|  |
| --- |
| Process  Circulating Block Heater  **SWPR004-02** |

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Measure Name

Circulating Block Heater

Statewide Measure ID

SWPR004-02

Technology Summary

According to the Washington State University and Bonneville Power Administration, block heaters typically consist of a simple resistance heater affixed at one of several locations to the engine. [[1]](#footnote-1) Convection circulates heated fluids in a process known as thermosiphon. These systems heat the engine block unevenly and inefficiently and may deteriorate piping materials. Replacing thermosiphon heaters with electrical pump heaters can reduce energy use.

This circulating block heater measure includes an integrated electric pump that circulates coolant throughout the engine block ensuring that there is a minimal temperature difference between the supply and return temperatures. The pump/heater (CBH) is an integral assembly.

The existing (base case) thermosiphon heater is removed as a unit and the new CBH is inserted into the exact same location. It is a single-unit installation within one housing with the mechanical element (pump) enclosed in the same "shell" as the smaller resistance heating element (relative to the thermosiphon) integral to the circulating block heater. Disconnect and reconnect points to existing hoses would not change unless improperly plumbed in the first place.

Along with the pump, a small resistance heater is used to heat the coolant within the engine block. By pumping the heated coolant, a more uniform temperature is obtained throughout the engine block. As a result of using a recirculation pump, a smaller electric resistance heater can be used to heat the coolant as there will be a more uniform temperature achieved through the mixing of fluid throughout the engine block.

Measure Case Description

This measure is defined as a recirculation pump with a downsized electric resistance heater to a backup diesel generator. This measure will replace an existing thermosiphon pump and heater with a recirculation pump and a smaller electric resistance heater. The measure will be tiered based upon the backup generator sizes*,* shown in the table below.

Measure Case Specification

|  |  |  |
| --- | --- | --- |
| **Base Case Thermosiphon Heater Size** | **Back-up Generator Size (kW)** | **Measure Offering ID** |
| Backup Generator with Circulating Block Heater replacing Undersized Thermosiphon Heater | 37-199 | A |
| 200-799 | C |
| Backup Generator with Circulating Block Heater replacing Properly Sized Thermosiphon Heater | 37-199 | B |
| 200-799 | D |

Base Case Description

The base case is defined as the existing thermosiphon heater that relies on the change in density, buoyancy, to circulate the heated coolant within the generator. A thermosiphon heater relies on the change in density (impacting buoyancy) to circulate the heated coolant. This type of circulation leads to non-uniform temperature distribution – the coolant is warmer at the top of the block and colder at the bottom, thus the electric resistance heater must operate for a longer duration. This type of circulation also means that there is waste heat in sections of the block – the heater must operate to maintain a certain temperature, so the top of the block will always be hotter than necessary.

The industry standard practice (base case) assumptions are supported by a pump-driven block heater study conducted by Avista in September 2012.[[2]](#footnote-2) The study indicates that historically, the thermosiphon heater technology has dominated the block heater market. The ubiquity of the thermosiphon heater is driven primarily by original equipment manufacturers because they install them at the factory.

Code Requirements

The circulating block heater measure is not covered by either State or Federal efficiency standards. Air quality management districts have established standards that define the requirements of emergency backup generators and the allowable air emissions. However, the allowable air emissions do not impact savings calculations, as backup generators are required to be ready at all times for use. Thus, emission standards are not specified in the eTRM for this measure. NFPA code 110 for Emergency Power Systems requires that standby generator engine blocks shall be heated as necessary to allow full power within 10 seconds.

Applicable State and Federal Codes and Standards

|  |  |  |
| --- | --- | --- |
| **Code** | **Applicable Code Reference** | **Effective Date** |
| CA Appliance Efficiency Regulations – Title 20 | None. | n/a |
| CA Building Energy Efficiency Standards – Title 24 | None. | n/a |
| Federal Standards | NFPA 110 | 2019 |

Normalizing Unit

Each.

Program Requirements

Measure Implementation Eligibility

The table below specifies all measure application type, delivery type, and sector combinations that are established for this measure. Measure application type is a categorization based on the circumstances and timing of the measure installation; each measure application type is distinguished by its baseline determination, cost basis, eligibility, and documentation requirements.  Delivery type is the broad categorization of the delivery channel through which the market intervention strategy (financial incentives or other services) is targeted. This table also designates the broad market sector(s) that are applicable for this measure.

