Work Paper SCE17RN018

**Revision 0**

**Southern California Edison**

**Low ASH Display Doors**

# At-a-Glance Summary

|  |  |
| --- | --- |
| **Measure Codes** | RF-43276  RF-25928 |
| **Measure Description** | RF-43276: Replacement of standard low temperature (“freezer”) display case doors with special display case glass doors that have no anti-sweat heaters.  RF-25928: Replacement of existing low temperature display cases with new low temperature display cases with special doors that have no anti-sweat heaters, LED lamps and ECM fan. |
| **Base Case Description** | RF-43276: For door replacement, base case is the existing low-temperature reach-in display cases equipped with standard ASH glass doors.  RF-25928: For replacing display cases, base case is reach-in display cases equipped with standard ASH glass doors, T12 lamps and shaded-pole fan motor. |
| **Units** | RF-43276: For door replacement the energy savings are based on a per door basis.  RF-25928: For replacing display cases with new low temperature display case savings are based on a per linear foot basis (case frontal width) |
| **Energy Savings** | Refer to Excel Calculation Attachment A |
| **Full Measure Cost ($/unit)** | Refer to Excel Calculation Attachment A |
| **Incremental Measure Cost ($/unit)** | Refer to Excel Calculation Attachment A |
| **Effective Useful Life** | 12 years (DEER EUL ID: GrocDisp-ZeroHtDrs) |
| **Measure Installation Type** | RF-43276: RET/ER – Retrofit or Early Replacement  RF-25928: ROB – Replace on Burnout |
| **Net-to-Gross Ratio** | 0.6 (DEER NTGR ID: Com-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 | 10/09/17 | Yin Yin Wu/BASE Energy, Inc. | - This work paper is an update of SCE13RN018.2  - The installation type of RF43276 is revised to be RET/ER instead of REF, and its baseline is revised accordingly  - Updated Section 1.4.2 based on the latest 2017 Title-20 and Federal code versions  - DEER2017 values are checked. No change is made.  - The base case cost of RF43276 is revised instead of no cost  - The work paper calculation template is updated using Version 6.7.4 |

# 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

## 1.1 Measure Description & Background

**RF-43276**: This work paper details the replacement of standard low temperature (“freezer”) display case doors with special display case glass doors that have no anti-sweat heaters. Display cases include remote and self-contained, low temperature, vertical open display cases (VOP. RC.L and VOP. SC. L.). For this measure, base case is the existing low-temperature reach-in display cases equipped with standard ASH glass doors, T12 lamps with magnetic ballast and shaded pole fan motors.

**RF-25928**: The work paper also details the replacement of the existing low temperature display cases with new low temperature display cases with special doors that have no anti-sweat heaters.

This measure is considered to be ROB – Replace on Burnout. Since the state and federal standards do not specifically regulate the display case components (such as the evaporator fan motor, case lighting and ASH door types) and no Industrial Standard Practice (ISP) study is available about ASH type, the DEER prototype Code Baseline model, representing commonly installed display cases, is considered as the baseline for this measure. The DEER Code Baseline model is the same as the DEER Baseline model, which is the existing equipment. Therefore, the base case of this measure is reach-in display cases equipped with standard ASH glass doors, T12 lamps with magnetic ballast and shaded pole fan motors.

The new display case includes special doors that have LED lamps and electronically commutated motor (ECM) fans, and no anti-sweat heaters. Hence, installing a new display case results in energy savings for high efficiency lamps and fan. RF-25928 includes replacing VOP.RC.L with VCT.RC.L and replacing VOP.SC. L with VCT.SC.L.

Terminology: VOP.RC.L – vertical open, remote-condenser, low temperature display case; VOP.SC.L – vertical open, self-contained, low temperature display case; VCT.RC.L – vertical closed transparent, remote-condenser, low temperature display case; VCT.SC.L – vertical closed transparent, self-contained, low temperature display case.

For both RF-43276 and RF-25928: Base case includes standard glass door with anti-sweat glass double-pane doors. Measure case includes special glass door with no anti-sweat glass double-pane doors. Case mullion and door frame heaters remain unchanged in the measure case. Refer to Secion 1.2 for details.

