Work Paper SCE13RN005

**Revision 2**

**Southern California Edison**

**Night Covers for Open**

**Vertical and Horizontal**

**Display Cases (Low and**

**Medium Temperature Cases)**

# At-a-Glance Summary

|  |  |
| --- | --- |
| **Measure Codes** | RF-45862  RF-96857  RF-25748 |
| **Measure Description** | Installation of night covers on existing low temperature open vertical (or multi-deck) and horizontal (or coffin type) cases, as well as medium temperature open vertical display cases |
| **Base Case Description** | Low temperature open vertical (or multi-deck) and horizontal (or coffin type) cases, as well as medium temperature open vertical display cases with no night cover |
| **Units** | per (linear) ft. |
| **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** | Source: DEER 2014-EUL-table-update-2014-02-05  5 years |
| **Measure Installation Type** | Retrofit Add-on |
| **Net-to-Gross Ratio** | Source: DEER2011\_NTGR\_2012-05-16.xls  0.6 or 0.85 |
| **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).  Major changes for Revision 1 include: updated the work paper based on DEER 2014 code update, updated eQuest prototype from MASControl version 3.00.20. Also, updated the eQuest model weather files per DEER2014 CZ2010 weather data files and used READi tool version 2.0.1 for 2013-2014 cycle. |

# Revision History

|  |  |  |  |
| --- | --- | --- | --- |
| **Rev** | **Date** | **Author** | **Summary of Changes** |
| 0 | 05/04/2012 | Yin Yin Wu/BASE Energy, Inc.  Christopher Fernandez /BASE Energy, Inc. | This is the original work paper for the bridge cycle 2013-2014 |
| 1 | 6/23/2014 | Yin Yin Wu/BASE Energy, Inc. | -Updated the work paper based on DEER 2014 code update  -Used the updated eQuest prototype from MASControl version 3.00.20  -Updated the eQuest model weather files per DEER2014 CZ2010 weather data files  -Used READi tool version 2.0.1 for 2013-2014 cycle  - Work paper updated for reporting period, effective 07/01/14-12/31/14 |
| 2 | 02/05/16 | Eduardo Munoz/SCE | -New template update for 2016 program year  -WP effective from 1/1/2016 thru 12/31/2016  -Removed SCE building types  -No value modifications |

# Commission Staff and Cal TF Comments

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

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

# Section 1. General Measure & Baseline Data

## Measure Description & Background

This work paper discusses the retrofit add-on installation of night covers on existing low temperature open vertical (or multi-deck) and horizontal (or coffin type) display cases, as well as medium temperature open vertical display cases. The base case for this measure is for display cases that do not use night covers. The tables below summarize the measures evaluated for this work paper.

**Base, Standard, and Measure Cases**

|  |  |
| --- | --- |
| **Case** | **Description of Typical Scenario** |
| Measure | Installation of night covers on existing low temperature open vertical and horizontal display cases and medium temperature open vertical display cases |
| Existing Condition | Display cases that do not use night covers |
| Code/Standard | N/A |
| Industry Standard Practice | N/A |

Measures and Codes

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Measure Codes** | | | | **Measure Name** |
| SCG | SDG&E | SCE | PG&E |
|  |  | RF-45862 |  | Low Temperature Open Horizontal Night Cover |
|  |  | RF-96857 |  | Low Temperature Open Vertical Night Cover |
|  |  | RF-25748 |  | Medium Temperature Open Vertical Night Cover |

This measure applies to non-residential buildings that utilize a low temperature open vertical (or multi-deck) and horizontal (or coffin type), and medium temperature open vertical display case for food products. The space where display cases are located should have space cooling and heating. The night covers should be applied for a minimum of six hours per day. This measure should be implemented with a film type cover with small perforated holes to decrease moister build-up.

The rebates for these measures are a part of the Express program. To qualify for the incentive, the following requirements must be met:

* The night cover must be installed on an otherwise open display case to decrease cooling load of the refrigerated case during off hours.
* The display case temperature set point is between 4 and 24 degrees Fahrenheit for low-temp cases, and between 24 and 38 degrees Fahrenheit for medium-temp cases.
* The linear footage of the installed night cover must be properly measured as the incentive is based on the linear footage of the installed night cover.
* The night cover must be applied for an average period of at least 6 hours per day.
* The display cases which have the installed night covers must have the following:
  + Compressor capacity modulation mechanisms (such as variable-speed drive (VSD) or cylinder unloader).
  + Evaporator pressure regulators (EPR) set to higher suction temperatures when night covers are applied.
  + Resized TXVs set with higher suction pressures when covers are applied.
  + Applications must include information regarding modifications to or proof of existing refrigeration capacity modulation controls.
* The night covers must be installed by an authorized product representative where the installer can verify that the night covers are compatible with the display cases so that they do not degrade system performance.

