**Work Paper PGE3PREF122**

**Low Temp Coffin to Reach-In**

**Revision # 4**

**PECI**

**EnergySmart Grocer**

**Refrigeration Coffin Retrofit – Low Temperature Coffin to High Efficiency Reach-In**

**Measure Code RA06, HB32**

**PECI EnergySmart Grocer**

# **At-a-Glance Summary**

|  |  |
| --- | --- |
| **Applicable Measure Codes:** | **RA06, HB32** |
| **Measure Description:** | Low Temperature Refrigerated Coffin Case to High Efficiency Reach-in Case |
| **Energy Impact Common Units:** | Linear feet of Reach-In display case. Wide coffins are replace with RI’s 1/3 the original coffin length (60 ft of coffin to 20 ft of RI) and narrow coffins are replace with 1/4 the original length (60 ft of coffin to 15 ft of RI) |
| **Base Case Description:** | Low Temperature Code Coffin Refrigerated Display Case, Wide or Narrow |
| **Base Case Energy Consumption:** | Varies based on base case width, 43 in or 35in.  Source: PECI |
| **Measure Energy Consumption:** | Varies based on base case width 43 in or 35 in.  Source: PECI |
| **Energy Savings (Base Case – Measure)** | Varies based on base case width, 43in or 35 in.  Source: PECI |
| **Costs Common Units:** | $ per linear feet of Reach-In display case. |
| **Base Case Equipment Cost ($/unit):** | $800 per linear feet of Reach-In display case  Source: PECI |
| **Measure Equipment Cost ($/unit):** | $836 per linear feet of Reach-In display case  Source: PECI |
| **Full Measure Cost ($/unit)** | $956 per linear feet of Reach-In display case  Source: PECI |
| **Measure Incremental Cost ($/unit):** | $36 per linear feet of Reach-In display case  Source: PECI |
| **Effective Useful Life (years):** | 12  Source: DEER2008 |
| **Measure Application Type:** | Replace on Burnout (ROB) |
| **Net-to-Full Ratios:** | 0.60  Source: DEER2011\_NTGR\_2012-05-16 |
| **Important Comments:** |  |

# Work Paper Approvals

The following Manager(s) approved this workpaper through the PG&E Electronic Data Routing System under Routing Requisition # \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

|  |
| --- |
|  |
| **Grant Brohard**  Manager, Technical Product Support |
| **Carolyn Weiner**  Principal, CES Products and Programs |

# Document Revision History

|  |  |  |  |
| --- | --- | --- | --- |
| **Revision #** | **Date** | **Section by Section Description of Revisions** | **Author (Company)** |
| Revision 0 | 04/15/2008 | Original short form work paper. | PECI |
| Revision 1 | 07/02/2009 | Workpaper in correct template, approvals page added, NAM reviewer’s comments addressed. | PECI |
| Revision 2 | 05/24/2012 | Updates for new template. | Dustin Bailey  (PECI Engineering) |
| Revision 3 | 05/07/2014 | Updated savings data according to new climate zone weather files. Formatting updated per PG&E guidelines | Jason Ochs, PECI  Danielle Geers, PECI |

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# Section 1. General Measure & Baseline Data

## 1.1 Product Measure Description & Background

***Catalog Description***

This measure replaces existing standard-efficiency low-temperature coffin refrigerated display cases with new high-efficiency low-temperature reach-in refrigerated display cases.

***Program Restrictions and Guidelines***

***Terms and Conditions***

The measure is applicable to any coffin base case that is less than or equal to code:

1. If the display width is less than 3 feet, the coffins must be replace by RI cases that are 1/4 the total length of the coffins or less
2. If the display width is greater than 3 feet, the coffins must be replace by RI cases that are 1/3 the total length of the coffins or less

The replacement case must use triple pane doors with low/no anti-sweat heat or anti-sweat-heat controls.

***Market Applicability***

This measure is applicable to retail grocery stores of all size.

## 1.2 Product Technical Description

This measure is replacing an old low-temperature open coffin case with a new or refurbished high- efficiency reach-in case. In addition to adding display capacity volume by 20% or more, the use of doors reduces air infiltration and therefore the required cooling capacity per unit volume of case.

## 1.3 Measure Application Types

The Measure Application type for the measure is Replace on Burnout (ROB).

The DEER Measure Cost Data Users Guide found on [www.deeresources.com](http://www.deeresources.com) under *DEER2011 Database Format* hyperlink, DEER2011 for 13-14, spreadsheet *SPTdata\_format-V0.97.xls*, defines the terms as follows:

Table 1 Measure Application Type[[1]](#endnote-1)

*Identifies the measure application type in the Measure Implementation table in DEER2014.*

|  |  |  |
| --- | --- | --- |
| **Code** | **Description** | **Comment** |
| ROB | Replace on Burnout | *Single baseline (above code), incremental or full costs* |

## Product Base Case and Measure Case Data

### 1.4.1 DEER Base Case and Measure Case Information

The DEER data does not contain the appropriate information for these measures.

### 1.4.2 Codes & Standards Requirements Base Case and Measure Information

***Title 20:*** The end of life replacement fixture for the horizontal open freezer is not addressed in Title 20 appliance regulations. Federal guidelines for commercial and industrial equipment must be referenced for this measure.

***Title 24:*** The end of life replacement fixture for the horizontal open freezer is not addressed in Title 24 building energy efficiency standards. Federal guidelines for commercial and industrial equipment must be referenced for this measure.

***Federal Standards:*** This measure falls under Federal DOE Regulations. Minimum refrigeration fixture energy efficiency standards are defined by the Commercial Refrigeration Equipment Final Rule. The energy conservation standards established in the final rule are applicable to products manufactured on or after January 1, 2012. The equipment class analyzed, HZO.RC.L (Horizontal Freezer without Doors with a Remote Condensing Unit, Low Temperature) limits a maximum daily energy consumption given by the formula 0.57 x TD + 6.88 kWh/yr. Due to the non-prescriptive nature of the Federal DOE Regulation, the minimum required case components were determined by sampling all available HZO.RC.L type cases available for retail by Hill Phoenix and choosing representative code cases. These brands are assumed to hold a predominate market share and thereby safely represent minimum code retail standards. The component options with the lowest energy efficiency specifications were established to be baseline of what is allowed for the case type HZO.RC.L. The baseline code cases for HZO.RC.L was determined to be a Hill Phoenix ONZ for a narrow coffin and OWZGG for a wide coffin. The proposed replacement is a code representative reach-in and is a Hill Phoenix ORZ case. The list of cases examined can be found in section 2.1.[[2]](#footnote-1)

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

Although there are several studies for case component upgrades there are no M&V and other studies which apply to these case replacement measures. Information on the base and measure case are found in the other sub-sections of 1.4.

