

Phase I Ex Ante Review Findings

Table Error! No text of specified style in document.-1: Project Information

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| IOU | PG&E |
| Application ID | 1036-01.2 |
| Application Date | Not provided |
| Program ID | PGE2182 |
| Program Name | C & I Boiler Efficiency Program (CIBEP) |
| Program Year | 2013 |
| Itron Project ID | X449 |
| IOU Ex Ante Savings Date | 10/15/2013 |
| ED Measure Name | Pipe Insulation & Steam Trap Replacement |
| Project Description | EEM1 - Replace failed open steam traps, and EEM2 - Insulate remaining bare steam and hot water pipes |
| Date of ED Review(s) | 11/9/2013 |
| Primary Reviewer / Firm | Joseph Ball / Itron |
| Review Supervisor / Firm | Nikhil Gandhi / Strategic Energy Technologies, Inc. |
| ED Project Manager | ██████████ / California Public Utilities Commission, Energy Division |
| ED Policy Authorization (as needed) | |
| Type of Review (Desk, On-site, Full M&V, Tool) | Desk |
| ED Recommendation | ED conditionally approves ex ante energy savings pending post-install M&V and energy savings true-up and a final ED review of “live”, unlocked summary calculations. |

Measure Description

Customer proposes to energy efficient boiler measures: 1) Replace ten (10) failed open steam traps, and 2) insulate all remaining (approximately 5%) of the bare steam & hot water pipes, including that include valve covers and flanges, totaling approximately 45.1 square feet of un-insulated surfaces being considered in this project will be insulated with an all surface jacket and 1.0” to 2.0” of fiberglass. The reduction in heat loss results in reduced natural gas consumption by the boiler.

Energy savings will result from reduced heat and steam losses from the boiler system, resulting in reduced boiler firing and gas usage. Annual boiler system operating hours are claimed to be 5,278. Energy savings were estimated at 13, 554.6 therms with a total project cost of \$4,360.18 and an incentive capped at 50% of the project costs, or \$2,180.09.

Summary of Review

The Investor-Owned-Utility (IOU) submitted the following documents on CMPA on Sunday the 3rd of November 2013 for ED’s Phase I review:

- Enovity - XXXXXX Audit Report v2.docx produced by kW Engineering as PG&E’s third party reviewer;
- Attachment 2 - ASHRAE Condensing Boiler Curve.pdf
- XXXXXX_Condensing Economizer Data.xlsx
- MissionLinen_Sal_FGA.csv that contains one set of flue gas measurements;
- And five (5) NAIMA 3EPlus V4.1 simulation output files (two for hot water pipes, and three for steam pipes).

In order to learn more about the proposed project and in situ baseline conditions ED contacted decision-maker via a phone call on 11/11/2013. The ED reviewer found no eligibility issues with either measure. For EEM2 the steam and hot water pipe insulation that was installed 30 years ago when the plant was opened, is still in place functioning well and meeting the OSHA code, and has covered about 95% of all hot pipes. The proposed insulation will cover the remaining 5% bare pipe, and match the specs (1” thick fiber glass with aluminum jacket sleeving) of the existing pipe insulation, but the sleeving material needs to be confirmed.

Although it is not explicitly stated in documents submitted, it appears that the hot water pipes will be insulated with 1” thick fiberglass and the steam pipes will be insulated with 2” thick fiberglass, both with aluminum jacket sleeving. This should be verified as suggested during the post-install M&V.

Because a calculation summary was not submitted, ED is unclear how the IOU/3P applied the boiler thermal or combustion efficiencies in estimating energy savings. The audit report discusses using the flue gas combustion efficiency measurement for the steam traps energy

savings estimates. But the single 80.9% reading may be an outlier since ED observed the simultaneous percent of excess air reading to be over 49%, which seems too high for an accurate measurement. Also, ASHRAE condensing boiler thermal efficiencies were submitted for use in the pipe insulation savings estimates, but this could not be confirmed without the summary energy saving calculations.

An hourly bin analysis from two weeks of monitored data in 2008 - using economizer flows and stack inlet and outlet temperatures - was developed to model the recovered heating energy. This method is acceptable, albeit 5 years old.

