

Phase 2 Ex Ante Review Findings

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

IOU	Pacific Gas and Electric
Application ID	Given an arbitrary ID of PGEHOTEL001ARCX. Actual application ID was not provided
Application Date	Not provided
Program ID	PGE21011
Program Name	Lodging Savers Program (NRR-DR)
Program Year	2012
Itron Project ID	X151a
IOU Ex Ante Savings Date	Not provided
ED Measure Name	Per the RCx Phase II preliminary report by Ecology Action, the following measure code and description is used: <ul style="list-style-type: none"> 1. HVAC; Retrofit / New-Controls - Local Controls - Add setback Controls (CHD22)
Project Description	This project is a retro-commissioning (RCx) and non-residential retrofitting (NRR) endeavor for a large hotel, It involves guestroom HVAC controls. This measure was removed from the original PGEHOTEL001RCX project application and allocated under a new, separate application, with project ID PGEHOTEL001ARCX
Date of ED Review(s)	Phase 1 Review: 07/20/2012 Phase 2 Review: 11/29/2012
Primary Reviewer and Firm	Chris Williams / DNV KEMA
Review Supervisor and Firm	Joseph Ball/Itron
Type of Review (Desk, On-site, Full M&V, Tool)	Desk Review
ED Recommendation	Savings not approved. A site specific baseline M&V approach needs to be

	<p>established for the guestroom controls measure. Baseline guestroom occupancy and FCU usage data need to be collected for a sample of guestrooms; this data also needs to be incorporated in to the eQUEST model. The revised model then needs to be re-calibrated without altering [baseline] guestroom conditions using building utility data.</p>
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Measure Description

The guestroom HVAC controls measure planned for implementation according to the Phase 2 Energy Efficiency Preliminary Report dated September 25, 2012 is:

- EEM-05 – Install Guestroom Control System. The facility has 1,362 guest rooms that are served by four-pipe fan coil (FC) units. They are set to maintain the setpoint temperature regardless of room occupancy. This measure would allow the hotel to control and reset the unoccupied guest room temperature setpoints.

The updated Phase II preliminary report (dated September 25, 2012) lists annual energy savings for this measure as 839,136 kWh and an on-peak demand reduction of 111.91 kW. A total incentive amount of \$86,713 was calculated for the guestroom control system. The total incentive amount was based on the Lodging Savers Program incentive rates of \$0.09/kWh and \$100/kW.

Summary of Phase 2 Review

New documents (pertaining to the guestroom controls system measure) provided for the phase 2 review include the following:

- Proposed guestroom control schedule specifications (savings summary in this document was not used for claimed program savings)
- Updated Phase II Energy Efficiency Preliminary Report dated September 25, 2012 showing EULs and revised M&V plans.
- Issue #3 (M&V plan for guestroom controls) presented in the phase 1 EAR was addressed by showing Ecology Action guestroom control work papers to support the current savings methodology
- Guest room and non-guestroom cooling capacity analysis performed by Ecology Action

See the phase 1 EAR for other documentation that were available for review.

The phase 2 review focused primarily on the EEM-05 (guestroom controls) savings methodology and assumptions.

The guestroom controls issue that was presented in the phase 1 EAR was partially addressed in the phase 1 response. Please see the phase 1 response document (EnergyEfficiencyOIR-Post-2008_DR_ED_222_EEGA_2210.doc) for context, if necessary.

1. EEM-05 (guestroom controls) savings approach was supported with Ecology Action work papers and referenced their published studies on guestroom controls.

2. Ecology Action presented another source of capacity analysis in order to support the assumption that the HVAC load attributable to the guestroom HVAC systems is linearly proportional to the floor space ratio of guestrooms to the entire hotel building. The capacity analysis is a spreadsheet calculation that compares full load cooling capacities of guestroom versus non-guestroom HVAC equipment. The analysis shows that the cooling capacity ratio of guestroom versus non-guestroom equipment is close to 0.5 and is thus in line with the current savings methodology which uses a guestroom HVAC factor of 0.55 to attribute the eQuest model's HVAC energy consumption to the guestrooms.
3. The existing post-installation M&V approach was modified in the Phase 2 preliminary report to include status loggers installed on fan coil units for a sample of adjacent guest room pairs (i.e., controls versus no controls), with fan coil unit run times being monitored for a period of 3-4 weeks. The size of the sample was not explicitly described, but a conference call with the Ecology Action estimated 15-20 rooms.

Review Conclusion

Savings not approved. A site specific baseline M&V approach needs to be established for the guestroom controls measure. Baseline guestroom occupancy and FCU usage data need to be collected for a sample of guestrooms; this data also needs to be incorporated in to the eQUEST model. The revised model then needs to be re-calibrated without altering [baseline] guestroom conditions using building utility data.