### 1.4.4 Assumptions and Calculations from other sources—Base and Measure Cases

***Effective Useful Life***

The effective useful life for this measure for a retrofit is 12 years. This is consistent with DEER measures that replace existing cases with new cases, such as DEER Measure ID D03-207, “Replace open MT case with new case with doors”.

***Net-to-Full Assumption***

The table below summarizes all applicable Net-to-Full ratios for programs that may be used by this measure.

Table 2 Net-to-Full Ratios

|  |  |  |  |
| --- | --- | --- | --- |
|  |  | **DEER Spreadsheet** | |
| Program Approach | NTG | File name | Cell Number |
| EnergySmart Grocer | 0.60 | DEER2011\_NTGR\_2012-05-16 | T56 |

### 1.4.5 Time-of-Use Adjustment Factor

As directed by the CPUC in decision 06-06-063 dated June 29, 2006, time-of-use (TOU) adjustment factors are to be applied for residential A/C and commercial A/C (packaged and split-system direct-expansion cooling) measures only. This measure is assigned a DEER08 load shape, i.e. the load shape starts with “DEER:” so the TOU assigned to this measure is zero.

## 1.5 Summary of Inputs for Savings Calculations

The following table provides references to sections that document the inputs for calculation:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Input Variable** | **Variations** | **Base Case 1 Average Value** | **Base Case 2 Average Value** | **Measure Case Average Value** | **Reference Section** |
| **Electric Savings** | N/A | 3022.66 kWh | *139.51 kWh* | *3022.66 kWh* | *Section 1.4.1* |
| **Gas Savings** | N/A | N/A | N/A | N/A |  |
| **Hours of operation** | N/A | N/A | N/A | N/A |  |
| **Full Cost** | ROB | $956 | $920 | $956 |  |
| **Incremental Cost** | ROB | $956 | $920 | $956 |  |
| **EUL /RUL** | ROB | 12 | 12 | 12 |  |
| **NTG** | One | 0.6 | 0.6 | 0.6 |  |
| **ISR** | Applies -- Yes | 1 | 1 | 1 |  |
| **TOU Factor** | N/A |  |  |  |  |

# Section 2. Calculation Methods

Table 3 Baseline by Measure Application Type

|  |  |  |  |
| --- | --- | --- | --- |
| **Measure Application Type** | **Measure Life Basis** | **First Baseline Period: Energy Savings Baseline** | **Second Baseline Period: Energy Savings Baseline** |
| ***ROB* (replace-on-burnout)** | **EUL** | Code Baseline | N/A |

## 2.1 Energy Savings Estimation Methodologies

Energy savings are the difference between the base case annual energy use, and the proposed case annual energy use. The base case and proposed case annual energy use are calculated separately.

This measure is rebated by linear foot of reach-in in display case installed, and energy savings and demand reduction are reported by the same unit, linear foot of reach-in display case installed.

Because the measure is implemented per linear foot of reach-in case installed, special attention must be given to the relationship the reach-in volume to length ratio and the coffin volume to length ratio. Depending on coffin width, a grocer can display approximately three times or four time more product with a reach-in display case than with a coffin display case (see Table 2 - Base and Proposed Volume, Length, and Door Relationships).

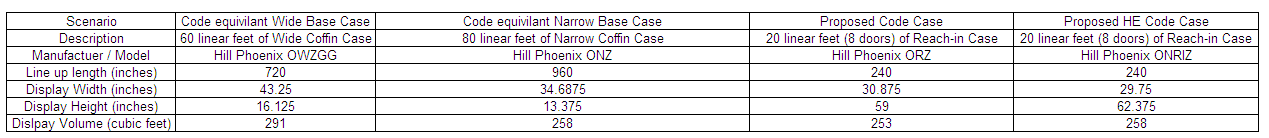
To account for this, the base case and proposed case scenarios are compared to in equivalent display case *volumes*, as opposed to length. That is, the proposed case reach-in cases will only display as much product as the base case coffin cases could. This will mean that the base case length and proposed case length will be different.

Additionally, through terms and conditions and special rebating requirements, the Energy Smart Grocer program limits the measure implementation to the portion of reach-in display case that would provide the equivalent display volume to the base case coffin scenario.

The base case scenario, a line-up of low temperature coffin case, is represented by 60 linear feet of the Hill Phoenix OWZGG case or 80 linear feet of the Hill Phoenix ONZ case. See the Figure 1 - Base Case Wide Coffin, Hill Phoenix OWZGG and Figure 2 - Base Case Narrow Coffin, Hill Phoenix ONZ below for more details about these cases.

The proposed case scenario, a line-up of low-temperature high-efficiency reach-in, is represented 20 linear feetof Hill Phoenix ONZ 4 Door Glass Door Reach-in Frozen Food display case as the code case and a Hill Phoenix ONRIZ case with Eliminator doors as the measure case. See Figure 3 - Proposed Code Case Reach-In, Hill Phoenix ORZ for more details. These cases were selected from the retail available cases to represent the code equivalent for their case types.

The following table (based on the dimensions of the two coffin cases and the proposed reach-in) demonstrates the length of coffin case that is represented by 20 feet (8 doors) of the proposed reach-in:

Table 4 - Base and Proposed Volume, Length, and Door Relationships

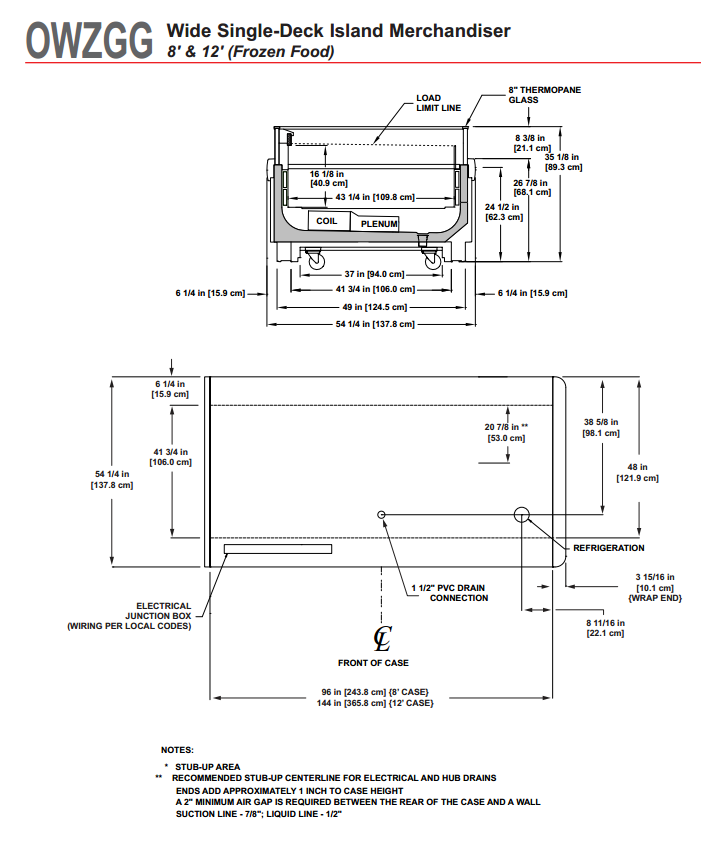
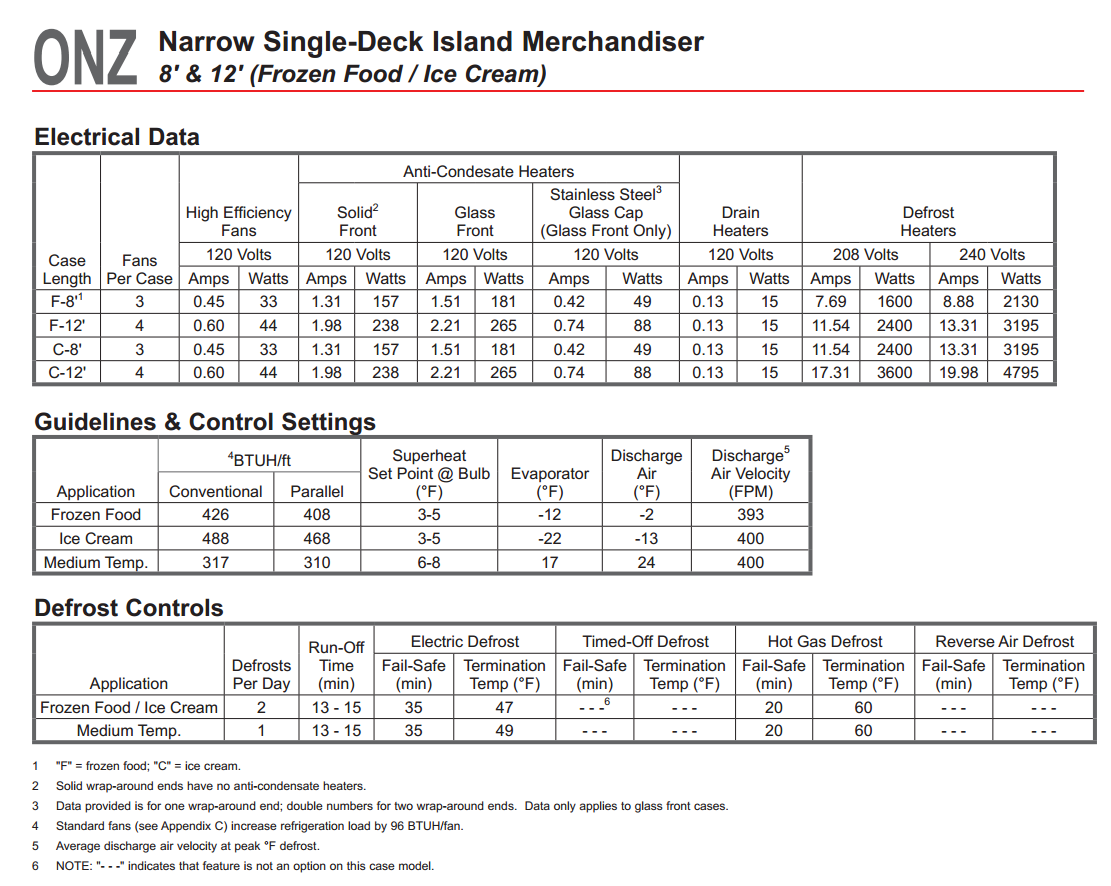


