

Phase 3 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 the implementer, 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 Phase 3 Review: 4/10/2013
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	Pre-M&V data collection did not provide

	<p>the comprehensive baseline expected due to logger/data attrition. As an alternative option, the CASE study approach was applied to the HOTEL001A eQUEST model. The following savings are recommended:</p> <p>129,136 kWh; 2,076 Therms; 48.284 kW.</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. Annual gas savings were estimated to be 5,448 Therms; however these savings were not claimed for incentives.

Summary of Phase 3 Review

The phase 2 ex ante review introduced a pre—implementation M&V plan that would collect baseline occupancy and FCU operation data for at least 18 guestrooms. Additionally, daily vacancy data (i.e., whether sampled room was rented/unrented for each day of the metering period) for the selected guestrooms were also to be collected from the hotel.

The guestrooms selected for the sample were chosen by the hotel management. Data loggers were installed in 21 rooms on various floors in the hotel. Motor state loggers were installed on the FCU motor housing, behind the FCU panel. Temperature loggers were installed underneath the guestroom bed, attached to the bed frame. This location was chosen to conceal the logger as much as possible in order to reduce the chance of it being removed by the guestroom occupant or cleaning staff. Finally, occupancy loggers were installed next to the existing FCU thermostat in order to mimic the location that the proposed INNCOM thermostat (and PIR occupancy sensor) would be placed.

Hotel management was informed of what rooms had data loggers installed; they were instructed to leave the loggers in place and to inform guestroom occupants about the presence and purpose of the loggers. The data loggers were installed in all 21 rooms on January 14, 2013; most of the loggers were removed on February 27, 2013 with a few being removed several days later because the rooms were occupied.

Several loggers were removed or stolen from the guestrooms during the metering period. Apparently, the cleaning staff and guestroom occupants were not sufficiently informed by the hotel management that the loggers needed to stay untouched and in place in the guestroom. A

number of loggers were also apparently stolen by the guestroom occupants, or went missing during the metering period. Many of the remaining occupancy loggers were also removed by the cleaning staff and then replaced when instructed that they were not supposed to remove them. The specific time periods of these instances could not be determined from conversations with the hotel so the periods where the occupancy loggers were outside of the room could not be estimated. A final tally of collected loggers counted 6 occupancy loggers, 12 temperature loggers, and 21 motor state loggers. Because of the logger attrition (except for the motor state loggers that were behind the FCU housing panel) the occupancy and temperature data were deemed to be unreliable to use in establishing baseline conditions in the eQUEST model. Hotel management was also unable to produce vacancy records for the metering period; without this data the motor/fan state data could not be categorized in to rented and unrented categories. However, the motor state data could determine that the FCUs cycle the fan while operating.

Without the suite of logger data and the hotel vacancy data, the M&V approach had to be abandoned. The modeled guestroom spaces could not be broken in to different categories of vacancy and occupancy rates. Upon learning about the high attrition of the data loggers, Ecology Action provided alternative strategies that included (1) using the salvageable data from the occupancy loggers and call the average occupancy from that data representative for all the rooms in the hotel; and (2) use the occupancy profile and savings strategy from a Codes and Standards Enhancement Initiative study on Guest Room Occupancy Controls (the CASE study). The CASE study documents and calculates the incremental costs, potential energy savings, energy cost savings, and life cycle costs resulting from controlling HVAC and plug-load/lighting in unoccupied guestrooms. This study is the basis for the 2013 Title 24 code additions regarding hotel/motel guestroom controls. The questionable occupancy data and failure of the hotel to provide vacancy data lowered the appeal of using strategy (1), above.

ED chose to recommend the savings approach of the CASE study as an alternative to the pre-implementation M&V plan. This approach, while less desirable than the original M&V approach, would at least be consistent with what is expected to be the default savings approach for future new construction projects involving hotel/motel guestroom controls. An additional benefit of this approach is that the savings is dependent on and contained within the eQUEST model instead of the strategy presented before the M&V plan which involved applying uncertain savings factors and HVAC load split assumptions to the model's baseline HVAC energy consumption to calculate measure savings externally of the model. ED chose to use the Title 24 heating and cooling set point schedules instead of using the heating and cooling set point schedules developed by Ecology Action, who used room temperature data collected during the pre-M&V period to assist in developing the schedules. The temperature data analysis and anecdotal information provided by the hotel did not provide a reasonably conclusive indication of cooling or heating set points for the guestroom FCUs.

Review Conclusion

The ED-recommended savings below were derived from the altering the baseline eQUEST hotel model and applying the CASE study's heating and cooling FCU temperature set point schedule & savings approach (5 °F set-back / set-up weighted by CASE occupancy daily schedule). The following alterations were made to the Ecology Action baseline eQUEST hotel model to obtain the savings recommended below:

1. The model's guestroom FCU systems' "Indoor fan mode" parameter was changed from "Continuous" to "Intermittent". This change accounted for the actual operation of the hotel's FCUs (i.e., the FCU fan cycles on and off to meet the cooling/heating set point);
2. The model's guestroom FCU systems' heating and cooling temperature set point schedules were modified to match the heating and cooling set point schedules documented in the CASE study (Title 24);
3. A parametric (measure) run changed the model's guestroom FCU system's heating and cooling temperature set point schedule to match the CASE study's modified schedule. The modified schedule is the Title 24 heating and cooling set point schedule with each hour's temperature being set-back or set-up (heating or cooling, respectively) by the product of 5 °F and a weighting factor corresponding to the CASE study's 24-hour occupancy schedule. In this way, the energy model simulates the effect of the occupancy controls by adjusting the FCU system temperature hourly set points corresponding to the percentage of time a room would be unoccupied over the course of each hour.