**Base, Standard, and Measure Cases**

|  |  |
| --- | --- |
| **Case** | **Description of Typical Scenario** |
| Measure | RF-43276: Replacement of standard low temperature (“freezer”) display case doors with special display case glass doors that have no anti-sweat heaters.  RF-25928: Replacement of existing low temperature display cases with new low temperature display cases with LED lamps, ECM fan and special doors that have no anti-sweat heaters. |
| Existing Condition | RF-43276: For door replacement, base case is the existing low-temperature reach-in display cases equipped with standard ASH glass doors. |
| Code/Standard | N/A |
| Industry Standard Practice | RF-43276: For door replacement, the second base case is low-temperature reach-in display cases equipped with standard ASH glass doors.  RF-25928: For replacing display cases, base case is reach-in display cases equipped with standard ASH glass doors, T12 lamps with magnetic ballast and shaded pole fan motors. |

Measures and Codes

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Measure Codes** | | | | **Measure Name** |
| SCG | SDG&E | SCE | PG&E |
|  |  | RF-43276 |  | Low Anti-Sweat Heater (ASH) Door |
|  |  | RF-25928 |  | Low Temperature High Efficiency Display Case with Special Door |

**Eligibility Requirements**

*For door replacement* (RF-43276) the energy savings are based on a per door basis. It is important to note that for replacing doors only, the anti-sweat heat (ASH) on the glass doors and frame is eliminated; the anti-sweat heat on the mullion of the cases continue to operate. The energy savings and cost figures are calculated per linear foot basis and account for the reduced ASH energy use of the doors only.

When replacing the whole display case with a new low temperature display case with special doors (RF-25928), they should be equipped with LED lights, electrically-commutated (EC) fan motors, and special low/no anti-sweat heater (ASH) glass doors. Rebate for replacing display cases with new low temperature display case is based on a per linear foot basis (case frontal width), and the display case must replace existing low-temperature, reach-in display cases equipped with standard ASH glass doors, T12 lamps with magnetic ballast and shaded pole fan motors.

**Express Requirements**

To qualify for the incentive for RF-43276, the following requirements must be met:

* An existing standard glass door with one glass pane of a low-temperature reach-in display case is being replaced with a special glass door that requires minimum to no anti-sweat heat (ASH). The replacement door is double-pane glass with heat-reflective treatment or gas filled. The display case temperature set point is between 5 and 24 degrees Fahrenheit.
* The new door will prevent condensation.
* The total wattage from the door rail, glass, and frame heater is not more than 7.1 watts per square foot (W/ft²) of door opening.
* This is the only Express Solution category under which the fixtures are receiving incentives. This solution cannot be used in conjunction with Anti-Sweat Heat (ASH) Controls category.

For early replacement of display case doors, IOU programs will offer incentives as part of programs aimed at targeted customers. Programs shall document that doors are replaced as a direct result of information, recommendations, and support provided by the IOU. Programs shall require the collection and submission of documentation in order to ensure proper conformance to eligibility and implementation requirements. The following are the types of information that will be required for all projects:

* Customer/site information
* Existing equipment
  + Proof that door is still operating
  + Display case nameplate data, to confirm remaining useful life.
* Replacement door information

To qualify for the incentive for RF-25928, the following requirements must be met:

* A new high-efficiency reach-in display case is replacing an existing low-temperature self-contained or remote reach-in as shown in the table below.
* The new case length is equal to or shorter than the original case. Incentive is based on linear footage of the new display case.
* This is the only Express Solution category under which the fixtures are receiving incentives. This solution cannot be used in conjunction with Anti-Sweat Heat (ASH) Controls category.

Express Requirements for RF-25928

|  |  |
| --- | --- |
| **Existing** | **Replacement** |
| T12 lamps with magnetic ballast | LED lamps |
| Shaded-pole fan motor | Electronically Commutated Motor(ECM) fan |
| Standard glass door with anti-sweat glass double-pane doors | Standard glass door with low/no anti-sweat glass double-pane doors |

## 1.2 Technical Description

This work paper details the replacement of standard low temperature (“freezer”) display case doors with special display case glass doors that have no anti-sweat heaters (RF-43276), as well as replacing existing low temperature display cases with new low temperature display cases with special doors that have no anti-sweat heaters (RF-25928).