Figure 1 - Base Case Wide Coffin, Hill Phoenix OWZGG



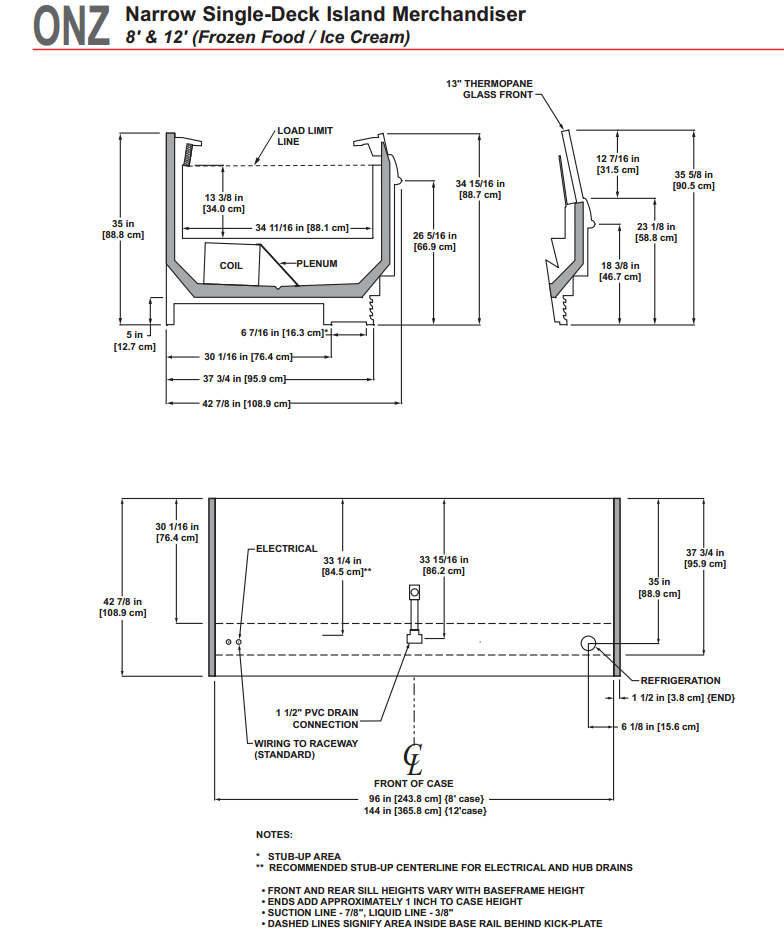
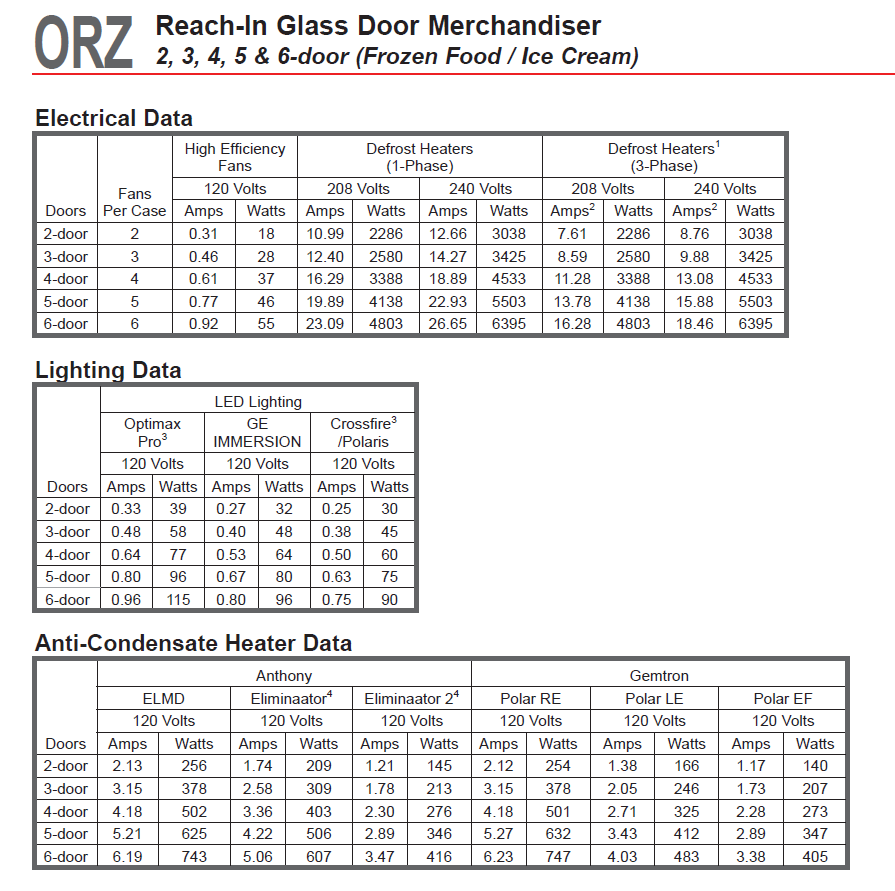
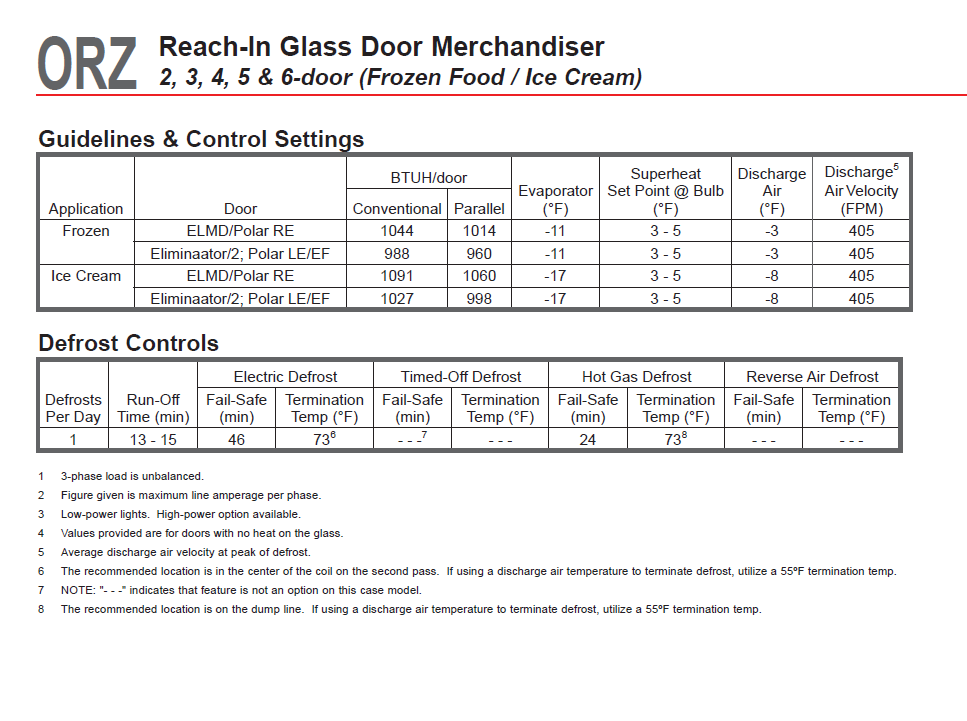


