

Phase II Ex Ante Review Findings

Table 1-1: Project Information

IOU	Pacific Gas and Electric Company
Application ID	HEEP 87
Application Date	2/5/2013 (Program Participation Agreement)
Program ID	PGE2206
Program Name	Healthcare Energy Efficiency Program (HEEP)
Program Year	2013
Itron Project ID	X309
IOU Ex Ante Savings Date	Not provided
ED Measure Name	Multiple HVAC measures
Project Description	<p>This is a [REDACTED] facility constructed in 1986. There are a total of five EEMs, as follows:</p> <ul style="list-style-type: none"> • EEM 1, Install variable frequency drives (VFD)s on secondary chilled water pumps and implement chilled-water reset • EEM 2, Install high efficiency heating hot water boilers. • EEM 3, Install premium-efficiency supply fan motors with VFDs on air handling units • EEM 4, Install high efficiency chillers. • EEM 5, Replace existing cooling tower with increased capacity and VFD fan controls.
Date of ED Review(s)	3/12/2013, 9/30/2013
Primary Reviewer / Firm	Dale Tutaj//DNV KEMA
Review Supervisor / Firm	Joseph Ball/Itron
ED Project Manager	[REDACTED] / California Public Utilities Commission, Energy Division
ED Policy Authorization (as needed)	
Type of Review (Desk, On-site, Full M&V, Tool)	Desk

ED Recommendation	Conditionally approved, pending response to data request. Also, upon completion of the project, revise the eQuest model to true up the savings based on post field findings.
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Measure Description

The measures involved with this project are listed below:

- EEM 1: Install variable frequency drives (VFDs) on two 15 hp secondary chilled water pumps and implement chilled-water reset.
- EEM 2: Installed high efficiency heating hot water boilers. Boilers use an estimated 80 to 90% of the sites natural gas usage. Two (2) 4,500 MBH units with 80% thermal efficiency were replaced with two (2) high efficiency 2,000 MBH units with a thermal efficiency of 88%.
- EEM 3: Install premium-efficiency supply fan motors with VFDs on air handling units (AHUs). The administration building and adjoining spaces are served by ten (AHU) with constant volume supply fans. The fans are serving variable-air-volume (VAV) boxes. The VAV boxes are under-utilized with constant speed fans. The RUL was not provided.
- EEM 4: Install high efficiency chillers. There are two (2) constant speed 300 ton chillers. One unit is redundant. The new units will be two (2) 250 ton VFD chillers. The reduced capacity is to match the load. The existing chillers are used as the baseline in savings calculations. The RUL was not provided.
- EEM 5: Replaced two (2) 280 ton cooling towers controlled by two-speed fans with two (2) new, expanded capacity cooling towers whose fans are controlled with VFDs. The existing cooling towers are used as the baseline in savings calculations. No RUL was provided for the exiting cooling towers.

These measures result in an ex ante total annual energy savings of 515,734 kWh, and 17,336 therms with a peak demand reduction of 32.6 kW

Summary of Review

The following documents were reviewed:

- HEEP-87 - Calculation Summary_1.29.2012.xlsx, this document contains a summary by measure of the energy savings, cost, and incentive.
- HEEP-87_XXXXXXXXXX_PPA_01.30.2012_signed.pdf, this document is the program participant agreement, dated 2/5/2013.
- HEEP-87_XXXXXXXXXX_AuditReport_01.31.2013.pdf is a comprehensive audit report.

eQuest Files were also provided:

- For Engineering Review - (Healthcare Energy Efficiency Program (HEEP) Pre Installation Report XXXXXXXXXXXX).msg

- RE For Engineering Review - (Healthcare Energy Efficiency Program (HEEP) Pre Installation Report XXXXXXXXXXXX).msg
- RE HEEP 87 project comments.msg

Several additional documents were provided as a result of the parallel review process, as follows:

- EnergyEfficiencyOIR-Post-2008_DR_ED_366_EEGA_2733Supp01.doc
- HEEP-87 - Calculation Summary_05.07.2013.xlsx
- HEEP-87 XXXXXXXXXXXX Energy Model Calibration.pdf
- EnergyEfficiencyOIR-Post-2008_DR_ED_366_EEGA_2733.doc
- Revised eQuest files. This includes a monthly calibrated model with local weather for the associated utility billing period used to calibrate the model.

