**Work Paper Abstract**

**Block Heaters**

**Revision # 1**

**California Technical Forum**

**WP Abstract Prepared by: Alfredo Gutierrez, SCE**

**Circulating Block Heater**

***Abstract***

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| WP Abstract Tracking Log | | | | |
|  | **Date Issued** | **Due By** | **Version** | **Author**  **(last name)** |
| Circulated to TF Members |  |  |  |  |
| Cal TF summarizes comments |  |  |  |  |
| Abstract presented at Meeting; consensus decision-marking |  |  |  |  |
| Cal TF finalizes abstract; prepares comparison exhibit of non-consensus items |  |  |  |  |
| Abstract to TF Subcommittee |  |  |  |  |
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Table 1 Work Paper Abstract Snapshot

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| --- | --- | --- |
| Work Paper Abstract Snapshot | | |
| Item | **Details** | **Notes** |
| Measure name | Circulating Block Heater |  |
| Measure description |  |  |
| Sector (Res/Non-Res) | Non-Res |  |
| Subsector (e.g. Ag) | Commercial, Industrial |  |
| Program(s) | Downstream |  |
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1. Measure Description

The measure is a circulating block heater used on backup diesel generators. The measure will be tiered based upon the generator sizes shown below:

* 37-199 kW
* 200-799 kW
* 800-1099 kW
* 1100-2500 kW

This technology has 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. 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.

The base case equipment is a thermo siphon heater. These types of heaters rely on the change in density (impacting buoyancy) in order to circulate the heated coolant. This type of circulation leads to non-uniform temperature distribution, where the coolant is warmer at the top of the block and colder at the bottom, which requires the electric resistance heater to operate for a longer duration. This also means that there is waste heat in sections of the block, as the heater must operate to maintain a certain temperature, so the top of the block will always be hotter than necessary.

The measures within this work paper will be targeted towards the commercial and industrial sector.

1. Key Terms

Circulating Block Heater – Uses electric heating element along with a circulating pump warms engine to increase the chance that the engine will start,

Thermo Siphon Heater – Relies on buoyancy to mix the warm coolant with the cold coolant.

1. Program Implementation Method

The measures within this work paper will have a downstream delivery method. Customers will receive incentives depending on the size of their generator. Generators which do not fall within the size ranges listed above in section 1 will not be eligible to participate within the program. The program will target commercial as well as industrial buildings which are required to have backup generators, such as hospitals. The measure is currently offered through our statewide custom program.

The installation type for these measures will be Early Retirement (RET), Replace on Burnout (ROB) and New (NEW).

1. Mixed Baseline

It is estimated that the majority of existing generators currently have thermo siphon heaters installed. The program will also only allow units with thermo siphon heaters to participate.

1. Measure Summary

Table 2 Measure Summary

|  |  |
| --- | --- |
| **Characteristic** | **Measure** |
| Baseline Technology or Mix | Thermo siphon heaters |
| Measure Technology | Circulating block heaters |
| Measure Application Type | RET (ER), ROB, NEW |
| Delivery Mechanism | Downstream |
| Impacted Markets | Commercial and Industrial |
| Relevant Codes and Standards | There are currently no codes known to the author. |

1. Estimated Size of Offer (Number of Participants)

It is estimated that there will be a minimum of 300 installations in 2014 in SCE territory through the customized program.

1. Estimated Impact of the Measure on Statewide Energy Efficiency Savings.

The savings values for this measure vary based on generator size (as seen in the tiers from section 1) as well as the outside ambient temperature (dry bulb). A sample set of savings are shown below for each generator tier size:

Table 3 Estimated kWh Savings

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Generator Size (in kW)** | **kWh Savings per**  **Annualized Average Dry Bulb Temperature (in Deg F)** | | | | | |
| 70 °F | 72 °F | 74 °F | 76 °F | 78 °F | 80 °F |
| **37 – 199 kW** | 1,739 | 1,770 | 1,800 | 1,830 | 1,861 | 1,891 |
| **200 – 799 kW** | 3,476 | 3,524 | 3,572 | 3,619 | 3,667 | 3,714 |
| **800 – 1099 kW** | 8,786 | 8,905 | 9,024 | 9,144 | 9,263 | 9,382 |
| **1100 – 2500 kW** | 19,160 | 20,791 | 22,422 | 24,054 | 25,685 | 27,316 |

Table 4 Estimated kW Savings

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Generator Size (in kW)** | **kW Savings per**  **Annualized Average Dry Bulb Temperature (in Deg F)** | | | | | |
| 70 °F | 70 °F | 70 °F | 70 °F | 70 °F | 70 °F |
| **37 – 199 kW** | 0.22 | 0.22 | 0.22 | 0.23 | 0.23 | 0.24 |
| **200 – 799 kW** | 0.43 | 0.44 | 0.45 | 0.45 | 0.46 | 0.46 |
| **800 – 1099 kW** | 1.10 | 1.11 | 1.13 | 1.14 | 1.16 | 1.17 |
| **1100 – 2500 kW** | 2.39 | 2.59 | 2.80 | 3.00 | 3.20 | 3.41 |

These estimates are taken from a tool developed by SCE, based on Bonneville Power Administration (BPA) data. This tool, along with the backup data used in the regression models can be seen in attachment 3.