Figure 2 - Base Case Narrow Coffin, Hill Phoenix ONZ





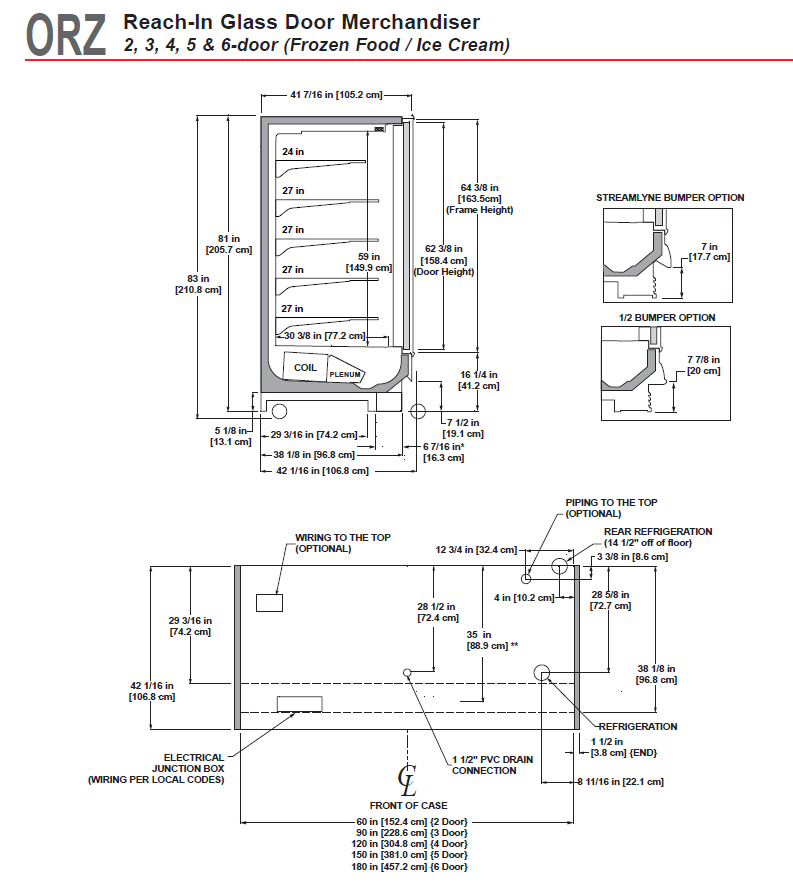
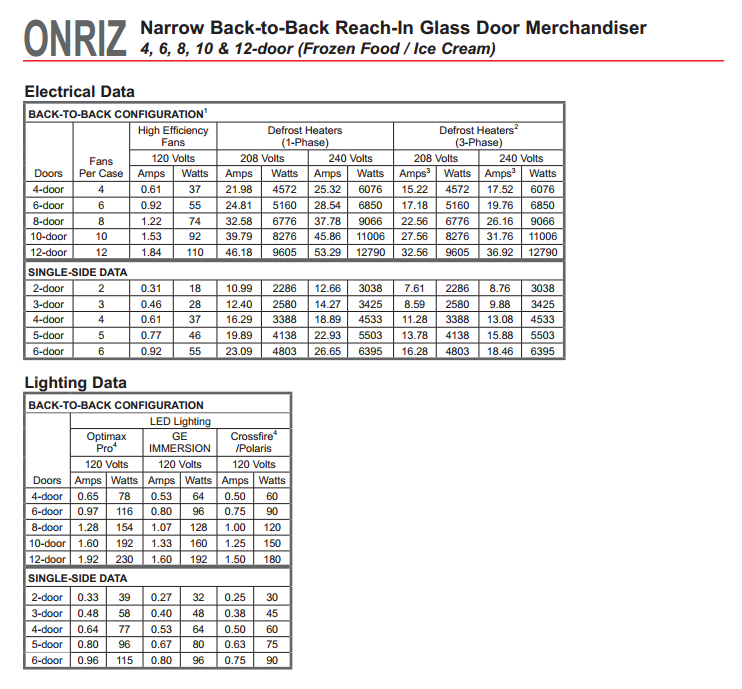
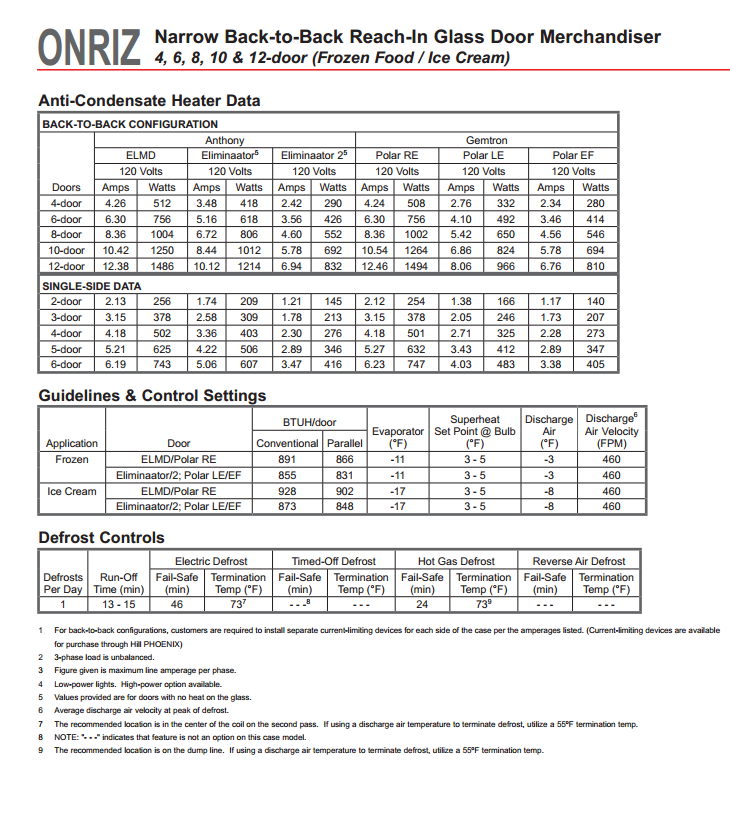