**Pacific Gas and Electric requirements:**

* Installation address must have a commercial electric account with PG&E.
* Must install a cover on an existing open refrigerated display case to decrease cooling load of the refrigerated case during off hours.
* Case manufacturer must not object to the use of night covers.
* Rebate is based on linear footage of the installed night cover.
* Customer should consider using proper compressor capacity modulation mechanisms [such as Variable Speed Drive (VSD) or cylinder un-loader], Evaporator Pressure Regulators (EPR) and possibly resetting to higher suction temperatures when covers are applied.
* The cover must be applied for a period of at least six hours.
* This measure should be implemented with a film type cover with small perforated holes to decrease moister build-up.

## 1.2 Technical Description

This work paper discusses the retrofit add-on installation of night covers on existing low temperature open vertical (or multi-deck) and horizontal (or coffin type) display cases, as well as medium temperature open vertical display cases. It is recommended that these covers be a film type cover with small perforated holes to decrease moisture build-up and must be applied for a period of at least six hours. These types of display cases can be found in small- and medium-to-large size grocery stores. Medium-temperature display cases are used to stock dairy, deli, fish and meat. Low-temperature display cases are used to stock frozen food and ice cream. The air temperature inside medium and low temperature display cases can range from +10 to +35°F and -25 to -15°F, respectively [A]. Since the majority of the losses are due to infiltration this work paper only considers infiltration.

## 1.3 Installation Types and Delivery Mechanisms

**Installation Type Descriptions**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Installation Type** | **Savings** | | **Life** | |
| 1st Baseline (BL) | 2nd BL | 1st BL | 2nd BL |
| Retrofit Add-on (REA) | Above Customer Existing | 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** |
| Direct Install | The program implements energy efficiency measures for qualifying customers, at no cost to the customer. |
| 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. |
| On-bill Finance – Loan (OBF) | The program offers financing for the cost of an efficient measure as part of the utility bill. This can be an add-on option to an existing program or can serve as an organizing principle for its own program. |

## 1.4 Measure Parameters

### 1.4.1 DEER Data

Measure ID D03-205 in the 2014 Database for Energy Efficient Resources (DEER) READi tool, which addresses installing night covers on medium-temperature open display cases.It does not address installing night covers on low-temperature open display cases (vertical or horizontal). The DEER 2014 savings are based on applying covers for a period of four hours and the database does not distinguish between vertical and horizontal cases. Also, the measure characteristics presents the savings due to installing infiltration barrier as 50%, this compares favorably with other studies on horizontal display cases and thus it is assumed that the database is referring to horizontal cases only. For medium-temperature display cases, existing DEER 2014 values are used.

DEER Difference Summary

|  |  |
| --- | --- |
| **DEER Item** | **Used for Workpaper?** |
| Modified DEER methodology | No |
| Scaled DEER measure | No |
| DEER Base Case | No |
| DEER Measure Case | No |
| DEER Building Types | Yes |
| DEER Operating Hours | Yes |
| DEER eQUEST Prototypes | Yes |
| DEER Version | DEER 2014, DEER 05 |
| Reason for Deviation from DEER | Deer does not include installing night covers on low-temperature open display cases (vertical or horizontal) |
| DEER Measure IDs Used | D03-205 – Medium Temperature (Grocery Building Type Only) |

**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>2yr | 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 |
| Com-Default-HTR-di | All other EEM with no evaluated NTGR; direct install to hard-to-reach only. | Com | Any | DirInstall | 0.85 |

This work paper includes measures that are offered via direct install activities into hard-to-reach (HTR) customer facilities. “Final Resolution E-4700”, dated December 18, 2014, defines specific criteria to classify customer facilities as HTR and also states that two criteria are sufficient to identify HTR customers if one of the criteria met is the geographic criteria.

SCE’s Commercial Direct Install program delivers free and low cost energy efficiency hardware retrofits through installation contractors to reduce peak demand and energy savings for small and medium commercial customers. The barriers for customer participation include limited capital resources, lack of expertise and understanding of the understanding of the benefits of energy efficiency, a suspicion of the “free offer” and its legitimacy, and language and cultural barriers. The program also addresses the ongoing concern with “split incentives”, where the customer is not the owner of the property, and therefore, lack incentive to improve their energy usage. SCE’s Commercial Direct Install program will track the following three (3) customer data points to identify direct install activities in HTR customer facilities. If geography and business size criteria are satisfied, SCE will identify the customer as HTR. If geography and language criteria are satisfied, SCE will identify the customer as HTR. Other measures in the Commercial Direct Install program will receive default NTG (NTGR\_ID: Com-Default>2), unless otherwise specified in DEER.