For both RF-43276 and RF-25928: Base case includes standard glass door with ainti-sweat glass double-pane doors. Measure case includes special glass door with no anti-sweat glass double-pane doors. Case mullion and door frame heaters remain unchanged in the measure case. Refer to technical description below for details.

Traditional clear glass display case doors consist of two-pane glass and aluminum doorframes and door rails. Anti-Sweat Heaters (ASH) are included to eliminate condensation on the door or glass surface. The heaters are traditionally designed to overcome the highest humidity conditions as cases are built for nation-wide applications. Typical case construction requires three sets of heaters:

* Case mullion heaters – located inside the case frame to keep the doors from freezing shut.
* Door frame heaters – located in the door frame to keep the doors from freezing shut and provide some heat to the glass.
* Glass heaters – located on the glass itself to raise its surface temperature and prevent condensation.

In standard installations, the ASH operates at full power 100% of the time. Some of the heat generated by ASH ends up as a load on the refrigeration system. Therefore, any reduction in ASH power not only will reduce the ASH electric demand, it will also result in secondary benefits on the refrigeration side. As a result, compressor run time and energy consumption are reduced.

## 1.3 Installation Types and Delivery Mechanisms

This work paper addresses retrofit (RET) of new low heat/no heat doors (RF-43276),and Replace On Burn Out (ROB) installations of new low-temperature refrigerated display case with new doors that prevent formation of condensation on the glass surface (RF-25928).

**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 |
| Retrofit or Early Replacement (RET/ER) | Above Customer Existing | Above Code or Standard | EUL | N/A |

The delivery method is Financial Support - Down Stream Incentive – Deemed.

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. |
| Partnership | The program implements projects through a partnership between the utility and an institutional, government, or community-based organization. |

**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. |
| 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

The energy savings methodology proposed in this work paper is based on the 2005 DEER measure ID No. D03-228. The main difference between the DEER savings and the savings reported in this work paper is that DEER savings are presented per climate zone, per building, for 6 different vintages. These vintages are: Built between 2002 and 2005, Built 2006 and later, Built before 1978, Built between 1978 and 1992, Built between 1993 and 2001, and Built 2006 and later. The savings in this work paper are presented per climate zone per building type and for vintage 2014. The updated eQuest prototypes from MASControl version 3.00.20 for vintage 2014 were used to calculate the savings in this work paper. The eQuest model weather files were updated with DEER2014 CZ2010 weather data files.

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 | MASControl version 3.00.20 for vintage 2014 |
| Reason for Deviation from DEER | N/A |
| DEER Measure IDs Used | N/A |

**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 | Any | 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)** |
| GrocDisp-ZeroHtDrs | Zero Heat Reach-in Glass Doors | Com | ComRefrig | 12 | 4 |

### 1.4.2 Codes and Standards Analysis

**Title 20**

California Title 20 Appliance Efficiency Standards, as of April 2017 [C] regulate the overall performance of low temperature, vertical display cases with doors in terms of maximum daily energy consumption. However, the standard does not specifically regulate the display case components, such as the evaporator fan motor, case lighting and ASH door types.

*Section 1605.1(a)(2) Commercial Refrigerators, Commercial Refrigerator-Freezers, and Commercial Freezers*

*(B) The daily energy consumption (in kilowatt hours per day) of each commercial refrigerator and commercial freezer manufactured on or after the effective dates shown shall be not greater than the applicable values shown in Tables A-4 and A-5.*

*Table A-4 Standards for Commercial Refrigerators and Freezers with a Self-Contained Condensing Unit That are Not Commercial Hybrid Units*

* *Effective January 1, 2012*
* *For Self Contained, Vertical Closed Transparent, Low Temperature (VCT, SC, L), the maximum daily energy consumption (kWh) is: 0.75 × V + 4.10*

*Table A-5 Standards for Commercial Refrigerators and Freezers with a Remote Condensing Unit That are Not Commercial Hybrid Units*

* *Effective January 1, 2012*
* *For Remote, Vertical Closed Transparent, Low Temperature (VCT, RC, L), the maximum daily energy consumption (kWh) is: 0.56 × TDA + 2.61*

**Title 24**

Nonresidential Compliance Manual for the 2016 Building Energy Efficiency Standards (Title 24, Part 6) [501] includes excerpts from the Appliance Efficiency Regulations in Appendix B. Table A-4 in Appendix B of Title 24 summarizes *Standards for Commercial Refrigerators, Refrigerator‐Freezers*, which is taken from Table A-4 of Title 20 discussed above.