Figure 3 - Proposed Code Case Reach-In, Hill Phoenix ORZ





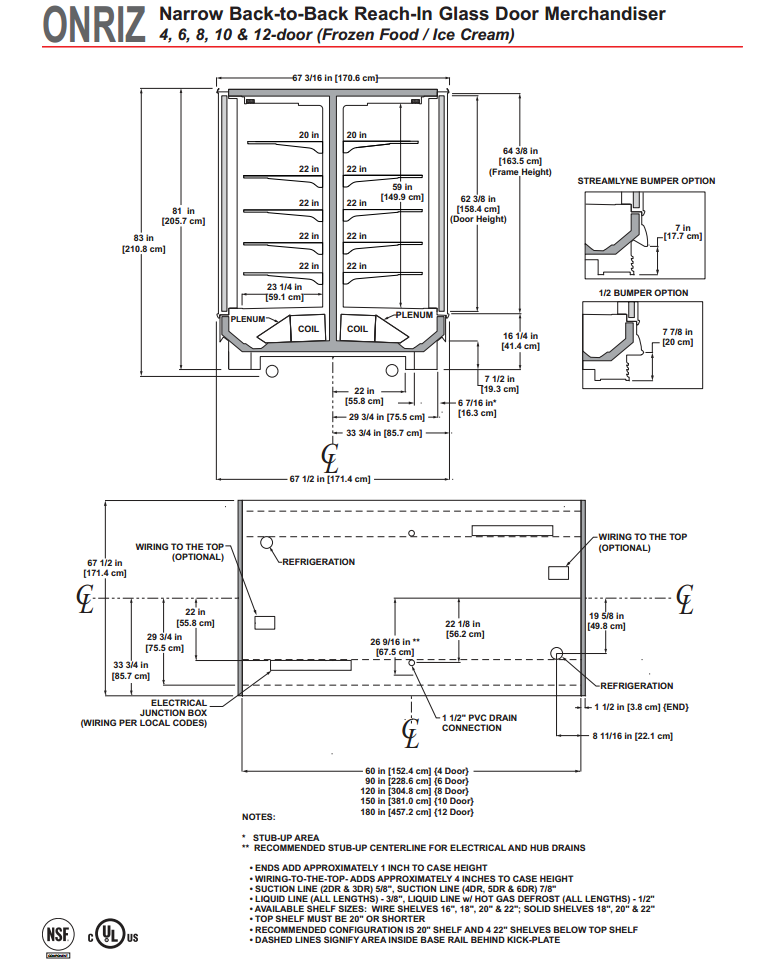


Figure 4 - Proposed Case Reach-In, Hill Phoenix ONRIZ

Refrigeration energy use is calculated based on the cooling coil capacity per linear foot, the compressor energy efficiency ratio and the refrigeration system run-time hours as shown in Equation 1 - Base Refrigeration Energy Use.

Equation 1 - Base Refrigeration Energy Use



Where:

*EB,REFRIG* is refrigeration energy use for the base case coffin lineup, kWh/fr-yr.

*QB* is the base case cooling coil capacity. See Figures 1 and 2 above for more details, Btu/hr-ft.

*HB,REFRIG* is the number of hours of refrigeration operation (8,578 hours/year[[3]](#footnote-2))

*LB*  is the base case length in linear feet (60 ft and 80 ft)

*EERB* is compressor refrigeration system energy efficiency (5.0[[4]](#footnote-3) Btu/Hr-W)

The base case (coffin case) auxiliary equipment annual electrical energy use is calculated with the following equation:

Equation 2 - Base Case Auxiliary Equipment Annual Energy Consumption



Where:

*EB,AUX* is the base case scenario annual energy consumption of the auxiliary equipment, (fans, anti-sweat-heaters, defrost heaters, and drain heaters.) Lighting is not included because this case does not contain display case lighting.

*PB,FAN* is the base case fan direct power consumption per case. This value is taken directly from the manufacturer’s data. See Figures 1 and 2 above for more details.

*HB,FAN* is the annual base case fan operating hours. This value is 8,578[[5]](#footnote-4) hrs / year.

*PB,ASH* is the base case anti-sweat-heater direct power consumption per case. This value is taken directly from the manufacturer’s data. See Figures 1 and 2 above for more details..

*HB,ASH* is the annual base case anti-sweat-heater operating hours. This value is 8760 hrs / year, as the duty cycle is assumed to be 100%[[6]](#footnote-5), where no controllers are present.

*PB,DEF* is the base case defrost-heater direct power consumption per case. This value is taken directly from the manufacturer’s data. See Figures 1 and 2 above for more details..

*HB,DEF* is the annual base case defrost-heater operating hours. This value is183[[7]](#footnote-6) hrs / year.

*PB,DRAIN* is the base case drain-heater direct power consumption per case. This value is taken directly from the manufacturer’s data. See Figures 1 and 2 above for more details..

*HB,DRAIN* is the annual base case anti-sweat-heater operating hours. This value is 8760 hrs / year, as the duty cycle is assumed to be 100%.

*CASESB* is the number of 12’ or 8’ cases in the case lineup. This value is dependent of the case type.

The base case annual energy use is calculated with the following equation:

Equation 3 - Base Case Annual Energy Consumption

****

Where:

*EB* is the annual energy used by the base case lineup.

*EB,REFRIG* is refrigeration energy use for the base case coffin lineup. See Equation 1 - Base Refrigeration Energy Use.

*EB,AUX* is the base case scenario annual energy consumption of the auxiliary equipment, (fans, anti-sweat-heaters, defrost heaters, and drain heaters.) Lighting is not included because this case does not contain display case lighting. See Equation 2 - Base Case Auxiliary Equipment Annual Energy Consumption.

The proposed case scenario will have a higher EER for the refrigeration system, because of the increase in evaporator suction temperature, which requires the compressor to work less hard. The proposed case refrigeration system EER is calculated with the following equation:

Equation 4 - Proposed Case Refrigeration System EER



Where:

*EERP* is the proposed case energy efficiency ratio of the refrigeration system. This value was calculated to be 6.2 Btu/hr/Watt.

1.02 is a coefficient to create the 2% increase[[8]](#footnote-7) in efficiency for every single degree Fahrenheit increase in evaporator suction temperature. This coefficient is unit less.

*DEGREE INCREASED* is the number of degrees Fahrenheit that the energy efficient evaporator suction temperature is increased. This value is 11[[9]](#footnote-8).

*EERB* is the base case compressor refrigeration system energy efficiency. This value is 5.0[[10]](#footnote-9) Btu/Hr-W.

The proposed case (high-efficiency reach-in display case) refrigeration system annual energy consumption is calculated based on the cooling coil capacity given by the manufacturer of the representative case, the assumed run-time hours of the refrigeration system, and the enhanced compressor EER due to an increased evaporator suction temperature, as seen in the following equation:

Equation 5 - Proposed Case Reach-in Refrigeration Annual Energy Consumption



Where:

*EP,REFRIG* is refrigeration energy use for the proposed case reach-in lineup, kWh/ft-yr.

*QP* is the proposed case cooling coil capacity. See Figure 3 above for more details, Btu/hr-ft.

*HP,REFRIG* is the number of hours of refrigeration system operation (8,578 hours/year)[[11]](#footnote-10)

*DP*  is the base proposed case number of doors. This value is 8 doors. See Table 2 - Base and Proposed Volume, Length, and Door Relationships.

*EERP* is the proposed case compressor refrigeration system energy efficiency. This value is 6.2 Btu/Hr-W. See Equation 4 - Proposed Case Refrigeration System EER.

The proposed case (reach-in case) auxiliary equipment annual electrical energy use is calculated with the following equation:

Equation 6 - Proposed Case Annual Auxiliary Equipment Energy Consumption



Where:

*EP,AUX* is the proposed case scenario annual energy consumption of the auxiliary equipment, (fans, anti-sweat-heaters, defrost heaters, and lighting.)

*PP,FAN*  is the proposed case fan direct power consumption per case. See Figure 3 above for more details.