Summary of ED Requested Action by the IOU

The current pre-implementation M&V plan for EEM-05 (Guestroom controls), although considered standard practice for smaller-sized projects, need to be revised to include more site-specific baseline detail for modeling a distribution of average guestroom fan coil unit schedules. This measure has large uncertainty in savings due to the inherent behavioral and occupancy rate components common for hotel guestrooms. The (electric) savings methodology uses the eQUEST model's HVAC end-use consumption results (model has been calibrated to annual building utility usage) and the model's ratio of total guest room area to total building area (55%) to estimate the baseline guestroom HVAC load. Besides the entire building model being calibrated to the building utility usage (the model components that were tweaked during the calibration are not known), no baseline information for the guestroom FCU schedules or set points have been measured or entered in to the eQUEST model. The modeled guestroom FCUs ("Sys 26") currently use one fan, cooling, and heating schedule to represent the usage of all

1,362 guestroom FCUs. The schedules have the FCUs operating continuously (i.e., the units are on 8,760 hours per year) and at constant temperatures (72 °F cooling and 70 °F heating).

The modeled guestroom FCU schedule(s) needs to be revised in order to more accurately estimate the baseline HVAC load that is associated with the guestrooms. Baseline vacancy and occupancy usage patterns need to be collected and reasonably modeled using the FCU fan schedules. This can be done within the eQUEST model by creating multiple FCU fan schedules that represent different guestroom types – categorized by occupancy (i.e., FCU usage) and vacancy patterns of the guestrooms. The guestroom types could be split in to the following categories:

1. Unrented rooms with FCU in normal mode (i.e., unit on at default cooling/heating set point) at all times
2. Unrented rooms with FCU in setback or off mode when unoccupied
3. Rented rooms; lightly used; FCU in normal mode at all times
4. Rented rooms; lightly used; FCU in setback or off mode when unoccupied
5. Rented rooms; moderately used; FCU in normal mode at all times
6. Rented rooms; moderately used; FCU in setback or off mode when unoccupied
7. Rented rooms; heavily used; FCU in normal mode at all times
8. Rented rooms; heavily used; FCU in setback or off mode when unoccupied

Occupant and light scheduling could be categorized using the following conditions:

- Unrented rooms: no occupants; lights off
- Light use: occupants present 1 to 8 hours per day; lights on during occupancy
- Average use: occupants present 8 to 16 hours per day; lights on during occupancy
- Heavy use: occupants present 16 to 24 hours per day; lights on during occupancy

The collected baseline occupancy data would be analyzed to estimate the distribution of the 1,362 guestrooms in to the eight categories listed above. Space multipliers can then be used in eQUEST to weight the guestroom floors based on the number of sampled guestrooms that fall in to each category. Each modeled floor type would then have individual FCU fan schedules, and occupancy and lighting schedules.

The normal mode of operation for a guestroom FCU and average use lighting conditions could use the default DEER hotel room lighting schedule and temperature set points; light and heavy use could be factored accordingly.

Depending on the hotel’s protocol for setting the FCU mode for unrented rooms the eight guestroom type categories could be altered accordingly e.g., if hotel staff turn off the FCUs of unrented rooms, or if they set the FCU set to a specific temperature.

Data collection could be performed in multiple waves collecting data for a sample of floors (e.g., floors 6 – 17 could be wave 1; floors 18 – 28 could be wave 2; floors 29 – 38 could be wave 3) so an accurate representation of occupancy frequency for the various floors can be measured. This data collection effort would involve occupancy loggers to trend occupancy times; state loggers to trend FCU operation (i.e., fan on or off); and temperature loggers to trend space temperature for guestrooms that may have had their FCU thermostat set back either when unoccupied or when unrented. Data collection sample size would be on the order of 27 guestrooms, 9 guestrooms for each wave. Each wave would monitor occupancy and FCU operation for a period of 2-4 weeks.

With this method, a representative sample of guestroom occupancy and vacancy rates can be collected and entered in to the models’ schedules and baseline guestroom HVAC usage can be quantified using the model without the assumed 55%/45% guestroom/non-guestroom split. After weighted guestroom schedules are entered in to the eQUEST model, it can then be recalibrated to the building utility data.

The post-implementation M&V plan should also include the approach described above to quantify the average FCU runtime reduction to true up the assumed 30% runtime reduction.

Table 1-2: Project Overview

Description	IOU Proposed Ex Ante Data	ED Recommendations
Project Baseline Type (Early Replacement, Normal Replacement, Capacity Expansion, New Construction, System Optimization, Add-on Measures)	Uses existing equipment as the baseline	Add-on Measure. The baseline equipment used for these measures appear to be appropriate
Project Cost Basis (Full Cost, Incremental Cost)	\$544,800; This is the total estimated project cost per the phase II assessment report	Full cost
RUL (Early retirement projects only, otherwise N/A (not applicable))	Not provided	N/A
EUL	Eleven (11) years	Use IOU-proposed EUL of 11 years

