

## Phase 1 Ex Ante Review Findings

Table 0-1: Project Information

<b>IOU</b>	Pacific Gas & Electric (PG&E)
<b>Application ID</b>	1539-01
<b>Application Date</b>	August 7, 2013
<b>Program ID</b>	PGE2223
<b>Program Name</b>	Heavy Industrial Energy Efficiency Program (HIEEP)
<b>Program Year</b>	2013
<b>Itron Project ID</b>	X388
<b>IOU Ex Ante Savings Date</b>	8/7/2013
<b>ED Measure Name</b>	Rotary Hearth Furnaces
<b>Project Description</b>	Replacement of Two Furnaces for Increased Production
<b>Date of ED Review(s)</b>	September 20, 2013
<b>Primary Reviewer / Firm</b>	Rachel Murray / DNV KEMA
<b>Review Supervisor / Firm</b>	Amit Kanungo / DNV KEMA and Joseph Ball / Itron
<b>ED Project Manager</b>	██████████ / California Public Utilities Commission, Energy Division
<b>ED Policy Authorization (as needed)</b>	TBD
<b>Type of Review (Desk, On-site, Full M&amp;V, Tool)</b>	Desk
<b>ED Recommendation</b>	The ex ante savings are conditionally approved pending completion of action items in the <i>Summary of ED Requested Actions by the IOU</i> section.

## **Measure Description**

This project involves the replacement of two gas batch-type furnaces with standard burners. They are currently in use eight hours per day, five days per week, 50 weeks per year and have been in operation for approximately 40 years. They are used to heat tool-steel bars to 2,350°F prior to being transferred to the forging hammer. Despite the age of the furnaces, the IOU claims the furnaces have more than one year of remaining useful life since they contain few moving parts and have been well maintained. The existing furnaces will be replaced with two eight-foot rotary hearth gas furnaces that have four high velocity burners, each, and self-recuperative combustion systems. Without changing the hours or methods of operation, the average daily production of salable product will increase from 20,706 pounds to an estimated 78,000 pounds while still yielding gas savings—the average production efficiencies of the existing furnaces are 12.78 percent and 14.31 percent whereas the production efficiency of both proposed furnaces is estimated to be 63 percent. The production efficiency of the industry standard practice equipment is estimated to be 20 percent. The proposed furnaces are estimated to yield annual gas savings of 339,261 therms for the RUL period. For the RUL-EUL period, the proposed furnaces are estimated to yield annual gas savings of 208,970 therms. The incremental measure cost, relative to the industry standard practice equipment, is \$810,000. With the proposed incentive of \$339,261, the net incremental measure cost will be \$470,739 and the simple payback period will be 1.4 years. The final incentive, however, will be based upon the actual project performance to be determined by performing a regression analysis of post-installation results of monitored gas consumption and salable product.

## **Summary of Review**

The Investor Owned Utility (IOU) submitted the following documents in response to Data Request (DR) 7913 of July 24, 2013, for this Phase 1 review:

- Response to data request (EnergyEfficiencyOIR-Post-2008\_DR\_ED\_445\_EEGA\_7913.doc)
- Report detailing furnace replacement project (1539-01 xxxxxxxx xxxxx xxxx PCIP Report 8 8 13 Final MS.doc & 1539-01 xxxxxxxx xxxxx xxxx PCIP Report 8 8 13 Final MS.pdf)
- Commitment Agreement between implementer and customer (1539-01 Form 2.pdf)
- Graph from North America Combustion Handbook that shows proportion of available heat relative to furnace flue gas temperature assuming 25 percent excess air without pre-heating and comprised of 4.54 percent oxygen (Attachment 1 – Available heat chart.pdf). This was used to establish the efficiency of industry standard practice equipment to be 25 percent without accounting for the door-opening losses of 5 percent.
- Graph showing firing efficiency of various types of furnaces, including the proposed furnace (Attachment 2 – Ecomax Self Recup Burners Efficiency charts.pdf). While this was properly used to establish the efficiency of the proposed furnace, the reported efficiency for “cold air burner” furnace at the same flue gas temperature was shown to be

approximately 35 percent. This value was not used for the industry standard practice equipment gas usage calculation.