* **Business Size** – Customer must have less than ten employees
* **Language** – Customer’s primary language spoken is not English
* **Geography** – Businesses in areas other than the United States Office of Management and Budget (OMB) Combined Statistical Areas (CSA) of the San Francisco Bay Area, the Greater Los Angeles Area and the Greater Sacramento Area or the OBM metropolitan statistical areas or San Diego County.

The “Required Corrections to Measure Level Input Parameters Identified by Commission Staff per D.14-10-046 Order Paragraph 16”, dated November 3, 2014, includes additional clarification for the geographic criteria:

“Notes on OMB CSA designations:

The OMB has designated a 12-county CSA titled the San Jose-San Francisco-Oakland, CA Combined Statistical Area which includes the nine counties of Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, Solano, and Sonoma which border the San Francisco Bay plus the three counties of San Joaquin, Santa Cruz, and San Benito that are economically tied to the nine counties that that border the San Francisco Bay.

The OMB definition of this CSA includes Los Angeles, Orange, San Bernardino, Riverside and Ventura counties.

The OMB definition of this CSA includes Sacramento, Yolo, El Dorado, Placer, Sutter, Yuba, and Nevada counties.”

**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)** |
| GrocDisp-DispCvrs | Night Covers for vertical and horizontal refrigerated display cases | Non-Residential | Refrigeration | 5 | 1.7 |

### 1.4.2 Codes and Standards Analysis

This measure is not governed by either State, such as Title 24 (2013) [355] and Title 20 (2014) [C], or Federal codes and standards.

Code Summary

|  |  |  |
| --- | --- | --- |
| **Code** | **Reference** | **Effective Dates** |
| N/A | N/A | N/A |

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

### 1.5.1 Non-DEER Study Review

All of the data used or reviewed in the preparation of this workpaper comes from DEER Database.

## 1.6 Data Quality and Future Data Needs

N/A

# Section 2. Calculation Methodology

The following table indicates which measures are taken directly from or created with the DEER READI tool.

READI Data Used

|  |  |  |
| --- | --- | --- |
| **Measure Code** | **Measure Name** | **READI Data** |
| RF-25748 | Medium Temperature Open Vertical Night Cover | Attachment B |

The following assumptions were made for the calculations of this work paper:

* The building simulation models were generated for a Grocery Store with multiplex-compressor systems for the refrigeration display cases. Single-compressor systems are less efficient than multiplex-compressor systems. According to the DEER Report [26], single-compressor systems were typically designed prior to 1980. To be conservative, it is assumed that the generated energy savings of this work paper will also be applied to display cases with single-compressor systems.
* This work paper is applied to display cases located inside a space which has space heating and space cooling. The unit energy savings is represented per linear-foot of the display case. The resulted savings involve savings of refrigeration load reduction and space heating load reduction. Note that there is also a slight increase to the space cooling energy consumption. The building simulation models were generated for a Grocery Store. Since the heat gain to a display case mainly depends on the temperature maintained for the display case and the surrounding space temperature, it is assumed that the building types would not have significant impact on the energy savings. Thus, the resulted savings of Grocery Store is applied to all other building types considered in this work paper.

The energy savings and demand reduction for this work paper are based on applying night covers on the following display case types: low temperature open horizontal, low temperature open vertical and medium temperature open vertical. The display cases are applicable to, but not limited to, grocery stores. According to the DEER Report [26], the majority of heat gain of an open display fixture is via infiltration. Covering open fixtures during hours the store is closed can reduce convection by 50% or more during this time, resulting in refrigeration load reductions.

The Medium Temperature Open Vertical Night Cover measure of this work paper is addressed in both the 2014 DEER READi Tool and the 2004-2005 Database for Energy Efficiency Resources (DEER) Update Study final Report of measure ID D03-205. Please refer to the DEER Report Section 6 for details of DEER Building Prototypes generated by eQuest (a graphical interface to DOE-2.2), Section 7.3 for general description for grocery refrigeration measures, and Page 7-74 for detail descriptions of this measure. The unit energy savings of this measure is obtained from READi, a DEER2014 Database Tool. The DEER measure ID D03-205 assumes constant infiltration for all hours as the base case, and the measure case applies a multiplier of 0.50 to the infiltration for night cover application. The energy savings reported in DEER 2014 are given per climate zone of the existing vintage for grocery store buildings. The savings for medium temperature night covers for grocery building type is taken from the DEER READi Tool for the existing vintage. The finals savings can be found in Attachment A.