Description	IOU Proposed Ex Ante Data	ED Recommendations
First Year kWh Savings	839,136	TBD
First Year Peak kW Savings	111.91	TBD
First Year Therms Savings	5,448	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 (EUL thru RUL Period)	839,136	TBD
Peak kW Savings (EUL thru RUL Period)	111.91	TBD
Therms Savings (EUL thru RUL Period)	5,448	TBD
Annual Non-IOU Fuel Impact (RUL Period)	N/A	N/A
Annual Non-IOU Fuel Impact (EUL thru RUL Period)	N/A	N/A
Net-to-Gross Ratio	Not provided	Assessment not completed

Table 1-3: Detailed Review Findings

Reviewed Parameter	Analysis
Project Gross Savings Baseline (for early retirement projects only, include RUL through EUL baseline)	IOU Proposal: Baseline equipment is existing equipment. Baseline guestroom FCU schedule uses the default eQUEST hotel schedule of continuous fan operation (i.e., 8,760 hours/year) and thermostat set points (74 °F cooling and 70 °F heating)
	ED Assessment: Baseline equipment appears to be appropriate for this project. A representative baseline schedule for guestroom FCUs has not been established. This is necessary to capture before implementation is completed otherwise the baseline conditions will be unrecoverable.
	ED Recommendation: See the “Summary of ED Requested Action” Section, above, for recommended method to measure baseline FCU usage and schedules

Ex Ante Review Report

Reviewed Parameter	Analysis
Project Cost Basis (for early retirement projects only, include RUL through EUL cost basis treatment)	IOU Proposal: Appears to be full cost
	ED Assessment: NRR measures should use full cost basis
	ED recommendation: When project is complete, provide project cost documentation in the form of vendor invoices, quotes, or estimates for equipment, labor, and materials.
RUL (required for early retirement projects only, otherwise n/a)	IOU Proposal: N/A
	ED Assessment: N/A
	ED recommendation: N/A
EUL	IOU Proposal: Provided in updated assessment report: EEM 5 – Eleven (11) years
	ED Assessment: IOU-proposed EULs is appropriate.
	ED Recommendation: Use the proposed EUL of 11 years for EEM-05 (Guestroom controls)
Savings Assumptions	IOU Proposal: Guestroom controls savings uses eQUEST baseline model HVAC end-use consumption results (model has been calibrated to annual building electricity usage), the model’s ratio of total guest room area to total building area (55%), and an assumed 30% FC unit runtime reduction to estimate guestroom controls electric savings. It is assumed that the building’s HVAC load is evenly distributed throughout the building’s floor space (HVAC kWh/sq. ft. is same for all building zones). Guestroom gas savings use a deemed value of 4 therms per room. This savings value comes from a previous LodgingSavers project in the same climate zone.
	ED Assessment: The assumption that the building HVAC load is evenly distributed throughout the hotel floor space (HVAC kWh/sq. ft. is the same for all building zones) is not well substantiated. For very large lodging spaces with multiple space functions such as restaurants, conference rooms, and fitness rooms zonal HVAC load requirements can vary between the zones significantly. Because of this variation, the assumed distribution of HVAC load and consumption throughout the entire hotel space should not be linear. The approach used to support this assumption uses the ratio of guestroom versus non-guestroom cooling unit capacities. This ratio is very close to 0.5 and thus it appears that this approach does substantiate the use of the existing guestroom load

Reviewed Parameter	Analysis
	<p>estimation approach. However, this can also simply be coincidence since the variety in zonal activities in this specific hotel can vary widely, as well as each zone’s specific part-load cooling demand.</p> <p>ED Recommendation: See the “Summary of ED Requested Action” Section</p>
Calculation Methods/Tool review	<p>IOU Proposal: Uses a combination of eQUEST model results and spreadsheet calculation tools to derive measure savings</p>
	<p>ED Assessment: IOU approach is appropriate for these types of measures and magnitude of savings; however savings assumptions and baseline FCU operation need to be established</p>
	<p>ED Recommendation: While the savings method is mostly appropriate, see the savings assumptions and baseline section for information regarding the reasonableness of the savings assumptions and baseline FCU operation.</p>
Pre- or Post-Installation M&V Plan	<p>IOU Proposal: Photos of a sample of the guestrooms showing the FC units and the pre-existing (non-programmable) thermostats for pre-installation, and photos of the controls with programmable thermostats for post-installation. In addition to the installation photos, status loggers will be installed on the fan coil units in a sample of adjacent room pairs (i.e., guestroom controls versus no controls), with the unit runtimes planned to be monitored for a period of 3-4 weeks</p>
	<p>ED Assessment: The measure has substantial savings with very little pre-installation M&V effort to capture baseline usage</p>
	<p>ED Recommendation: See the “Summary of ED Requested Action by the IOU” section for details on M&V Plan</p>
Net-to-Gross Review	<p>IOU Proposal: Not provided</p>
	<p>ED Assessment: Assessment not completed</p>
	<p>ED Recommendation: No work is recommended at this time</p>