Implementation Eligibility

|  |  |  |
| --- | --- | --- |
| **Measure Application Type** | **Delivery Type** | **Sector** |
| Normal Replacement | DnDeemed | Com |
| Normal Replacement | DnDeemed | Ind |
| Normal Replacement | DnDeemed | Ag |
| New Construction | DnDeemed | Com |
| New Construction | DnDeemed | Ind |
| New Construction | DnDeemed | Ag |
| Normal Replacement | UpDeemed | Com |
| Normal Replacement | UpDeemed | Ind |
| Normal Replacement | UpDeemed | Ag |
| New Construction | UpDeemed | Com |
| New Construction | UpDeemed | Ind |
| New Construction | UpDeemed | Ag |

Eligible Products

For normal replacement installation (NR), the existing backup generator is eligible if it is not currently fitted with a circulating block heater or device utilizing similar electro-mechanical system to heat and circulate generator block pre-warming fluid.

A new generator installation (NC), for which the base design prescribes a pre-heating device (e.g., thermosiphon heater) other than a circulating block heater or similar device is eligible to upgrade from base design to efficient design including a circulating block heater.

In addition, eligibility requirements regarding the installation include:

* Installation of a circulating block heater should be performed by a qualified technician (i.e. generator maintenance technician or mechanical service technician).
* Installer should follow the manufacturer installation requirements and assess and perform (if necessary) fluid hose adjustments that may be associated with the retrofit to enable the circulating block heater to function at optimal energy efficiency.
* Installation shall meet all applicable regulations including but not limited to latest NFPA Code 110 for Emergency Power Systems and NEC.

Eligible Building Types and Vintages

This measure is applicable to the following non-residential building types, of any vintage:

|  |  |
| --- | --- |
| Assembly | Manufacturing - Bio/Tech |
| Education - Community College | Manufacturing - Light Industrial |
| Education - Primary School | Office - Large |
| Education - Relocatable Classroom | Office - Small |
| Education - Secondary School | Restaurant - Fast-Food |
| Education - University | Restaurant - Sit-Down |
| Grocery | Retail - Multistory Large |
| Health/Medical - Hospital | Retail - Single-Story Large |
| Health/Medical - Nursing Home | Retail - Small |
| Lodging - Guest Rooms | Storage - Conditioned |
| Lodging - Hotel | Storage - Unconditioned |
| Lodging - Motel | Warehouse - Refrigerated |

Eligible Climate Zones

This measure is applicable to any California climate zones.

Program Exclusions

This measure is not eligible for residential buildings.

Use Category

Process

Electric Savings (kWh)

The unit energy savings (UES) is calculated as the difference between the unit energy consumption of a baseline preexisting thermosiphon heater and the measure case retrofitted circulating block heater. The baseline and measure case UEC estimates were derived from field monitoring data that was collected from numerous case studies developed through the Bonneville Power Authority (BPA) Emerging Technology program. The data collected included average daily energy usage and outdoor air temperatures for both the preexisting thermosiphon heater and the retrofitted circulating block heater. The BPA data includes 17 sources of data from different sites, including wastewater plants and data centers. The data was collected for different periods of time for each site, but on average, there are two months pre- and post-installation for each site included in the analysis.

The BPA field monitoring data was used to create multiple regression models for the different backup generator sizes specified for this measure.[[3]](#footnote-3) *The raw data used for the regression analysis is available upon request.*

Studies conducted through the California Emerging Technologies Program that pertain to this measure are summarized below.

* *Air Source Heat Pump for Preheating of Emergency Diesel Backup Generators* (2009)[[4]](#footnote-4) investigated usage of air source heat pumps for this measure but found that the use of air source heat pumps was not cost effective. This study indicates that measure offerings were facilitated through the Southern California Edison (SCE) Emerging Technologies program.
* The results of the *Forced Circulation Engine Generator Block Heater Energy Performance Assessment* (2014)[[5]](#footnote-5) found there are no savings with forced circulation retrofits for ambient temperatures greater than 68 oF. The current calculation methodology does not take this into account; most of the test data is below 68 oF.

HotStart ® is a major equipment manufacturer of engine heaters that supplies components to generator companies like Quinn, CAT, and Cummins. No new studies with latest version of HotStart® products has been conducted. In October 2020, HotStart was contacted for updates related to pertinent studies; however, Hotstart indicated new studies were still being conducted. The analysis should be updated if additional data becomes available.