The above steps were applied to the baseline model to yield the recommended savings for EEM-05: 129,136 kWh; 2,076 Therms; and 48.284 kW.

The changes that were applied to the baseline model reduced the modeled annual energy consumption such that the baseline model is currently "uncalibrated" to utility electric billing data. The baseline model had once been calibrated to within 92% of 2011 utility electric consumption and to within 87% of 2011 utility gas consumption. The main cause of the reduction in energy consumption is due to the FCU fan operation being changed from continuous to intermittent. This change allows the model to more accurately simulate the actual operation of the guestroom FCUs where the fan cycles on and off to meet the FCU cooling/heating set point instead of continuously operating 8,760 hours a year. ED believes recalibration at this point will not substantially improve the accuracy of the savings estimate for this particular measure. Ecology Action may optionally recalibrate the modified baseline model to utility data and recalculate savings for EEM-05. If the savings differ by more than 10% from the ED-recommended savings then they can be re-submitted for ED review.

Additionally, measures (EEMs) allocated under HOTEL001, which also utilized the eQUEST model, can have their savings resubmitted for ED review if their estimated savings differ from the previous submittal by more than 10%.

Summary of ED Requested Action by the IOU

1. Upon receiving details regarding the customer’s selection of the guestroom thermostat and energy management system, inform ED of the potential to use the guestroom EMS as a means to trend occupancy, FCU thermostat set points, and operating mode (fan on, heating, cooling) for the purpose of pre- and post-M&V. This initial feedback will determine next steps for M&V planning. Post M&V planning will be conducted in parallel between ED and the IOU.

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 this measure appears to be appropriate
Project Cost Basis (Full Cost, Incremental Cost)	\$544,800; This is the total estimated full 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	15 years (CASE study)
First Year kWh Savings	839,136	129,136 recommended for pre-implementation ex ante
First Year Peak kW Savings	111.91	48.28 recommended for pre-implementation ex ante

Description	IOU Proposed Ex Ante Data	ED Recommendations
First Year Therms Savings	5,448	2,076 recommended for pre-implementation ex ante
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)	N/A	TBD
Peak kW Savings (EUL thru RUL Period)	N/A	TBD
Therms Savings (EUL thru RUL Period)	N/A	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 probably be unrecoverable.
	ED Recommendation: In lieu of the pre-implementation results, the CASE study approach was implemented in to the existing baseline eQUEST model. Additionally, the baseline guestroom FCU fan schedule was changed from the default continuous operation to intermittent operation by changing the “indoor

Reviewed Parameter	Analysis
	fan mode” of all FCU systems from “continuous” to “intermittent”
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: The CASE study provides an updated EUL estimate of 15 years
	ED Recommendation: Use the EUL of 15 years proposed in the CASE study.
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 value, previously approved by the IOU, 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

Reviewed Parameter	Analysis
	<p>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 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: In lieu of the pre-implementation M&V results, the CASE study approach was implemented in to the existing baseline eQUEST model. Additionally, the baseline guestroom FCU fan schedule was changed from the default continuous operation to intermittent operation by changing the “indoor fan mode” of all FCU systems from “continuous” to “intermittent”. This approach isolates the source of the savings to the quality of the energy model; and removes the need to use savings factors and part load factors external of the model.</p>
<p>Calculation Methods/Tool review</p>	<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: In lieu of reasonable pre-implementation M&V results, use the CASE study approach to establish baseline and post-retrofit FCU schedules within the eQUEST model, and calculate savings using parametric runs within eQUEST. Post-implementation M&V results can then be fed in to the model in order to true up savings</p>
<p>Pre- or Post-Installation M&V Plan</p>	<p>IOU Proposal:</p> <p>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. A pre-implementation</p>

Reviewed Parameter	Analysis
	<p>M&V plan was recommended by ED and accepted by the IOU in late 2012. The pre-implementation M&V plan failed due to data attrition and the hotel's inability to produce vacancy data.</p> <p>ED Recommendation: Implement CASE study savings approach in to the baseline eQUEST model and determine savings from parametric eQUEST runs. Upon receiving details regarding the customer's selection of the guestroom thermostat and energy management system, inform ED of the potential to use the guestroom EMS as a means to trend occupancy, FCU thermostat set points, and operating mode (fan on, heating, cooling) for the purpose of pre- and post-M&V. This initial feedback will determine next steps for M&V planning. Post M&V planning will be conducted in parallel between ED and the IOU.</p>
Net-to-Gross Review	IOU Proposal: Not provided
	ED Assessment: Assessment not completed
	ED Recommendation: No work is recommended at this time