- Spreadsheets showing the pre-installation metering results, production regression analysis and calculations used to determine the gas savings attributable for the two proposed furnace replacements (xxx Furnace 1 big door Efficiency analysis 8 7 13.xlsx and xxx Furnace 2 double door Efficiency analysis 8 7 13.xlsx)

Beginning on Feb. 12, 2013, the two baseline furnaces were metered to determine the amount of gas used each production day. The weight of salable product was also tracked daily. At the end of the metering, the average baseline production parameters of each furnace were determined as follows:

- Average weight of finished product: [REDACTED] lbs/day for Furnace #1; [REDACTED] lbs/day for Furnace #2. According to ED analysis of the pre-installation data,
  - Furnace #1 production occurred during 27 of the 33 non-holiday weekdays. For those 27 days, the average weight of finished product was [REDACTED] lbs. with a standard deviation of [REDACTED] lbs. Minimum and maximum daily production was [REDACTED] lbs. and [REDACTED] lbs., respectively.
  - Furnace #2 production occurred during 32 of the 33 non-holiday weekdays. For those 32 days, the average weight of finished product was [REDACTED] lbs. with a standard deviation of [REDACTED] lbs. Minimum and maximum daily production was [REDACTED] lbs. and [REDACTED] lbs., respectively.
- Estimated weight of heated metal: [REDACTED] lbs/day for Furnace #1; [REDACTED] lbs/day for Furnace #2 (assuming [REDACTED] scrap rate).
- Energy required to heat [REDACTED] from 70°F to 2,350°F (using specific heat of carbon steel=0.15 Btu/lb/°F): [REDACTED] Btu/day for Furnace #1; [REDACTED] Btu/day for Furnace #2.
- Energy used according to sub-metering: [REDACTED] Btu/day for Furnace #1; [REDACTED] Btu/day for Furnace #2.
- Production efficiency: [REDACTED] for Furnace #1; [REDACTED] for Furnace #2.
- Energy/Production Average: [REDACTED] therms/lb for Furnace #1; [REDACTED] therms/lb for Furnace #2.

Using the energy/production averages, above, multiplied by the daily production of salable product, the predicted baseline energy usage was fitted to the metered energy usage and yielded R-squared values of [REDACTED] for Furnace #1 and [REDACTED] for Furnace #2.

For the proposed furnaces, the production parameters for each furnace were estimated as follows:

- Weight of finished product: [REDACTED] lbs/day per furnace.
- Weight of heated metal: [REDACTED] lbs/day per furnace (assuming [REDACTED] scrap rate).
- Rated efficiency per manufacturer: [REDACTED]

- Production efficiency: [REDACTED] (assuming [REDACTED] losses from opening of furnace doors).
- Energy required to heat metal: [REDACTED] Btu/day per furnace.
- Energy usage predicted: [REDACTED] Btu/day per furnace.
- Energy/Production Prediction: [REDACTED] therms/lb.

For the industry standard practice furnaces, the production parameters for each furnace were estimated as follows:

- Weight of finished product: [REDACTED] lbs/day per furnace.
- Weight of heated metal: [REDACTED] lbs/day per furnace (assuming [REDACTED] scrap rate).
- Rated efficiency per graph from referenced handbook: [REDACTED].
- Production efficiency: [REDACTED] (assuming [REDACTED] losses from opening of furnace doors).
- Energy required to heat metal: [REDACTED] Btu/day per furnace.
- Energy usage predicted: [REDACTED] Btu/day per furnace.
- Energy/Production Prediction: [REDACTED] therms/lb. Note: This ratio is only a slight improvement over those of the existing furnaces ([REDACTED] and [REDACTED]).

The two baselines consider both the accelerated replacement of the existing furnaces and the increase in production using industry standard practice equipment. Since the remaining useful life of the existing equipment is more than one year *and* this project will result in increased production, the estimated annual gas savings for the RUL period are comprised of the following two terms:

1. At the current production level, savings equal the gas used by the existing equipment minus the gas used by the proposed equipment.
2. For the proposed production *increase*, beyond the current production level, savings equal the incremental gas used by the proposed equipment minus the incremental gas used by industry standard practice equipment.

For the RUL-EUL period, only the second term is considered for the annual gas savings.

## Review Conclusion

The proposed ex ante savings are conditionally approved pending acceptance and completion of the ED Requested Actions listed below.

## Summary of ED Requested Action by the IOU

ED requests that the IOU undertake the recommended steps and submit the following information:

1. Additional documentation to support the efficiency of industry standard practice equipment. Provide a product cut-sheet from a manufacturer of industry standard practice

equipment with evidence that these are commonly used in forging applications. From forging furnace manufacturers obtain estimate of market share by efficiency type for this equipment.

2. Repeat the pre-installation monitoring while tracking the daily weight of heated metal (rather than salable product). Given the variability of the production during the previous pre-installation monitoring in February-March, 2013, the monitoring should persist for eight weeks.
3. Document and provide past production patterns for an entire year to establish whether seasonal production variability exists and that the furnaces were functioning smoothly, without major maintenance issues.
4. Perform post-installation verification activities as described in the PCIP report for the project for 8 weeks rather than the proposed duration of 3 weeks.