DEER CZ2022 weather data files for ambient outside air temperature were used to update all savings estimates of this measure.

Data Exploration

Temperature and Daily kWh Variation within Size Categories

Sites were assigned to one of four size categories (1-4), which loosely correspond to the actual (baseline) usage and is highly dependent on base case heater size. There is significant variation and overlap across categories in generator size, heater size, and observed kWh usage. Measure offerings that correspond to size categories 3 and 4 have been removed from the workpaper due to negative incremental measure costs. These size categories remain in this section of the workpaper for reference, but they are not used in the calculations.

Site-Specific Heater Sizes

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Site** | **Site Size Category** | **Generator Size (kW)** | **Baseline Heater Size (kW)** | **Existing Measured kW** | **Avg Baseline kWh** | **New Rated Heater Size (kW)** | **New Measured kW** | **Avg Treatment kWh** |
| COCCH | 1 | 15 | 0.5 | 0.46 | 11.0 | 1 | 0.99 | 6.8 |
| Kid Kare | 1 | 40 | 1 | 0.89 | 21.1 | 1 | 0.99 | 13.4 |
| TCWWTP | 1 | 15 | 1 | 0.93 | 10.9 | 1 | 1.03 | 8.2 |
| HCNW | 1 | 600 | 6 | 4.3 | 52.0 | 6 | 5.4 | 46.8 |
| COCFD | 2 | 75 | 1 | 0.88 | 20.9 | 1 | 0.94 | 11.6 |
| COCTV | 2 | 100 | 1 | 0.88 | 20.9 | 1 | 0.92 | 7.2 |
| COMKR | 2 | 50 | 1 | 0.93 | 20.7 | 1 | 1 | 11.7 |
| COMW | 2 | 100 | 1 | 0.95 | 22.7 | 1 | 0.98 | 16.1 |
| KE ECAM | 2 | 65 | 1 | 0.93 | 22.3 | 1 | 0.99 | 12.5 |
| TCWP | 2 | 20 | 1 | 0.97 | 22.3 | 1 | 1.05 | 10.5 |
| BLDG210 | 2 | 250 | 2.5 | 2.22 | 47.1 | 3 | 2.8 | 24.2 |
| PCDC | 2 | 900 | 6[[6]](#footnote-6) | 4.62 | 48.4 | 6 | 5.5 | 44.1 |

Observations were recorded at varying times of year and reveal significant variation in range of temperatures observed across sites and from baseline to treatment periods. Some sites reveal significant temperature dependence in base case usage, and other sites show no temperature dependence (often displaying remarkably consistent usage). Temperature dependence was observed at sites with larger baseline heater sizes (within a size category) and is consistent with a properly sized heater. Temperature independence (flat baseline) was observed at sites with smaller baseline heater sizes and is consistent with an undersized heater (reflecting the heater is running consistently on full).

Figure 1 Category 1 Daily kWh v. Temp by Site

Figure 2 Category 2 Daily kWh v. Temp by Site

The number of sites per size category that exhibit flat baselines (indicative of undersized heaters) suggest the following designation of undersized v. proper-sized heaters. The heater range applies only to base case heater sizes; the new heaters all exhibit temperature dependence.)

Baseline Heater Size Ranges (as suggested by data)

|  |  |  |
| --- | --- | --- |
| **Site Size Category** | **Undersized Heater Range** | **Proper-sized Heater Range** |
| 1 | 1 kW and below | 2 kW and above |
| 2 | 1 kW and below | 2 kW and above |

Methodology

Undersized and proper-sized sites operate differently, and thus were modeled separately. Each is described below.

Baseline Unit Energy Consumption

**Undersized Units:** The baseline UEC of undersized sites frequently showed remarkable consistency; individual sites did not display enough variation to warrant modeling. Therefore, a single expected base case usage was attributed for each site. (At sites where an overwhelming mode value was observed, the mode was used as the expected baseline usage.) Otherwise, the mean baseline usage was used. Across sites, the usage exhibited a linear relationship with heater size across site size categories.