The measures for this project are all eligible according to the Nonresidential Retrofit – Demand Response Procedures Manual.

This project involves 5 measures. Savings were estimated using a whole building energy model and the base case was simulated using existing equipment’s efficiencies. The details of the proposed measures are enumerated as follows:

- EEM 1, Install variable frequency drives (VFDs) on two 15 hp secondary chilled water pumps and implement chilled-water reset. This is an add-on measure; therefore estimating the savings with existing condition as baseline is appropriate for this measure. Savings for the chilled-water reset will only be achieved for the remainder of the RUL period, as chilled water reset does not qualify for the RUL through EUL period, as stated in T24.
- EEM 2, Install two high efficiency heating hot water boilers that were replacing two pre-existing inefficient boilers. Title-20 boiler efficiency was used in the base case to estimate the savings for this measure.
- EEM 3, Replace ten constant volume air handling units (AHUs) with premium-efficiency supply fan motors and VFDs. Existing constant speed AHUs were used as baseline to estimate the savings of this measure. Existing AHUs had more than 1 year of RUL therefore the existing conditions are used for the RUL period. However, for the RUL through EUL period, normal baseline should be applied where the proposed air handling units (AHUs) should be compared with 2008 Title-24 standard air handling system to estimate the savings. According to 2008 Title-24, Individual VAV fans with motors 10 horsepower or larger shall be driven by a mechanical or electrical variable speed drives. Because the capacities of the proposed AHUs are more than 10 hp, the VFD controls savings will be zeroed out for the RUL through period.
- EEM 4, Replace two existing constant speed 300-ton chillers with two high efficiency 250 ton variable speed chillers. One of the chillers is redundant. The capacity reduction was achievable because the existing system was oversized. Since the existing chillers had

some service life remaining, using the existing chiller efficiency as baseline was appropriate for estimating savings for the RUL period. For the RUL through EUL period, T-24 chiller efficiencies applicable as of January 1, 2014 should be used as baseline

- EEM 5 Replace two 280 ton cooling towers with two-speed fan controls with two new cooling towers and VFDs on fans and expanded capacity. The VFD fan control will allow for savings of the cooling tower fans during cold conditions. The increased cooling tower capacity will result in lower condenser water return to the chiller resulting in reduced loading of the chiller. The existing cooling tower utilizes two 15 hp two-speed fans. The new cooling tower has two 7.5 hp fans with VFDs. For the RUL period, existing conditions is the baseline. For EUL through RUL, T-24 efficiency should be used. ED's reviewer thoroughly examined the Title-24 2008 standard document and found that the T-24 mandates for VFD control for cooling tower fans equal or above 7.5 hp capacity. **Because both the proposed cooling tower fans are 7.5 hp each, savings from the VFD will not be eligible for savings.** T-24 requires that approach temperatures should be 10F or lower. The post case approach temperature is 11F, and therefore no savings will be achieved. The pumping performance in T-24 is 38.2 gpm/hp, therefore if pumping performance exceeds this, savings will be achieved.

Through the parallel review process, additional data was provided, as indicated:

1. Estimate of RUL for all equipment in years.

3P Implementer response: EEM 2 is a normal replacement. Measures EEM 3 through EEM 5 all have an RUL of greater than 1 year.

2. Provide calculated savings for RUL through EUL period. For the second baseline (EEMs 2-5) the calibrated model should use T-24 as baseline. Also, the T-24 chiller and T-20 boiler efficiencies should be used. For the VFD controls on the cooling tower fan motors, no savings will be achieved during this period (EUL – RUL). Provide the eQuest model (with .inp, .pd2, .sim, and 8760 files)

3P Implementer response: Revised simulation provided, with peak kW using 1991 weather. The baseline efficiency for the boiler is T-20 code.

3. Provide a post-install M&V plan that includes:

- Chiller water pumps and secondary pumps, power, flow rate.
- Supply fan motors with VFDs on AHUs power, & airflow, actual spot-measured VFD speeds
- Chiller power, supply temperature, return temperature,
- Cooling tower fan power, approach temperature, fan VFD speed, fan kW, condenser water temperature.

3P Implementer response: The M&V plan will be submitted post-installation

It was observed that negative payback and zero payback measures means the IOU is paying more than the measure cost and these measures are subsidizing the chiller replacement. If program rules are applied strictly, each measure will have to be capped at 50% of the individual measure cost. However, the 3P appears to have induced a deeper retrofit and the incentive, on the project basis, is not outrageously high. The ED has decided to waive this non-compliance with the program rules in the interest of encouraging a deeper retrofit.