1. Applicable DEER

Currently, DEER does not address this type of measure. Also, DEER interactive effects will not be used as most backup generators are kept in non-conditioned or exterior spaces.

1. Proposed Measure Parameter Data and Sources

Table 5 Proposed Measure Parameter Data and Sources

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Measure Parameter** | **Data** | **Source Description[[1]](#footnote-1)** | **Modification of DEER or reason for not using DEER** | **Confidence Level**  **(High, Medium, Low)** |
| Savings – kWh | kWh/unit;  See savings estimate in Section 7. | The source of the savings comes from a custom tool that has been developed by SCE, where the data has been collected by BPA. BPA has provided data from 17 different sites, including waste water plants and data centers.  The tool will be used for custom projects. A subset of these projects will be monitored to obtain more data to be used in the work paper. | DEER does not contain this type of measure, nor can the interactive effects be used as backup generators are typically kept in non-conditioned or exterior spaces. | Medium |
| Savings – kW | kW/unit;  See savings estimate in Section 7. | The source of the savings comes from a custom tool that has been developed by SCE, where the data has been collected by BPA. BPA has provided data from 17 different sites, including waste water plants and data centers.  The tool will be used for custom projects. A subset of these projects will be monitored to obtain more data to be used in the work paper. | DEER does not contain this type of measure, nor can the interactive effects be used as backup generators are typically kept in non-conditioned or exterior spaces. | Medium |
| Savings – therm | N/A.  Therm savings are not expected from this measure. | N/A | N/A | N/A |
| EUL or RUL | EUL: 15 years  RUL: 15/3 = 5 years | The EUL has been mapped to DEER as an approximation. The EUL of Motors-pump has been mapped to this measure. | Mapped to DEER as an approximation. | Medium |
| MC or IMC | TBD | Manufacturer Data | DEER does not contain this information. | High |
| NTG | 0.85 | DEER: ET-Default | N/A | High |

1. Proposed Measure Parameter Methodology Sources

The savings for this measure are based on data from the Bonneville Power Administration (BPA); please see attachment 1 for more information regarding the BPA study, where the average kWh and outside air temperature were monitored for both generators with thermo siphons and the retrofitted circulating block heater. There are 17 sources of data, which are taken from different sites including waste water plants and data centers, where BPA measured/obtained the following parameters:

* OA temp, though unclear if this was measured, or taken from bin data. This parameter will be taken from SCE specific custom project data for the work paper.
* Duty Cycle
* Daily kWh
* kW

The data was collected for different amounts of time for each site, but on average, there are 2 months pre and post for each site used in the regression analysis. Using the data, plots of daily energy usage vs. outdoor air temperature are used to generate regression models. The regression models where found, by generator size, and used to calculate savings at different OA temperatures. It was assumed that these generators are operating 334 days out of the year, with only a month of downtime for maintenance.

Figure 1. Daily Average kWh vs. Average Outside Air Temperature: Thermo Siphon

Figure 2. Daily Average kWh vs. Average Outside Air Temperature: Circulating Block Heater

The kW savings were found by dividing the kWh savings by the total assumed operating hours (approx. 8,000 hrs/year). This was deemed reasonable as the backup generators are always on.

Table 6 Proposed Measure Parameter Methodology and Sources

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Measure Parameter** | **Methodology** | **Source Description[[2]](#footnote-2)** | **Modification of DEER or reason for not using DEER** | **Confidence Level**  **(High, Medium, Low)** |
| Savings – kWh | Please see the outlined methodology above. | The source from this data came from 17 different sites. This data was collected by BPA. BPA has provided data from 17 different sites, including waste water plants and data centers. | DEER does not contain this type of measure, nor can the interactive effects be used as backup generators are typically kept in non-conditioned or exterior spaces. | Medium |
| Savings – kW | Please see the outlined methodology above. | The source from this data came from 17 different sites. This data was collected by BPA. BPA has provided data from 17 different sites, including waste water plants and data centers. | DEER does not contain this type of measure, nor can the interactive effects be used as backup generators are typically kept in non-conditioned or exterior spaces. | Medium |
| Savings – therm | N/A.  Therm savings are not expected from this measure. | N/A | N/A | N/A |
| EUL or RUL | EUL: 15 years  RUL: 15/3 = 5 years | The EUL has been mapped to DEER as an approximation. The EUL of Motors-pump has been mapped to this measure. | Mapped to DEER as an approximation. | Medium |
| MC or IMC | TBD |  |  |  |
| NTG | 0.85 | DEER: ET-Default | N/A | High |

1. Proposed Level of Complexity

Currently, the savings are based off of regression models from data collected from BPA. It is proposed that custom project applications through SCE’s custom program be monitored for a given time period (TBD) in order to true up the data used within the calculation tool. This new data will then be used to substantiate a work paper covering these measures. Currently, it is estimated that there will be 300 applications for this measure by 2014; however, measurements will only be taken in about 10% (TBD) of the total sites. The kWh, OA temperature, and actual operating schedule should be captured. It is preferable to calculate the energy savings using monitored data of actual site installations as this will provide the most representative and realistic savings associated with these measures. The work paper should be completed within a month or two after approval from the CALTF.