The measures are weather sensitive and the building energy simulation tool eQuest Refrigeration V3.65 was used to determine the annual impacts. The built-in, Code 2013 DEER building prototypes of grocery store, generated by MASControl version 3.00.20, were used for simulations of the other two measures: Low Temperature Open Horizontal Night Cover and Low Temperature Open Vertical Night Cover. To be conservative, energy savings for vintage 2014 were evaluated for these two measures in eQuest simulation. The DEER building prototypes consider multiplex-compressor systems as the refrigeration type. Using the same methodology as the DEER measure ID D03-205, the simulation modes assume constant infiltration for all hours as the base case, and the measure case applies a multiplier of 0.50 to the infiltration for 6 hours per day between mid-night to 6 A.M. with night covers applications on the low temperature open horizontal and vertical display cases.

The DEER building prototypes have built-in refrigeration fixtures for low temperature open horizontal display cases. These fixture models were used for the Low Temperature Open Horizontal Night Cover measure simulations. Since no built-in refrigeration fixtures are available for low temperature open vertical display cases, a low temperature open vertical display case was added in the DEER building prototypes for the Low Temperature Open Vertical Night Cover measure simulations. Components of the low temperature open vertical display case model are included in the table below.

Summary of Modeled Low Temperature Open Vertical Display Case

|  |  |
| --- | --- |
| **Component** | **Values** |
| Evaporator Fan Power | 0.0251 (kW/ft) \* |
| Lighting Power | 0.0199 (kW/ft) \* |
| Defrost | 2,474 (Btu/hr-ft) |
| Anti-Sweat Power | 0.05 (kW/ft) |
| Infiltration Load | 1303.5 (Btu/hr-ft) |
| Conduction Load | 248.8 (Btu/hr-ft)\* |
| Total Refrigeration Load | 1918.9 (Btu/hr-ft) \* |
| Saturated Evaporator Temperature | -16.9 (°F) \* |
| Line-Up Length | 24 (ft) |

Source: DOE 2009a, Appendix D [B]

\* Average value of all efficiency levels considered for low temperature open vertical display cases.

Once the base case and measure case model simulations were completed, the energy demand savings could be determined. Comparing the total energy consumption (electricity and natural gas) of both models, the total energy savings were determined. The unit energy savings, in kWh/yr-ft2 for electricity and therm/yr-ft2 for natural gas, were calculated by dividing the total energy consumptions by the total line-up length of the display cases. Refer to Attachment C for summary of savings outputs.

Since the night covers will be applied during hours the store is closed, which are in the night time, implementing this measure will not impact the energy demand during peak period. Thus, it will not result in any demand reduction.

# 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 | Refrigeration | Assembly |
| Grocery | Refrigeration | Grocery\_Store |
| Restaurant - Fast-Food | Refrigeration | Fast\_Food\_Restaurant |
| Restaurant - Sit-Down | Refrigeration | Sit\_Down\_Restaurant |
| Retail - Multistory Large | Refrigeration | Large\_Retail\_Store |
| Retail - Single-Story Large | Refrigeration | Large\_Retail\_Store |
| Retail - Small | Refrigeration | Small\_Retail\_Store |

# Section 4. Costs

## 4.1 Base Case Cost

As these measures are Retrofit – Add-Ons, the base case assumes the refrigerated display cases are not equipped with night covers. According to 2014 DEER Measure ID D03-205, there is no cost ($0.00 per unit) associated with the base case [215].

## 4.2 Measure Case Cost

According to the DEER 2014 cost documentation [215], the material and labor costs for both medium and low temperature night covers for open horizontal and vertical refrigerated display cases is $37.63 and $4.57 per linear foot of night cover, respectively.

## 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** |
| REA | MEC + MLC | MEC + MLC | 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** |
| RF-45862 | REA | $42.20 | $42.20 | N/A |
| RF-96857 | REA | $42.20 | $42.20 | N/A |
| RF-25748 | REA | $42.20 | $42.20 | N/A |

# Attachments

A.

B. 

C. 

D. 

# References



[355]

[26]

[215]

[A] ASHRAE 2006. Refrigeration Handbook. Atlanta, Georgia. pp. 46.2, Table 1.

[B] DOE 2009a. Energy Conservation Standards for Commercial Refrigeration Equipment:

Technical Support Document, U.S. Department of Energy, January 2009.

<http://apps1.eere.energy.gov/buildings/publications/pdfs/corporate/commercial_refrig_report_10-09.pdf>

APPENDIX D. ANNUAL ENERGY SIMULATION INPUTS AND RESULTS FOR COMMERCIAL REFRIGERATION EQUIPMENT: <http://www1.eere.energy.gov/buildings/appliance_standards/commercial/pdfs/cre_tsd_appendixd.pdf>

[C] 2014 Appliance Efficiency Regulations (Title 20), CEC-400-2014-009-CMF (2014).