Production has been steady over the past 5-10 years, although there is seasonality to the business, with the summer being their peak production (July), while winter is their slowest time of the year, related to the tourist industry in ██████████ County. Due to the steady cyclical nature of their business production data will not need to be normalized during the post-install period. It is noted that the two-week monitoring period in August 2008, may represent slightly higher production values than a fall or spring measurement would have.

According to the decision maker, the plant's boiler has never failed the local pollution control district's emissions test with zero violations over the 30 year steam system life.

There is likely measure interactivity occurring between the two proposed measures that improve boiler steam and hot water system efficiencies; however, since M&V will be performed during the post-install, IOU true-up phase the combined system savings will be verified with system temperatures, flows, and boiler operating hours compared to in situ.

Review Conclusion

The ex ante savings are conditionally approved, pending post-install M&V and IOU true-up.

Summary of ED Requested Action by the IOU

ED requests that the IOU undertake the following recommended actions within 14 days of the submittal of this phase I disposition:

1. Submit the signed (customer & 3P) CIBEP program application.
2. The most current "live" and unlocked IOU/3P calculation summary spreadsheet (prior to IR) for both measures.
3. Confirm what the new jacket material is: Aluminum or vinyl.
4. Provide the EUL for the pipe insulation system.
5. Modify the M&V plan to include the following tasks:

- a. Log boiler stack temperature logs for a minimum of two weeks during either of the shoulder seasons (spring or fall) to avoid both annual peak and slowest annual production, and using no greater than 15-minute intervals.
 - b. Take a minimum of five (5) solid flue gas measurements, excluding any outlier reads, while allowing the boiler to be running at least 10 minutes beyond its start-up condition. Take the average of the five good readings for boiler combustion efficiency.
 - c. Take spot measurements of the steam system pressure.
6. Re-submit M&V plan

After implementation of the project, submit the following documents:

- 7. The IR report and any revised savings calculations.
- 8. Copies of the actual final invoices broken out by material and labor costs.

Table 1-2 Review Findings

| Reviewed Parameter | Analysis |
|--|--|
| Project Baseline Type (Early Replacement, Normal Replacement, Capacity Expansion, New Construction, System Optimization, Add-on Measures, Major Renovation) Note: For early retirement projects only, include RUL through EUL baseline) | IOU Proposal: EEM1 – No baseline is claimed however a retrofit of failed-open steam traps suggests a system optimization of the boiler system. EEM2 – A code-compliant add-on measure is implied. |
| | ED Assessment: The 3P implementer should clearly state a baseline for each measure in the project. For EEM1 – a system optimization is acceptable. For EEM2 a code-compliant add-on measure is acceptable. |
| | ED Recommendation: EEM1 – System optimization; EEM2 – Add-on measure |
| Project Baseline Technology (in situ equipment, Title 24 (specify year), other code or other efficiency level (specify), industry standard practice - ISP) | IOU Proposal: EEM1 – In situ equipment and conditions are assumed. EEM2 – OSHA code baseline requiring insulation on hot surfaces that are within seven feet (7 ft) of walkways. |
| | ED Assessment: Accept |
| | ED Recommendation: None |
| Project Cost Basis (Full Incremental, or Both. Note: For early retirement projects, include RUL through EUL cost basis) | IOU Proposal: Full cost |
| | ED Assessment: Full cost appropriate |
| | ED recommendation: None |