**Federal Standards**

Federal Standard 10CFR § 431.66 (January 1, 2017) [393] regulate the overall performance of low temperature, vertical display cases with doors in terms of maximum daily energy consumption. However, the standard does not specifically regulate the display case components, such as the evaporator fan motor, case lighting and ASH door types.

*(e) Each commercial refrigerator, freezer, and refrigerator-freezer with a self-contained condensing unit designed for holding temperature applications and with solid or transparent doors; commercial refrigerator with a self-contained condensing unit designed for pull-down temperature applications and with transparent doors; commercial refrigerator, freezer, and refrigerator-freezer with a self-contained condensing unit and without doors; commercial refrigerator, freezer, and refrigerator-freezer with a remote condensing unit; and commercial ice-cream freezer manufactured on or after March 27, 2017, shall have a daily energy consumption (in kilowatt-hours per day) that does not exceed the levels specified:*

*(1) For equipment other than hybrid equipment, refrigerator/freezers, or wedge cases:*

* *For Self Contained, Vertical Closed Transparent, Low Temperature (VCT, SC, L), the maximum daily energy consumption (kWh) is: 0.29 × V + 2.95*
* *For Remote, Vertical Closed Transparent, Low Temperature (VCT, RC, L), the maximum daily energy consumption (kWh) is: 0.49 × TDA + 2.61*

Code Summary

|  |  |  |
| --- | --- | --- |
| **Code** | **Reference** | **Effective Dates** |
| Title 24 (2016) | Appendix B, Table A-4 | January 1, 2016 |
| Title 20 (2017) | Section 1602.1(a)2 | April, 2017 |
| FS 10CFR (2017) | § 431.66 (e)(1) | January, 2017 |

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

N/A

## 1.6 Data Quality and Future Data Needs

N/A

# Section 2. Calculation Methodology

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 building simulation models were generated for a Grocery Store. Since the heat gain of 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 2004-2005 Database for Energy Efficiency Resources (DEER2005) Update Study final Report [26] has included the measure of Zero Heat Reach-in Glass Doors (ID D03-228). 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 7-90 for detail descriptions of this measure. The DEER measure ID D03-228 replaces conventional low temperature reach-in glass door display cases, utilizing doors with both door heaters and frame heaters, with doors having frame heaters only (no door heaters).

The DEER2005 measure considers multiplex-compressor systems as the refrigeration type. The baseline of the Zero Heat Reach-in Glass Doors (ID D03-228) measure considers the anti-sweat heater (ASH) power of 214 Watt/door for the door and frame heaters with humidity control. The measure case of this measure considers the ASH power of 54 Watt/door for door frame heat only (eliminating door heaters). The energy savings methodologies of this DEER measure ID D03-228 is applied to the two solution codes of this work paper.

***RF-43276: Low Anti-Sweat Heater (ASH) Door***

The energy savings of DEER measure ID D03-228 for sixteen climate zones and vintage 2014 was extracted from DEER 2014 prototypes from MASControl version 3.00.20. The eQuest baseline and measure models were modified based on values provided in Measure ID "D08-NE-GrocRefg-FixtDoors-AllTemp-Dr&FrmHt-FxdDrHt" for the D03-228 DEER measure. The weather files were updated using DEER2014 CZ2010 weather data files. The table shown below summarizes the baseline and measure inputs extracted from the DEER prototype models on D03-228.

The reporting unit energy savings is per door (kWh/dr) for this measure.