*HP,FAN* is the annual proposed case fan operating hours. This value is 8578[[12]](#footnote-11) hrs / year.

*PP,ASH* is the proposed case anti-sweat-heater direct power consumption per case. See Figure 3 above for more details.

*HP,ASH* is the annual proposed case anti-sweat-heater operating hours. This value is 2278 hrs / year. This is based on a 26% run time[[13]](#footnote-12).

*PP,DEF* is the proposed case defrost-heater direct power consumption per case. See Figure 3 above for more details.

*HP,DEF* is the annual base case defrost-heater operating hours. This value is 183[[14]](#footnote-13) hrs / year.

*PP,LIGHT* is the proposed case fluorescent display case lighting direct power consumption per case. See Figure 3 above for more details.

*HP,LIGHT* is the annual proposed case lighting operating hours. This value is 5798[[15]](#footnote-14) hrs / year.

*CASESP* is the number of 4 door reach-in cases in the proposed case scenario. This value is 2 cases. See Table 2 - Base and Proposed Volume, Length, and Door Relationships.

The proposed case scenario annual energy consumption is the sum of the proposed case refrigeration system and auxiliary equipment annual energy consumption:

Equation 7 - Proposed Case Annual Energy Consumption



Where:

*EP* is the annual energy consumed by the proposed case scenario.

*EP,REFRIG* is refrigeration energy use for the proposed case reach-in lineup. See Equation 5 - Proposed Case Reach-in Refrigeration Annual Energy Consumption

*EP,AUX* is the proposed case scenario annual energy consumption of the auxiliary equipment, (fans, anti-sweat-heaters, defrost heaters, and lighting). See Equation 7 - Proposed Case Annual Energy Consumption.

Annual energy consumption values for the base case and proposed case scenarios have been calculated, where their refrigerated display case volume was approximately equal (See Table 2 - Base and Proposed Volume, Length, and Door Relationships.) The difference between these two values is the annual energy savings. For the rebating and energy savings reporting purposes of the Energy Smart Grocer program, the annual energy savings are presented per linear foot of reach-in display case installed. The program terms and conditions and rebate practices limit the measure to 1/3rd or 1/4th (based on the case width) of the existing coffin display case lineup to ensure that no new load is added in this retrofit measure. The annual energy savings per linear foot of installed reach-in display case are calculated with the following equation:

Equation 8 - Annual Energy Savings



Where:

*ESAVE* is the annual energy savings per linear foot of installed reach-in display case. The rebate should be limited to 1/3rd of the length of the original base case for a wide coffin and 1/4th of the length of the original base case for a narrow coffin.

*EB* is the annual energy used by the base case lineup. See Equation 3 - Base Case Annual Energy Consumption

*EP* is the annual energy consumed by the proposed case scenario. See Equation 7 - Proposed Case Annual Energy Consumption

*LP* is the length of the proposed case scenario, the reach-in display cases. This value is 20 linear feet, and ensures the energy savings calculated is for replacing the entire existing coffin case lineup with about 1/3 or 1/4 (based on the coffin case width) the length of a proposed case lineup. See Table 2 - Base and Proposed Volume, Length, and Door Relationships

## 2.2. Demand Reduction Estimation Methodologies

The approach taken to calculate the demand reduction was to determine the annual average power consumption and multiply it by the peak coincident diversity factor:

Equation 9 - Demand Reduction



Where:

*DREDUCTION* is the demand reduction per linear foot of reach-in display case installed. The rebate should be limited to 1/3rd of the length of the original base case for a wide coffin and 1/4th of the length of the original base case for a narrow coffin.

*ESAVE* is the annual energy savings per linear foot of installed reach-in display case. See Equation 8 - Annual Energy Savings.

8760 is the number of hours in a year.

*FP-C-D* is the peak coincident demand factor. This value is 0.81.

# Section 3. Load Shapes

## 3.1 Base Cases Load Shapes

The base case load shape resembles the load shape of any other refrigerated display case load shape. The compressor and condenser will use the most amount of power when the temperature is high and the least amount of power when the temperature is low. The direct power consumption associated with the auxiliary equipment, the evaporator fans and the case lighting, run continuously and do not fluctuate with temperature. The load shape for the PG&E E3 calculator is Commercial Refrigeration.

## 3.2 Measure Load Shapes

The measure load shape for the PG&E E3 calculator is Commercial Refrigeration

# Section 4. Base Case & Measure Costs

|  |  |  |  |
| --- | --- | --- | --- |
| **Measure Application Type** | **Measure Life Basis** | **First Baseline Period Full Measure Cost (RUL)** | **Second Baseline Period Full Measure Cost (EUL – RUL)** |
| ***ROB(replace on burnout)*** | EUL | Calculated as Incremental Measure Cost | N/A |

## 4.1 Base Case(s) Costs

The baseline for this measure is a code coffin case to a code reach-in case[[16]](#footnote-15).

The following Measure Application Types is appropriate to these measures. The Base Case Costs are:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| ***Measure Code*** | **Measure Application Type** | **Baseline** | **Equipment Cost** | **Labor / Installation Cost** | **Maintenance / Other Cost** | **Total Base Case Cost** |
| RA01 | ROB | Code coffin case to a code reach-in case | $800 | $120 | $0 | $920 |
| HB32 | ROB | Code wide coffin case to a code reach-in case | $800 | $120 | $0 | $920 |

*All costs are noted as $ per measure unit*

## 4.2 Measure Case Costs

The following Measure Application Types is appropriate to these measures. The Measure Case Costs are:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| ***Measure Code*** | **Measure Application Type** | **Baseline** | **Equipment Cost** | **Labor / Installation Cost** | **Maintenance / Other Cost** | **Total Measure Case Cost** |
| RA01 | ROB | Code coffin case to a code reach-in case | $800 | $120 | $36 | $956 |
| HB32 | ROB | Code wide coffin case to a code reach-in case | $800 | $120 | $36 | $956 |

*All costs are noted as $ per measure unit*

There is additional cost for replacing standard reach-in doors with high efficiency doors with low or no anti sweat heat.

## 4.3 Incremental & Full Measure Costs

### 4.3.1 Full Measure Cost

|  |  |  |  |
| --- | --- | --- | --- |
| **Measure Application Type** | **Full Measure Cost**  **(RUL Period/First Baseline)** | **Full Measure Cost**  **(EUL-RUL Period/ Second Baseline)** | **Incremental Measure Cost** |
| ROB | Measure Equipment Cost  – Base Case Equipment Cost | N/A | Measure Equipment Cost  – Base Case Equipment Cost |

Full Measure Cost is the cost to install an energy efficient measure per the CPUC calculators. This definition implies a different meaning depending on the install type.