**Properly-Sized Units:** The base case usage of properly-sized sites was modeled (for each size category) as a function of temperature.[[7]](#footnote-7) There were not enough sites or variation in the baseline heater size to model usage as a function of heater size as well as site size category. The regression model applied (per site size category) is represented as:

where:

*Daily\_kWh* = the daily usage (kWh) as collected

*Temperature* = the observed average outside air temperature (°F)

Measure Case Unit Energy Consumption

Measure undersized heaters were not an issue as in the baseline periods; therefore, the measure case UEC at all sites was modeled as a function of temperature and new heater size. The regression model (per site size category) is:

*Daily\_kWh = the daily usage (kWh) as collected*

*New\_Heater\_Size = the recorded new heater size (kW)*

*Temperature = the observed average outside air temperature (°F)*

Note that interactive effects are not applied in the calculation of the energy savings as the equipment will either be installed outside or in a room. Due to the equipment being installed either outside or in an unconditioned room, the energy savings will not vary by building type.

Estimation Results

The baseline usage for undersized sites is represented by the following calculation.

*daily\_kWh* = 20.2 x *Baseline\_Heater\_Size*

The regression results for the baseline usage for properly sized sites and for treatment (measure case) usage are provided below.

Estimated Baseline Usage for Properly Sized Sites (regression results)

|  |  |  |
| --- | --- | --- |
| **Site Size Category** | **Regression Coefficients** | |
| **Intercept** | **Temp.** |
| 1 | 105.91 | -1.178 |
| 2 | 88.92 | -0.701 |

Estimated Treatment Usage (regression results)

|  |  |  |  |
| --- | --- | --- | --- |
| **Site Size Category** | **Regression Coefficients** | | |
| **Intercept** | **Heater Size** | **Heater Size Temp.** |
| 1 | 3.70 | 13.135 | -0.136 |
| 2 | 5.86 | 13.195 | -0.133 |

Using the estimation results to estimate the UES from a CBH installation requires the following items:

* Site size category
* Baseline heater size
* New heater size
* Climate zone (to determine average temperature)

Note that the range of observed temperatures are generally lower than those observed in SCE territory climate zones, particularly for baseline regression. These savings estimates, therefore, project heater performance for temperatures generally outside the observed range.

The UES of this measure is determined by the following steps:

* Determine whether baseline heater is *undersized* or *properly sized* for the site size category.
  + For *undersized* baseline heaters, average daily UEC is determined using regression results in the previous tables.
  + For *properly sized* heaters, averaged daily UEC is determined for climate zone average temperature, using regression results in the previous tables.
* Estimate treatment usage based on new heater size and climate zone average temperature, using regression results provided in the table above.
* The difference in daily kWh can be projected into annual saving using preferred assumed days of operation.

Sample Calculations

Sample 1: Climate Zone 6, site size category 1, baseline heater size 1 kW, new heater size 1 kW, annual operation 334 days / year.

* Designation: Undersized
* Annual Average Temperature: 63.95°F
* Baseline Daily kWh: 20.2 \* [Baseline Heater Size] = 20.2 kWh / day.
* Treatment Daily kWh: 3.70 + 13.135 \* [New Heater Size] – 0.136 \* [New Heater Size] \* [63.95°F] = 8.1 kWh / day
* Annual Savings: (20.2 kWh/day – 8.1 kWh/day) \* 334 days/year = **4,039 kWh/year.**

Sample Calculation - Climate Zone 6

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **Baseline Heater Size** | **New Heater Size** | **Baseline Heater Designation** | **Baseline Daily Usage (kWh)** | **Treatment Daily Usage (kWh)** | **Annual Savings (kWh)** |
| 1 | 1 | 1 | Undersized | 20.2 | 8.1 | 4,039 |
| 3 | 3 | Proper-Sized | 30.6 | 16.9 | 4,553 |
| 2 | 1 | 1 | Undersized | 20.2 | 10.5 | 3,233 |
| 6 | 6 | Proper-Sized | 44.1 | 33.8 | 3,431 |

Sensitivity Analysis

A sensitivity analysis was conducted to examine the validity of using the annual average temperature instead of daily average temperature to estimate the UES for this measure.[[8]](#footnote-8) For climate zone 6, the savings using daily average temperature were on average, within 0.06% of the savings results using the yearly average temperature. For climate zone 15, the savings estimated with daily average temperature were on average, within 0.03% of the savings estimated using the yearly average temperature. Based on the results of the sensitivity analysis, the savings using the yearly average temperature seems to be an appropriate assumption for this measure.