Summary of Built-In Display ASH Inputs from DEER Prototypes

|  |  |  |
| --- | --- | --- |
| **Input Component** | **Standard ASH Door (Baseline)** | **Efficient ASH Door (Measure)** |
| ASH Heater Power | 0.214 kW/dr | 0.054 kW/dr |
| ASH Heater Control | Humidity-Ration | Fixed |

***RF-25928: Low Temperature High Efficiency Display Case with Special Door***

In addition to the simulation methodology discussed for RF-43276 above, RF-25928 also includes savings due to the higher efficiency LED lighting and ECM motors included in the new display case. The table shown below summarizes the baseline and measure inputs in the eQuest simulation for this measure.

The reporting unit energy savings is per feet (kWh/ft) for this measure. The per door savings have been converted to per feet based on the conversion value of 2.6 ft/dr extracted from eQuest model.

Summary of Built-In Display ASH Inputs from DEER Prototypes

|  |  |  |
| --- | --- | --- |
| **Input Component** | **Standard ASH Door (Baseline)** | **Efficient ASH Door (Measure)** |
| ASH Heater Power | 0.214 kW/dr | 0.054 kW/dr |
| ASH Heater Control | Humidity-Ration | Fixed |
| Canopy Lighting Power | 0.078 kW/dr (T12 Lighting) | 0.0492 kW/dr\* (LED Lighting) |
| Evaporator Fan Power | 0.055 kW/dr (Shaded-Pole Motor) | 0.02475 kW/dr (ECM Motor) |

\* Provided in a DOE report [443].

**Peak Demand Savings**

The baseline and measure peak demands were averaged for the hourly demand outputs between 2 P.M. and 5 P.M. in the 3 consecutive peak days specified in the DEER2014 Update documentation [386] for each climate zone. DEER2017 Peak-Demand periods remain the same as DEER2014. Therefore, DEER 2017 is the reference in this revision. Table below summarizes the 2017 DEER Peak-Demand periods for 16 climate zones considered in this work paper.

|  |  |
| --- | --- |
|  | **2017 DEER Peak-Demand Periods** |

|  |  |  |  |
| --- | --- | --- | --- |
| **Climate Zone** | **Dates** | **Climate Zone** | **Dates** |
| CZ01 | Sep 16-18 | CZ09 | Sep 1-3 |
| CZ02 | Jul 8-10 | CZ10 | Sep 1-3 |
| CZ03 | Jul 8-10 | CZ11 | Jul 8-10 |
| CZ04 | Sep 1-3 | CZ12 | Jul 8-10 |
| CZ05 | Sep 8-10 | CZ13 | Jul 8-10 |
| CZ06 | Sep 1-3 | CZ14 | Aug 26-28 |
| CZ07 | Sep 1-3 | CZ15 | Aug 25-27 |
| CZ08 | Sep 1-3 | CZ16 | Jul 8-10 |

The measure results were subtracted from the baseline results to determine the demand reduction. Similar to the energy savings the unit demand reduction, in kW/ft, was calculated by dividing the total demand reduction by the total line-up length for RF-25928.

The unit demand reduction, in kW/dr, was calculated by dividing the total demand reduction by the total doors for RF-43276.

Refer to Attachment-B for the eQuest output savings summary.

# 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** |
| Grocery | Refrigeration | Grocery\_Store |
| Lodging – Hotel | Refrigeration | Hotel\_Motel |
| 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

**RF-43276: For installing New Low Heat/No Heat Doors (RET/ER):**

The base case assumes low temperature display cases with standard glass doors that are equipped with ASH. The base material cost is estimated to be $323.77 per door based on vendor costs of various models and brands. Refer to Attachment [D] for detailed information on material cost. The labor cost of $109.7 per door is assumed to be the same as the cost for installing the measure case doors, as described in Section 4.2 below. Therefore, the full base case cost is calculated to be $433.47 per door.

**RF-25928: *For installing New Low Temperature Display Case with New Doors (ROBNR):***

For this measure category, the base case cost is to be used to calculate the incremental measure cost. Department of Energy’s (DOE) Commercial Refrigeration Equipment Final Rule Technical Support Document [A] lists a 5 door (12.7ft.) vertical closed transparent, remote condensing, low display case as $7,356. $579.21/linear ft was calculated as the base cost for this measure.