| Reviewed Parameter | Analysis |
|---|--|
| treatment) | |
| RUL (required for early retirement projects only, otherwise N/A) | IOU Proposal: N/A |
| | ED Assessment: N/A |
| | ED recommendation: N/A |
| EUL (for each measure) | IOU Proposal: EUL not provided. |
| | ED Assessment: EEM1 – Steam trap EUL is 6 years based on previous evaluations. EEM2 – Since the existing insulation with aluminum jacket sleeving is still in existence, this supports previous ED findings on pipe insulation projects that EUL of 20 years is appropriate. |
| | ED Recommendation: 6 for steam traps; 20 years for pipe insulation. |
| Savings Assumptions | IOU Proposal: The IOU used two weeks of SCADA trends from 2008, or five years ago. <ol style="list-style-type: none"> 1. 10 opened steam traps 2. Annual operating hours is 5,278 3. ASHRAE condensing boiler thermal efficiencies 4. 80.9% condensing boiler combustion efficiency 5. Pipe lengths were not provided; instead 45.1 square feet was estimated 6. 4” diameter steel steam pipe = ASTM C 585 Rigid 7. 2” diameter hot steel hot water = ASTM C 585 Rigid 8. Process Steam Temperature = 344 9. Process Hot Water Temperature = 165 10. Ambient Temperature = 57.5 11. Wind Speed = 0.0 12. Bare Metal = Steel 13. Bare Surface Emittance = 0.8 14. Insulation Layer 1 = Glass Fiber Felt, C1086-09 15. Outer Jacket Material = All Service Jacket (ASJ) or Oxidized Aluminum 16. Outer Surface Emittance = 0.9 (ASJ) or 0.1 (Aluminum) |
| | ED Assessment: Accepted |
| | ED Recommendation: None |
| Calculation Methods/Tool review | IOU Proposal: EEM1 – For the steam trap retrofit, a spreadsheet model was developed using Napier’s equation, system steam pressure and the orifice size of the steam trap along with a spot measurement of combustion efficiency. EEM2 – NAIMA 3EPlus tool using ASHRAE condensing boiler thermal efficiency curves. |
| | ED Assessment: Both methods are acceptable |
| | ED Recommendation: None |
| Pre- or Post- | IOU Proposal: The 3P M&V plan includes visual and photo verification of |

| Reviewed Parameter | Analysis |
|----------------------------------|---|
| Installation M&V Plan | the installed equipment quantity, type, and controls during the post-installation inspection. Enovity will also measure or verify the following parameters: <ul style="list-style-type: none"> ▪ Verify correct type and thickness of the insulation on each type of piping system. ▪ Spot measure surface temperatures of insulated surfaces ▪ Spot measure surface temperatures across steam traps |
| | ED Assessment: Acceptable; however, ED recommends adding the following tasks to the M&V plan: <ul style="list-style-type: none"> ▪ Log the boiler stack temperatures for a minimum of two weeks during either of the shoulder seasons (spring or fall), to avoid both annual peak and slowest production. ▪ Take at least five flue gas analysis measurements for boiler combustion efficiency, throwing out any outliers and taking the average for use in the savings calculations. ▪ Take spot measurements of the steam system pressure. |
| | ED Recommendation: Per above directive. |
| Net-to-Gross Review | IOU Proposal: Not provided |
| | ED Assessment: Not assessed nor recommended |
| | ED Recommendation: None |

Table 1-3 Energy Savings Summary, Project Costs & Incentive

| Description | IOU Ex Ante Claim | ED Recommendations |
|--|-------------------|--------------------|
| First Year kWh Savings | N/A | N/A |
| First Year Peak kW Savings | N/A | N/A |
| First Year Therms Savings | 13,354.6 | TBD |
| kWh Savings (RUL Period) | N/A | N/A |
| Peak kW Savings (RUL Period) | N/A | N/A |
| Therms Impact (RUL Period) | N/A | N/A |
| kWh Savings (RUL thru EUL Period) | N/A | N/A |
| Peak kW Savings (RUL thru EUL Period) | N/A | N/A |

Phase I Ex Ante Review Findings

| Description | IOU Ex Ante Claim | ED Recommendations |
|---|---|---------------------------|
| Therms Savings (RUL thru EUL Period) | 13,354.6 | TBD |
| Annual Non-IOU Fuel Impact (RUL Period) | N/A | N/A |
| Annual Non-IOU Fuel Impact (RUL thru EUL Period) | N/A | N/A |
| Project Costs for Baseline #1 (RUL or EUL) | \$4,360.18 | Accepted |
| Project Costs for Baseline #2 (EUL minus RUL period) | N/A | N/A |
| Project Incentive Amount | \$2,180.09 capped at 50% of the full project cost | Accepted |