A site visit was conducted to observe the operating conditions and assess the RUL of equipment pertaining to EEM 3 through EEM 5. While all of the equipment exceeds the EUL according to DEER 2008, equipment was in good operating condition. Only one of the two chillers operates at a time and they are regularly rotated, reducing stress on equipment. Lifetime run hours were collected to support this claim. No major repair work was ever needed. The customer had no plans to replace equipment. The project payback period with incentives is 3.2 years and it will require the participant to come up with about \$300K. Some measures have a negative payback those measures are subsidizing the chiller replacement which has a payback of 27.2. Given the data collected, customer input, and negative payback measures this project does not appear to be a replace on burn out. Therefore, a RUL of 1 year is recommended for these measures.

Review Conclusion

The first year ex ante savings of 515,700 kWh, 99.8 kW, and 17,300 therms are conditionally approved. Upon completion of this project post M&V activities need to be performed to true-up energy savings.

Summary of ED Requested Action by the IOU

Upon completion of this project, conduct post M&V activities as described above in Summary of Review section, item #3.

ED requests that the IOU undertake the recommended steps and submit the following information **due on 10/17/2013 (or 14 days from submittal date to IOU):**

1. ECM 2, provide incremental cost and basis of estimate,
2. ECM 2, provide cost estimate for only one boiler, since second boiler is redundant,
3. ECM 5, provide cost estimate basis,
4. ECM 5, provide cost estimate for only one chiller since second chiller is redundant.

Table 1-2 Review Findings

Reviewed Parameter	Analysis
<p>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)</p>	IOU Proposal: early replacement
	ED Assessment: EEM 1, Add-on measure, EEMs 2-5, early replacement
	ED Recommendation: baseline types have been revised to reflect ED recommendations.
<p>Project Baseline Technology (in situ equipment, Title 24 (specify year), other code or other efficiency level (specify), industry standard practice - ISP)</p>	IOU Proposal: EEM 1, in situ equipment, EEM 2 T20
	EEM 3, existing for RUL and T24 2008 for RUL through EUL
	EEM 4, existing for RUL and T24 2014 for RUL through EUL
	EEM 5, existing for RUL and T24 2008 for RUL through EUL
<p>Project Cost Basis (Full Incremental, or Both. Note: For early retirement projects, include RUL through EUL cost basis treatment)</p>	IOU Proposal: Full cost
	ED Assessment: EEM 2, incremental cost should be used for the RUL through EUL period, full cost. All other EEMs should use the full cost. It appears that the cost for EEM 5 of \$250K, includes both chillers, however since there is a redundant chiller, the cost should only include one chiller. Similarly, the cost for EEM 2 should include only one boiler.
	ED Recommendation: Provide cost estimate source for EEM 2 and EEM 5. Provide incremental cost for EEM 2. Adjust cost for EEM 2 and EEM 5 to include only one piece of equipment, respectively.
<p>RUL (required for early retirement projects only, otherwise N/A)</p>	IOU Proposal: EEM 3 through EEM 5 has RUL of 1 year
	ED Assessment: A site visit was conducted to observe the operating conditions. While all of the equipment exceeds the EUL, given the operating conditions and the circumstances of the project, an RUL of 1 year is acceptable.
	ED Recommendation: An RUL of 1 year for EEM 3 through EEM 5 is acceptable
<p>EUL (for each measure)</p>	IOU Proposal: not provided
	ED Assessment: According to DEER 2008 high efficiency chillers and high