This Measure Application Type is: ROB, so the Full Measure Cost (FMC) is represented by the equation below (choose):

FMC = Measure Equipment Cost – Base Case Equipment Cost

*FMC = $ 956 per ft - $920 per ft = $ 36 per ft*

\*Note: Various complicated price fluctuations are not addressed in these equations, such as future costs due to inflation in labor, future costs due to deflation in material cost, and other variables that cannot be accurately described at this time.

### 4.3.2. Incremental Measure Costs

Incremental Measure Cost is the premium cost to install an energy efficient measure over a standard efficiency measure or code baseline measure. While IMC has a straight forward definition depending on the install type, the equation does vary.

This measure transaction type is: ER so the Full Measure Cost (GMC) is represented by the equation below:

IMC = (Measure Equipment Cost + Measure Labor Cost) –

(Base Case Equipment Cost + Base Case Labor Cost)

\*Note: Unless stated otherwise the measure case labor and base case labor are assumed to be the same value reducing the equation to the following:

IMC = Measure Equipment Cost – Base Case Equipment Cost

IMC = $ 956 per ft - $920 per ft = $ 36 per ft

**Summary Table for Section 4**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Measure ID** | **Measure Application Type** | **Base Case Total Cost** | **Measure Case Total Cost** | **Full Measure Case Cost** | **Incremental Measure Cost** |
| RA06 | ROB | $920 | $956 | $956 | $36 |
| HB32 | ROB | $920 | $956 | $956 | $36 |

# Appendices

# References

1. The DEER Measure Cost Data Users Guide found on [www.deeresources.com](http://www.deeresources.com) under *DEER2011 Database Format* hyperlink, DEER2011 for 13-14, spreadsheet *SPTdata\_format-V0.97.xls.* [↑](#endnote-ref-1)
2. Code of Federal Regulations: Title 10, Part 431: Energy Conservation Program for Commercial and Industrial Equipment; Final Rule, Section 431, p.1140. Edition: 1/9/2009. [↑](#footnote-ref-1)
3. The Average EER value should be used with a refrigeration system duty load of 100%. However, the refrigeration system will not run during defrost hours (153 hrs/year, see footnote 10), so this value is reduced to 8,578 hrs/year. [↑](#footnote-ref-2)
4. 2006 ASHRAE Handbook, Refrigeration: Page 46.14 – “EERs range from 4 to 5 Btu/h per watt for frozen food units to as low as 3.5 to 4.0 Btu/h per watt for ice cream units.” [↑](#footnote-ref-3)
5. Base case fan annual operating hours are the number of hours in a year, minus the time they are off during the defrost cycle, which occurs for 30 minutes a day, (See Footnote 10) 8760 hrs / year - 0.5 hrs / cycle \* 1 cycle / day \* 365 days / year = 8578 hrs / year. [↑](#footnote-ref-4)
6. 100% ASH w/o control runtime. Final Evaluation, Monitoring, and Verification (EM&V) Report for 2004-2005 EnergySmart Grocer Program. 2006. PWP, Inc. Value corroborated with PECI Sr. Engineering. [↑](#footnote-ref-5)
7. Base case defrost-heater operating hours are the number of hours on per cycle times the cycles per day times the day per year. 0.5 hrs / cycle \* 1 cycle / day \* 365 days / year = 183 hrs / year. Min Defrost is 15 min, cut off is 45 minutes, typical is 30 minutes. See Figure 1 - Base Case Coffin, Hill Phoenix OIZ [↑](#footnote-ref-6)
8. The efficiency of a compressor in a refrigeration system increases by about 2% per degree Fahrenheit increase in suction temperature. “Industrial Refrigeration Best Practices Guide” December 2004, prepared by Cascade Energy Engineering with support from Northwest Energy Efficiency Alliance. Page 46, Effect of increasing Suction Pressure. [↑](#footnote-ref-7)
9. DEGREE INCREASED = 11, this is the difference between the Base Case (OIZ Coffin) evaporator suction temperature of -22°F, (See Figure 1 - Base Case Coffin, Hill Phoenix OIZ) and the proposed case (ONZ Reach-in) evaporator suction temperature of -11°F (see Figure 2 - Proposed Case Hill Phoenix ONZ Reach-in.) [↑](#footnote-ref-8)
10. 2006 ASHRAE Handbook, Refrigeration: Page 46.14 – “EERs range from 4 to 5 Btu/h per watt for frozen food units to as low as 3.5 to 4.0 Btu/h per watt for ice cream units.” [↑](#footnote-ref-9)
11. The Average EER value should be used with a refrigeration system duty load of 100%. However, the refrigeration system will not run during defrost hours (153 hrs/year, see footnote 10), so this value is reduced to 8,578 hrs/year [↑](#footnote-ref-10)
12. Proposed case fan annual operating hours are the number of hours in a year, minus the time they are off during the defrost cycle, which occurs once a day for 30 minutes a day. 8760 hrs / year - 0.5 hrs / cycle \* 1 cycle / day \* 365 days / year = 8669 hrs / year. See Figure 2 - Proposed Case Hill Phoenix ONZ Reach-in [↑](#footnote-ref-11)
13. ASHC runtime: Three Studies and one assumption to find an average value of 26%: Final Evaluation, Monitoring, and Verification (EM&V) Report for 2004-2005 EnergySmart Grocer Program. 2006. PWP, Inc. Page 28-29. Value was 8%. A second value at 50% is a conservative estimate, which was made by PECI Senior Engineer Scott Moore, formerly Energy Manager for Albertsons. [↑](#footnote-ref-12)
14. Base case defrost-heater operating hours are the number of hours on per cycle times the cycles per day times the day per year. 0.5 hrs / cycle \* 1 cycle / day \* 365 days / year = 183 hrs / year. Min Defrost is 15 min, cut off is 46 minutes. See Figure 2 - Proposed Case Hill Phoenix ORZ Reach-in [↑](#footnote-ref-13)
15. GrocerSmart Survey of Main Lighting Schedule of Large Grocery Stores in PG&E Service Territory: Out of 422 stores meeting criteria, average hours/year is 5,798. [↑](#footnote-ref-14)
16. Based on manufacturer quote June 07, 2012. [↑](#footnote-ref-15)