## 4.2 Measure Case Cost

**RF-43276: *For installing New Low Heat/No Heat Doors (RET/ER)***

The full measure cost is not available in Revised DEER Measure Cost Summary table, therefore, the actual equipment cost of projects [B] implemented and rebated in 2006 by PG&E’s Deemed Rebate Program (Small Business and Existing Facilities) under the Refrigeration catalog was used. The measure cost data from 2006-08 was converted to 2017 cost based on the Historical Cost Indexes table from 2017 RS Means Mechanical Cost Data. According to RS Means, the cost index in 2017 in 100 while the cost index is 77.7 in 2006. The labor cost is estimated based on data given in the tables shown below.

**Measure Cost based on PG&E R6 rebate applications for 2006-08**

|  |  |  |  |
| --- | --- | --- | --- |
| **Invoice Date** | **Qty** | **Invoice Amount**  **(Material + labor)** | **$/door** |
| Oct-06 | 7 | $5,149.43 | $735.63 |
| Nov-06 | 127 | $43,183.00 | $340.02 |
| Dec-06 | 8 | $2,712.00 | $339.00 |

The full measure cost per door = (100/77.7)\*($735.63 + $340.02 + $339.00)/3 = $606.89.

**Material Cost based on PG&E R6 rebate applications for 2006-08**

|  |  |  |  |
| --- | --- | --- | --- |
| **Invoice Date** | **Qty** | **Invoice Amount**  **(Material)** | **$/door** |
| Oct-06 | 7 | $4,199.43 | $599.92 |
| Nov-06 | 127 | $35,563.00 | $280.02 |
| Dec-06 | 8 | $2,232.00 | $279.00 |

The material cost per door = (100/77.7)\*($599.92 + $280.02 + $279.00)/3 = $497.19.

The labor cost per door = $606.89 - $497.19 = $109.70.

**RF-25928: For installing New Low Temperature Display Case with New Doors (ROB)**

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**Figure 1 DOE’s Technical Support Document**

The measure cost is extrapolated from DOE’s Commercial Refrigeration Equipment Final Rule Technical Support Document as shown in Figure 1 [A]. The price of the measure was obtained by taking the difference of design level AD1 and AD4 to isolate the cost of the high-performance doors. Then, the difference in cost was divided by the baseline (AD1) for a percentage value that was applied to the baseline cost of $7,356 for a measure cost of $9,270.56. Measure cost of $9,270.56 converted to per linear foot yields $729.97.

## 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 |
| RET/ER | (MEC + MLC) – (BEC + BLC) | MEC + MLC | (MEC + MLC) – (BEC + BLC) |

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-43276 | RET/ER | $173.42/door | $606.89/door | $173.42/door |
| RF-25928 | ROB | $150.76/ft | $150.76/ft |  |

# Attachments

1. Attachment 1 - Low ASH Display Doors SCE17RN018.0 Low ASH Display Doors
2. Attachment 2 - SCE17RN018.0 eQuest Models
3. Attachment 3 - SCE17RN018.0 - eQuest Models

# References



[393] Title 10 → Chapter II → Subchapter D → Part 431, §431.66 (e)

[443]

[501]

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[A] Energy Savings Potential and R&D Opportunities for Commercial Refrigeration, September 23, 2009. Submitted to U.S. Department of Energy Efficiency and Renewable Energy Building Technologies Program by Navigant Consulting, Inc. Chapter 8 - Life-Cycle Cost and Payback Period Analysis, pg.12, Appendix B, pg.6 & 18.

[B] Average of actual costs from R6 rebate customers’ invoices, including freight charges, based on projects implemented and rebated in 2006 by PG&E’s Deemed Rebate Program (Small Business and Existing Facilities) under the Refrigeration catalog.

[C] California Energy Commission. (April 2017). California Code of Regulations Title 20. Retrieved from <http://www.energy.ca.gov/2017publications/CEC-140-2017-002/CEC-140-2017-002.pdf>

[D] Resolution E-4818 . D. 16-08-019 / CT6. March 2, 2017. Retrieved from <http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M179/K264/179264220.PDF>