1. Preliminary TRC Estimates

Table 7 Preliminary TRC Estimates and Parameters

|  |  |  |  |
| --- | --- | --- | --- |
| **TRC Parameter** | **Parameter Estimate or**  **Required Parameter Value Threshold** (specify if estimate or threshold) | **Confidence Level**  **(High, Medium, Low)** | **Comments** |
| UES | 3333 kWh;  0.42 kW | Medium | These are savings estimates based off the data provided by BPA. |
| IMC | $2,450.00 | Medium | Cost provided by manufacturer. |
| EUL | 15 | High |  |
| NTG | 0.85 | High |  |
| Incentive/unit | $612.50 | Medium | Assumed a quarter of the cost of the measure. |
| Number of units | 300 | Medium |  |
| Installation Rate | 1 | High |  |
| Gross Realization Rate | 1 | High |  |
|  |  |  |  |
|  |  |  |  |
| ***TRC Value:*** | **1.46** | | |

Please see attachment 2 for an E3 export for one generator size.

1. Questions for CPUC Staff on Applicability of DEER Values, Methods, Tools, Data, Etc.

Is the CPUC staff comfortable with the methodology laid out to calculate the energy savings? This would include the data collection aspect as well as the time period chosen to monitor the generator sets pre and post.

1. Additional Research Needed

Additional research should be done on the existing market and the cost of the equipment. We have provided costs from one manufacturer, but it would be good to get a better sample from a number of manufacturers. Also, exploring the existing market would help us understand the prevalence of thermo siphon heaters.

1. Applicable EM&V

The BPA has done monitoring of pre and post generator sets. This data has been used to estimate the savings associated with these measures.

Before writing a work paper, more data is to be collected from SCE specific projects in order to validate the savings estimates. Average kWh and OA temperatures will be monitored. The average yearly operating schedule will be obtained.

1. Workpaper Development
2. Alfredo Gutierrez/SCE – Involved with the creation of the custom calculation tool.
3. Draft work paper pending the collection of SCE specific custom project data that will be used to justify savings estimates. Cost of existing thermo siphons and circulating block heaters will also need to be determined.
4. Work Paper Budget – TBD.
5. Cal TF Comments on Proposed Measure Parameter Data and Sources

*Cal TF comments on proposed data and sources. Do data represent best available data? If not, what are alternate data/sources that should be considered?*

**Table 6.** Cal TF Comments on Measure Parameter Data and Sources

|  |  |  |
| --- | --- | --- |
| **Measure Parameter** | **Cal TF Comments on**  **Proposed Data/Source** | **Cal TF Recommendation(s) on Alternate Sources to Consider** |
| Savings – kWh |  |  |
| Savings – kW |  |  |
| Savings – therm |  |  |
| EUL or RUL |  |  |
| MC or IMC |  |  |
| NTG |  |  |

1. Cal TF Comments on Proposed Measure Parameter Methodology and Sources

*Cal TF comments on proposed methodology and sources. Do values represent best available data? If not, what are alternate methods/sources that should be considered?*

**Table 7.** Cal TF Comments on Measure Parameter Methodology and Sources

|  |  |  |
| --- | --- | --- |
| **Measure Parameter** | **Cal TF Comments on**  **Proposed Data/Source** | **Cal TF Recommendation(s) on Alternate Sources to Consider** |
| Savings – kWh |  |  |
| Savings – kW |  |  |
| Savings – therm |  |  |
| EUL or RUL |  |  |
| MC or IMC |  |  |
| NTG |  |  |

1. Cal TF Comments on Proposed Level of Complexity

*Cal TF comments on proposed level of complexity based on input from abstract developer and Cal TF discussion.*

1. Commission Staff Review and Feedback

*Commission staff should provide feedback on proposed data and sources within 10 days of request.*

**Table 8.** Commission Staff Feedback on Proposed Data and Sources

|  |  |  |  |
| --- | --- | --- | --- |
| **Measure Parameter** | **Date Sent to Staff** | **Date Staff Responded** | **Commission Staff Comment** |
| Savings – kWh |  |  |  |
| Savings – kW |  |  |  |
| Savings – therm |  |  |  |
| EUL or RUL |  |  |  |
| MC or IMC |  |  |  |
| NTG |  |  |  |

# Appendix A – Sources

1. BPA Presentation



1. E3 Output for One Generator Size Category



1. Custom Calculation Tool



1. Provide a link to source or embed source in Appendix A of this document with page numbers specified. [↑](#footnote-ref-1)
2. Provide a link to source or embed source in Appendix A of this document with page numbers specified. [↑](#footnote-ref-2)