**Table 1-2 Review Findings**

Reviewed Parameter	Analysis
<b>Project Baseline Type</b> (Early Replacement, Normal Replacement, Capacity Expansion, New Construction, System Optimization, Add-on Measures) Note: For early retirement projects only, include RUL through EUL baseline)	IOU Proposal: Early Replacement (RUL>1 year) & Capacity Expansion (by a factor of 3.77)
	ED Assessment: Early Replacement & Capacity Expansion
	ED Recommendation: Same as above
<b>Project Baseline Technology</b> (in situ equipment, Title 24 (specify year), other code or other efficiency level (specify), industry standard practice - ISP)	IOU Proposal: For existing production volume: in situ equipment; for the <i>increase</i> in production volume: industry standard practice.
	ED Assessment: For existing production volume: in situ equipment; for the <i>increase</i> in production volume: industry standard practice.
	ED Recommendation: Same as above
<b>Project Cost Basis</b> (Full Incremental, or Both. Note: For early retirement projects, include RUL through EUL cost basis treatment)	IOU Proposal: Incremental since this project will yield increased production capacity
	ED Assessment: Both full and incremental costs should be used. For the RUL period, the gross measure cost is appropriate. For the RUL-EUL period, the incremental measure cost is appropriate

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Reviewed Parameter	Analysis
	ED recommendation: Full and incremental
<b>RUL</b> (required for early retirement projects only, otherwise N/A)	IOU Proposal: >1 year
	ED Assessment: 1 year conditionally accepted, pending additional documentation
	ED recommendation: See ED Requested Actions
<b>EUL</b> (for each measure)	IOU Proposal: Not provided
	ED Assessment: Large industrial furnaces have an acceptable ED maximum of 20-years for their EUL.
	ED Recommendation: 20 years
<b>Savings Assumptions</b>	IOU Proposal: (1) 5% efficiency losses due to opening of furnace doors (2) 25% scrap product (3) 25% efficiency for industry standard practice equipment
	ED Assessment: Assumptions (1) and (2) are reasonable for pre-implementation calculations; assumption (3) requires substantiating documentation.
	ED Recommendation: See ED Requested Actions
<b>Calculation Methods/Tool review</b>	IOU Proposal: Linear regression analysis of metered gas consumption and recorded salable product production was used to determine existing energy intensity (Btu/pound). (39 days for Furnace #1 and 41 days for Furnace #2)
	ED Assessment: This type of analysis is appropriate for this measure.
	ED Recommendation: None
<b>Pre- or Post-Installation M&amp;V Plan</b>	IOU Proposal: More than one month of pre-installation monitoring of salable production and gas usage; three weeks of post-installation monitoring of salable production and gas usage.
	ED Assessment: Pre-installation monitoring should have also tracked the weight of the heated metal rather than the weight of the salable product. Furthermore, the high variability of daily production rates warrants a longer pre-installation monitoring period.
	ED Recommendation: Conduct eight weeks of pre- and post-installation monitoring.
<b>Net-to-Gross Review</b>	IOU Proposal: Not provided
	ED Assessment: TBD
	ED Recommendation: A NTG review may be recommended at a later time.

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

<b>Description</b>	<b>IOU Ex Ante Claim</b>	<b>ED Recommendations</b>
<b>First Year kWh Savings</b>	N/A	N/A
<b>First Year Peak kW Savings</b>	N/A	N/A
<b>First Year Therms Savings</b>	339,261	TBD
<b>kWh Savings (RUL Period)</b>	N/A	N/A
<b>Peak kW Savings (RUL Period)</b>	N/A	N/A
<b>Therms Impact (RUL Period)</b>	339,261	TBD
<b>kWh Savings (RUL thru EUL Period)</b>	N/A	N/A
<b>Peak kW Savings (RUL thru EUL Period)</b>	N/A	N/A
<b>Therms Savings (RUL thru EUL Period)</b>	208,970	TBD
<b>Annual Non-IOU Fuel Impact (RUL Period)</b>	N/A	N/A
<b>Annual Non-IOU Fuel Impact (RUL thru EUL Period)</b>	N/A	N/A
<b>Project Costs for Baseline #1 (RUL or EUL)</b>	Full costs (RUL) - \$1,060,000	TBD
<b>Project Costs for Baseline #2 (EUL minus RUL period)</b>	Incremental costs - \$810,000	TBD
<b>Project Incentive Amount</b>	\$339,261	TBD