Sensitivity Analysis Results – Climate Zone 6

|  |  |  |  |
| --- | --- | --- | --- |
| Measure | Sensitivity Analysis Savings (kWh) | Original Savings (kWh) | % Difference in Savings |
| 37-199 kW Backup Generator with Circulating Block Heater replacing Undersized Thermosiphon Heater | 4,039 | 4,037 | -0.05% |
| 200-799 kW Backup Generator with Circulating Block Heater replacing Undersized Thermosiphon Heater. | 3,233 | 3,231 | -0.06% |

Sensitivity Analysis – Climate Zone 15

|  |  |  |  |
| --- | --- | --- | --- |
| Measure | Sensitivity Analysis Savings (kWh) | Original Savings (kWh) | % Difference in Savings |
| 37-199 kW Backup Generator with Circulating Block Heater replacing Undersized Thermosiphon Heater | 4,601 | 4,602 | 0.02% |
| 200-799 kW Backup Generator with Circulating Block Heater replacing Undersized Thermosiphon Heater | 3,782 | 3,783 | 0.03% |

Peak Electric Demand Reduction (kW)

The peak demand reduction for this measure was calculated by dividing the estimated annual unit energy savings(UES) by the total operating hours. Because circulating block heaters are typically installed on backup generators that are required to kick on when needed (when the power goes out), the energy savings calculations assume that the circulating block heaters are enabled continuously for 334 days out of the year (accounting for maintenance). A sample calculation is provided below.

Sample 3: Climate Zone 6, site size category 1, baseline heater size 1 kW, new heater size 1 kW, annual operation 334 days / per year.

* Designation: Undersized
* Annual Average Temperature: 63.95°F
* Base Case Daily Usage (kWh): 20.2 \* [Baseline Heater Size] = 20.2 kWh / day.
* Measure Case Daily Usage (kWh): 3.70 + 13.135 \* [New Heater Size] – 0.136 \* [New Heater Size] \* [63.95°F] = 8.1 kWh / day
* Annual UES: (20.2 kWh/day – 8.1 kWh/day) \* 334 days/year = 4,039 kWh/year.
* Annual peak demand reduction (kW): 4,039 kWh/year / (334 days/year \* 24 hours/day) = 0.504 kW

Gas Savings (Therms)

Not applicable.

Life Cycle

Effective useful life (EUL) is an estimate of the median number of years that a measure installed through a program is still in place and operable. Remaining useful life (RUL) is an estimate of the median number of years that a technology or piece of equipment replaced or altered by an energy efficiency program would have remained in service and operational had the program intervention not caused the replacement or alteration.

The EUL and RUL specified for a circulating block heater is presented in the table below. The estimated lifetime for this measure is based upon a water loop pump and is supported by several retention studies conducted by California investor-owned utilities. Note that RUL is only applicable for Add-on Equipment (AOE) measures, thus not applicable.

Effective Useful Life and Remaining Useful Life

|  |  |  |
| --- | --- | --- |
| **Parameter** | **Value** | **Source** |
| EUL (yrs) | 15.0 | San Diego Gas & Electric (SDG&E), Marketing Programs & Planning. 2004. 1994 & 1995 Commercial Energy Efficiency Incentives Ninth Year Retention Evaluation. Study ID Nos. 925 & 961.  ADM Associates, Inc. 2003. Southern California Edison Commercial/Industrial/Agricultural Energy Efficiency Incentives Program Retention Study. Prepared for Southern California Edison Company.  San Diego Gas & Electric (SDG&E). 2003. 1996 & 1997 Agricultural Energy Efficiency Incentives Sixth Year Retention Evaluation. Study ID Nos. 1000 & 1024. |
| RUL (yrs) | n/a | n/a |

Base Case Material Cost ($/unit)

Base case material costs were developed from the same data and methodology as the Measure Case Material Cost.

**Base Case Material Costs**

|  |  |
| --- | --- |
| **Cost Description** | **Cost ($)** |
| Thermosiphon for 37 - 199 kW Generator Capacity | $201.25 |
| Thermosiphon for 200 – 799 kW Generator Capacity | $717.35 |

Measure Case Material Cost ($/unit)

The measure case equipment costs were derived from data obtained in 2017 from HotStart®, a major equipment manufacturer of engine heaters that supplies components to generator companies like Quinn, CAT, and Cummins. The 2017 costs were updated in 2020 with cost data provided by HotStart. The methodology to calculate the base case and measure case costs from the data provided by HotStart is summarized below: [[9]](#footnote-9)