Reviewed Parameter	Analysis
	<p>efficiency boilers both have an EUL 20 years; while packaged cooling towers VAV boxes and VSD fans have an EUL of 15 years</p> <p>ED Recommendation: use DEER 2008 values</p>
<p>Savings Assumptions</p>	<p>IOU Proposal: The existing building schedule is used with existing equipment operation as the baseline. The utility billing data is used to calibrate the whole building model. The calibration results of NMBE and CV (RMSE) are -2.7%, 7.5%, -1.0% and 9% for kWh and therm utility bills, respectively.</p> <p>During the parallel review process, the following changes were made to from the baseline model:</p> <ul style="list-style-type: none"> ▪ CHW Loop Pump, added VFD with minimum speed of 20% and VFD loss of 0.05%, and pump kW of 11.19 kW, ▪ Chilled Water Loop cool setpoint was fixed and changed to OA reset, with head set point control valve reset, ▪ Chiller capacity was changed from 360 tons to 300 tons with variable speed. The electric input ratio was changed from 0.18 to 0.178, ▪ Boiler capacity was changed from 4,500 Mbtuh to 2,000 Mbtuh with heat input ratio of 1.25 improved to 1.136 ▪ Cooling tower capacity was increased from 375 tons to 470 tons, with variable speed fans installed. The designed approach temperature was 13F changed to 11F. <p>For the VAV system, VFDs were installed from constant volume baseline, with a minimum fan ratio of 0.3.</p> <p>ED Assessment: Using the utility bills for calibration is appropriate. The results should fit the CPUC Guidelines (consistent with ASHRAE Guideline 14-2002 standard of 5.3.2.4 (f)). The computer model shall have an MBE of 5% and a CV (RMSE) of 15% relative to monthly calibration. The assumptions used for each measure are reasonable. As part of the parallel review effort, savings were calculated for the EUL through RUL period.</p> <p>ED Recommendation: None</p>
<p>Calculation Methods/Tool review</p>	<p>IOU Proposal: A whole building energy model was developed to identify building loads. The model was calibrated using monthly utility data. The calibrated model was run with baseline conditions and post conditions using local weather data.</p> <p>ED Assessment: The whole building model is appropriate for these measures. By using the monthly utility data calibrated model approach; the calibrated model needs to be run with the appropriate CZ weather data.</p>

Reviewed Parameter	Analysis
	ED Recommendation: The post-retrofit operational parameters such as equipment efficiency, schedule, set points, and all other operation parameters should be used to true up savings, in the post-retrofit eQuest model.
Pre- or Post-Installation M&V Plan	IOU Proposal: No pre or post M&V plans were provided for review.
	<p>ED Assessment: Post installation end-use data should be used to true up energy savings upon completion of this project. Temperature set points and schedules should be verified. Additionally metered data should be collected for several weeks to calibrate the model. Data to collect should include a minimum of two weeks of data at an interval of 15 minutes, and cover a representative range of operating conditions (schedules and weather conditions):</p> <ul style="list-style-type: none"> ▪ Chiller water pumps and secondary pumps, power, flow rate. ▪ Supply fan motors with VFDs on AHUs power, & airflow, actual spot-measured VFD speeds ▪ Chiller power, supply temperature, return temperature, Cooling tower fan power, approach temperature, fan VFD speed, fan kW, condenser water temperature.
	ED Recommendation: Post M&V needs to be conducted to true-up energy savings estimates.
Net-to-Gross Review	IOU Proposal: Not provided
	ED Assessment: Not assessed
	ED Recommendation: TBD

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

Description	IOU Ex Ante Claim	ED Recommendations
First Year kWh Savings	515,700	TBD, pending post-install M&V and IOU true-up
First Year Peak kW Savings	99.8	TBD, pending post-install M&V and IOU true-up
First Year Therms Savings	17,300	TBD, pending post-install M&V and IOU true-up
kWh Savings (RUL Period)	534,100	TBD, pending post-install M&V and IOU true-up
Peak kW Savings (RUL Period)	74.7	TBD, pending post-install M&V and IOU true-up
Therms Impact (RUL Period)	-600	TBD, pending post-install M&V and IOU true-up
kWh Savings (RUL thru EUL Period)	29,500	TBD, pending post-install M&V and IOU true-up
Peak kW Savings (RUL thru EUL Period)	7.9	TBD, pending post-install M&V and IOU true-up
Therms Savings (RUL thru EUL Period)	0	TBD, pending post-install M&V and IOU true-up
Annual Non-IOU Fuel Impact (RUL Period)	None expected	None expected
Annual Non-IOU Fuel Impact (RUL thru EUL Period)	None expected	None expected
Project Costs for Baseline #1 (RUL or EUL)	Full cost: EEM 1 \$6,000 EEM 3 30,000 EEM 4 \$250,000 EEM 5 \$20,000	TBD
Project Costs for Baseline #2 (EUL minus RUL period)	EEM 2, incremental cost not provided	TBD
Project Incentive Amount	\$77,220	\$77,220