-F and the following:

1. To qualify as a Luminaire Modification-in-Place, luminaires shall only be modified by one or more of the following methods:
   1. Replacing lamps and ballasts with like type or quantity in a manner that preserves the original luminaire listing.
   2. Changing the number or type of light source in a luminaire including: socket renewal, removal or relocation of sockets or lampholders, and/or related wiring internal to the luminaire including the addition of safety disconnecting devices.
   3. Changing the optical system of a luminaire in part or in whole.
   4. Replacement of whole luminaires one for one in which the only electrical modification involves disconnecting the existing luminaire and reconnecting the replacement luminaire.
2. Luminaire Modifications-In-Place shall include only alterations to lighting system meeting the following conditions:
   1. Luminaire Modifications-in-Place shall not be part of or the result of any general remodeling or renovation of the enclosed space in which they are located.
   2. Luminaire Modifications-in-Place shall not cause, be the result of, or involve any changes to the panelboard or branch circuit wiring, including line voltage switches, relays, contactors, dimmers and other control devices, providing power to the lighting system.

**EXCEPTION to Section 141.0(b)2Iiii2.** Circuit modifications strictly limited to the addition of occupancy or vacancy sensors and class two lighting controls are permitted for Luminaire

Modifications-in-Place

Title 20 [422] Appliance Efficiency Regulations include an Energy Efficiency Standard for Metal Halide Luminaires. Probe-start ballasts metal halide luminaires rated at least partially within the range of 150 to 500 watts are not eligible. Additionally, metal halide luminaires that are not probe-start ballasts must comply with Section 1605.3(n)(1)(A) and 1605.3(n)(2)(B) as applicable.

Code Summary

|  |  |  |
| --- | --- | --- |
| **Code** | **Reference** | **Effective Dates** |
| Title 24 (2013) | Section 141.0(b)2 Lighting System Alterations | July 1, 2014 |
| Title 20 (2014) | Section 1605.3(n)1 | May 1, 2014 |

## 1.5 EM&V, Market Potential, and Other Studies – Base Case and Measure Case Information

No non-DEER studies or data were reviewed for this workpaper.

## 1.6 Data Quality and Future Data Needs

No future data needs.

# Section 2. Calculation Methodology

To document savings for this work paper, measure case and base cases were selected that represent an appropriate replacement and most are near the upper bound of the acceptable replacement wattage to be conservative in the saving estimates as these measures will represent a large majority of similar replacements.

For each of the measure classifications, a typical Metal Halide lamp and fixture were selected in the appropriate ranges used in the energy savings estimates. The lamps were chosen in the middle to lower section of the range to be conservative. The fixture wattage is taken from Appendix B of the 2013 SPC Program Manual [431]. The base cases and code cases used in the calculations are shown in Table 8 below.

The following 2 tables show the measure and base case wattages used to calculate the savings.

Measure Wattage Used

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Measure Code** | **Measure Name** | **Measure Case Selection** | **Lamp Wattage** | **Fixture Wattage** |
| LT-51211 | Up to 70 Watt Interior Fixture Induction replacing less than or equal to 100 Watt lamp base case | 70W Induction Lamp | 40 | 44\* |
| LT-26734 | Up to 120 Watt Interior Fixture Induction replacing 101 - 175 Watt lamp base case | 120W High Bay Induction Fixture | 100 | 110\* |
| LT-80108 | Up to 180 Watt Interior Fixture Induction replacing 176 - 399 Watt lamp base case | 180W High Bay Induction Fixture | 150 | 165\* |
| LT-34098 | Up to 250 Watt (Tier 1) Interior Fixture Induction replacing 400 Watt lamp base case | 250W High Bay Induction Fixture | 200 | 220\* |
| LT-69009 | Up to 360 Watt (Tier 2) Interior Fixture Induction replacing 400 Watt lamp base case | 360W High Bay Induction Fixture | 300 | 330\* |

\*Industry study shows the connected load of the induction fixtures are 10% above the nominal lamp wattage.