* HotStart representative provided a list of recommended thermosiphon and forced circulation heater models corresponding to engine displacement in liters ranging from 2.4 L to 76.3 L.
* These engine displacements in liters are converted to generator capacities in kW using manufacturer websites (Generac and Kohler). The resultant range of generator capacities after the conversion is 30 kW to 2,500 kW. These conversions were reviewed with the HotStart representative.
* The engine heaters are designed for different voltages, phases, frequencies, and features based on the application. Some variations in features include with-thermostats, adjustable thermostats, and without thermostats.
* Pricing information for a variety thermosiphon models was provided by HotStart. However, for the forced circulation heaters, cost data was limited to a few recommended models:

Backup Generator 40 to 600 kW – Single phase and 120 Volts

Backup Generator 750 to 2000 kW – Single phase and 208 Volts

Backup Generator 2500 kW – Three phase and 208 Volts

* To provide an accurate cost analysis, the above forced circulation heater models were compared with the thermosiphon counterparts with the same features.
* The average price for the base and measure equipment was calculated for each of the size categories of the generator capacities identified for measure savings.
* The HotStart representative was not aware of the concept of properly sized and undersized thermosiphon heaters as defined in the calculation methodology. It is assumed that the base case cost is the same for properly sized and undersized. There is no under sizing of the forced circulating heater. Hence, measure cost will always be properly sized circulating block heater.

**Measure Material Costs**

|  |  |
| --- | --- |
| **Cost Description** | **Cost ($)** |
| Forced Circulation Block Heater for 37 - 199 kW Generator Capacity | $700.00 |
| Forced Circulation Block Heater for 200 – 799 kW Generator Capacity | $804.86 |

Base Case Labor Cost ($/unit)

Base case labor costs were developed from the same data and methodology as the Measure Case Labor Cost.

Measure Case Labor Cost ($/unit)

The labor installation cost was derived from RSMeans Data Year 2020 Quarter 3 electrician union labor rates, along with the labor hours required for installing a 2 hp size 00 motor, Magnetic FVNR with enclosures and heaters (Line Number 262419400080).[[10]](#footnote-10) Based on discussions with HotStart®, the installation of the thermosiphon and circulating block heaters typically requires a couple of hours and there is no variation in the installation times across different sized units.

**Measure Labor Costs**

|  |  |
| --- | --- |
| **Cost Description** | **Cost ($)** |
| (1) Union Electricians Labor Rate at the Labor Hours Required to Install (1) 2 HP size 00 motor, Magnetic FVNR with enclosures and heaters (Line Number 262419400080) - RS Means 2020 Q3  Labor Rate: $91.35 Labor Hours: 2.286 | $208.83 |

Net-to-Gross (NTG)

The net-to-gross (NTG) ratio represents the portion of gross impacts that are determined to be directly attributed to a specific program intervention. The relevant NTG value for the circulating block heater is specified in the table below. This NTG value is documented in the 2011 DEER Update Study conducted by Itron, Inc. This sector average NTGs (“default NTGs”) is applicable to all energy efficiency measures that have been offered through residential or nonresidential sector energy efficiency programs for two years or less and for which impact evaluation results are not available.

Net-to-Gross Ratios

|  |  |  |
| --- | --- | --- |
| **Parameter** | **Value** | **Source** |
| NTG – Commercial  NTG ID – Com-Default>2yrs | 0.60 | Itron, Inc. 2011. *DEER Database 2011 Update Documentation.* Prepared for the California Public Utilities Commission. Page 15-4 Table 15-3. |
| NTG – Industrial  NTG ID – Ind-Default>2yrs | 0.60 | Itron, Inc. 2011. *DEER Database 2011 Update Documentation.* Prepared for the California Public Utilities Commission. Page 15-4 Table 15-3. |
| NTG – Agriculture  NTG ID – Agric-Default>2yrs | 0.60 | Itron, Inc. 2011. *DEER Database 2011 Update Documentation.* Prepared for the California Public Utilities Commission. Page 15-4 Table 15-3. |

Gross Savings Installation Adjustment (GSIA)

The gross savings installation adjustment (GSIA) rate represents the ratio of the number of verified installations of the measure to the number of claimed installations reported by the utility. This factor varies by end use, sector, technology, application, and delivery method. The GSIA rate specified for a circulating block heater is included in the table below. This GSIA rate is the current “default” rate specified for measures for which an alternative GSIA has not been estimated and approved.