Base Wattage Used

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Measure Code** | **Base Case** | **Base Case Fixture Code** | **Base Case Fixture Wattage** | **Code Case** | **Code Case Fixture Code** | **Code Case Fixture Wattage** |
| LT-51211 | Metal Halide, (1) 100W lamp | MH100/1 | 128 | N/A | N/A | 128 |
| LT-26734 | Metal Halide, (1) 150W lamp | MH150/1 | 190 | N/A | N/A | 185 |
| LT-80108 | Metal Halide, (1) 250W lamp | MH250/1 | 295 | Pulse Start, (1) 200W lamp | PSMH-200W | 232 |
| LT-34098 | Metal Halide, (1) 400W lamp | MH400/1 | 458 | Pulse Start, (1) 350W lamp | PSMH-350W | 400 |
| LT-69009 | Metal Halide, (1) 400W lamp | MH400/1 | 458 | Pulse Start, (1) 400W lamp | PSMH-400W | 456 |

The following table indicates which measures are taken directly from or created with the DEER READI tool. The READI data export can be found in the Attachments section [attachment 2].

READI Data Used

|  |  |  |
| --- | --- | --- |
| **Measure Code** | **Measure Name** | **READI Data** |
| LT-51211 | Up to 70 Watt Interior Fixture Induction replacing less than or equal to 100 Watt lamp base case | C-In-Ind(44w)-dwP84 |
| LT-26734 | Up to 120 Watt Interior Fixture Induction replacing 101 - 175 Watt lamp base case | C-In-Ind(110w)-dwP80-dwC75 |
| LT-80108 | Up to 180 Watt Interior Fixture Induction replacing 176 - 399 Watt lamp base case | C-In-Ind(165w)-dwP130-dwC67 |
| LT-34098 | Up to 250 Watt (Tier 1) Interior Fixture Induction replacing 400 Watt lamp base case | C-In-Ind(220w)-dwP238-dwC180 |
| LT-69009 | Up to 360 Watt (Tier 2) Interior Fixture Induction replacing 400 Watt lamp base case | C-In-Ind(330w)-dwP128-dwC126 |

Savings for all building types and climate zones can be found in the Attachments section [attachment 1].

# Section 3. Load Shapes

The ideal load shape for net benefits estimates would represent the difference between the base case and measure case. The closest load shapes that are applicable to the measures in this work paper are listed in the table below.

Building Types and Load Shapes

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

# Section 4. Costs

## 4.1 Base Case Cost

Base case costs are calculated using the Work Order 17 methodology [attachment 3].

**Base Case Costs**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Measure** | **Installation Type** | **Base Equipment Cost** | **Base Labor Cost** | **Total Base Cost** |
| LT-51211 | ROB | $209.67 | $187.14 | $396.82 |
| LT-26734 | ROB | $214.56 | $187.14 | $401.71 |
| LT-80108 | ROB | $223.17 | $187.14 | $410.31 |
| LT-34098 | ROB | $280.25 | $187.14 | $467.39 |
| LT-69009 | ROB | $280.25 | $187.14 | $467.39 |

## 4.2 Measure Case Cost

Measure case costs are taken from multiple online retailers and averaged [attachment 3].

**Measure Case Costs**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Measure** | **Installation Type** | **Measure Equipment Cost** | **Measure Labor Cost** | **Total Measure Cost** |
| LT-51211 | ROB | $313.44 | $187.14 | $500.58 |
| LT-26734 | ROB | $327.92 | $187.14 | $515.06 |
| LT-80108 | ROB | $545.06 | $187.14 | $732.20 |
| LT-34098 | ROB | $498.96 | $187.14 | $686.10 |
| LT-69009 | ROB | $632.30 | $187.14 | $819.44 |

## 4.3 Full and Incremental Measure Cost

**Full and Incremental Measure Cost Equations**

|  |  |  |  |
| --- | --- | --- | --- |
| **Installation Type** | **Incremental Measure Cost** | **Full Measure Cost** | |
| **1st Baseline** | **2nd Baseline** |
| ROB | (MEC + MLC) – (BEC + BLC) | (MEC + MLC) – (BEC + BLC) | N/A |

MEC = Measure Equipment Cost; MLC = Measure Labor Cost

BEC = Base Case Equipment Cost; BLC = Base Case Labor Cost

**Full and Incremental Costs**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Measure** | **Installation Type** | **Incremental Measure Cost** | **Full Measure Cost** | |
| **1st Baseline** | **2nd Baseline** |
| LT-51211 | ROB | $103.76 | $103.76 | N/A |
| LT-26734 | ROB | $113.36 | $113.36 | N/A |
| LT-80108 | ROB | $321.89 | $321.89 | N/A |
| LT-34098 | ROB | $218.71 | $218.71 | N/A |
| LT-69009 | ROB | $352.05 | $352.05 | N/A |

# Attachments

1. 2. 3.

# References



[355]

[422]

[431]