Gross Savings Installation Adjustment

|  |  |  |
| --- | --- | --- |
| **Parameter** | **Circulating Block Heater** | **Source** |
| GSIA GSIA ID – Def-GSIA | 1.0 | California Public Utilities Commission (CPUC), Energy Division. 2013. *Energy Efficiency Policy Manual Version 5*. Page 31. |

Non-Energy Impacts

Non-energy impacts for this measure have not been quantified.

DEER Differences Analysis

This section provides a summary of DEER-based inputs and methods, and the rationale for inputs and methods that are not DEER-based. Currently, DEER does not address this type of measure. Also, DEER interactive effects are not incorporated, as most backup generators are kept in a non-conditioned or exterior space.

DEER Difference Summary

|  |  |
| --- | --- |
| **DEER Item** | **Comment / Used for Workpaper** |
| Modified DEER methodology | No |
| Scaled DEER measure | No |
| DEER Base Case | No |
| DEER Measure Case | No |
| DEER Building Types | No |
| DEER Operating Hours | No |
| DEER eQUEST Prototypes | No |
| DEER Version | n/a |
| Reason for Deviation from DEER | n/a |
| DEER Measure IDs Used | n/a |
| NTG | The NTG of 0.60 is associated with NTG ID: *Com-Default>2yrs, Ind-Default>2yrs, and Agric-Default>2yrs* |
| GSIA | The GSIA of 1.0 is associated with GSIA ID: *Def-GSIA* |
| EUL/RUL | The value of 15 years is associated with EUL ID: *Motors-pump*. |

Revision History

Measure Characterization Revision History

|  |  |  |  |
| --- | --- | --- | --- |
| **Revision Number** | **Date** | **Primary Author, Title, Organization** | **Revision Summary and Rationale for Revision**  **Effective Date and Approved By** |
| 01 | 06/30/2018 | Jennifer Holmes  Cal TF Staff | Draft of consolidated text for this statewide measure is based upon:  SCE17HC055 Revision 0 (November 16, 2017)  SCE13HC055 Revision 0 (September 19, 2014)  Consensus reached among Cal TF members. |
| 3/28/2019 | Jesse Manao | Text and cost data updated using the latest workpaper:  SCE17HC055 Revision 2 (May 9, 2018) |
| 02 | 11/13/2020 | Rich Williams  TRC  Kara Vega  TRC | Updated costs based on vendor material costs and labor costs based on hourly RS Means 2020 labor rates.  Updated energy savings calculations based on 2017 ASHRAE handbook ambient design air temperatures for CZ reference sites.  Measure offerings SWPR004E and SWPR004F were removed from the workpaper due to negative incremental measure costs. |
| 07/06/2021 | Adan Rosillo  PG&E | Added PG&E’s measure codes to adopt indicated measures. |

1. Bonneville Power Administration (BPA). (n.d.) “Energy Efficient Stationary Engine Block Heater.” [↑](#footnote-ref-1)
2. Avista. 2012. *Pump-Driven Block Heaters: A Study in Energy Efficiency.* [↑](#footnote-ref-2)
3. Southern California Edison (SCE). 2017. "SCE17HC055.0 Circulating Block Heater - Savings Analysis and Estimates.xlsx." [↑](#footnote-ref-3)
4. Southern California Edison (SCE). 2009. *Air Source Heat Pump for Preheating of Emergency Diesel Backup Generators.* ET08SCE1020. [↑](#footnote-ref-4)
5. Pacific Gas & Electric (PG&E). 2014. *Forced Circulation Engine Generator Block Heater Energy Performance Assessment.* ET Project Number: ET13PGE1091. [↑](#footnote-ref-5)
6. PCDC was reported to have a baseline heater size of 12 kW; this value is anomalously large and not consistent with other observable data. Based on measured kW and usage levels, a heater size of 6 is more plausible and more consistent. [↑](#footnote-ref-6)
7. Outside air temperature data are based on DEER 2022 Outside dry-bulb temperature data. [↑](#footnote-ref-7)
8. Southern California Edision (SCE). 2020. “SWPR004-02 Sensitivity Analysis.xslx.” [↑](#footnote-ref-8)
9. Southern California Edison (SCE). 2020. "SWPR0040-02 Cost Analysis.xlsx." [↑](#footnote-ref-9)
10. Southern California Edison (SCE). 2020. "SWPR0040-02 Cost Analysis.xlsx." [↑](#footnote-ref-10)