

## Phase 1 Ex Ante Review Findings

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

<b>IOU</b>	Pacific Gas and Electric
<b>Application ID</b>	Given an arbitrary ID of PGEHOTEL001RCX. Actual application ID was not provided
<b>Application Date</b>	Not provided
<b>Program ID</b>	Not provided
<b>Program Name</b>	Lodging Savers Program (NRR-DR)
<b>Program Year</b>	2012
<b>Itron Project ID</b>	X151
<b>IOU Ex Ante Savings Date</b>	Not provided
<b>ED Measure Name</b>	<p>Per the RCx Phase II preliminary report by Ecology Action, the following measure codes and descriptions are used:</p> <ol style="list-style-type: none"> <li>1. Commissioning; RCx Recode Controls - HVAC-Airflow (CCB14)</li> <li>2. HVAC; Retrofit / New-AHU / Package Units-VAV-Convert, including Terminal Boxes (CHA31)</li> <li>3. Commissioning; RCx Repair Hardware - HVAC Economizer / Outside Air (CCC11)</li> <li>4. Commissioning; RCx Recode Controls - HVAC Setpoint Change (CCB12)</li> <li>5. HVAC; Retrofit / New-Controls - Local Controls - Add setback Controls (CHD22)</li> <li>6. HVAC; Retrofit / New-Exhaust / Ventilation - Building Exhaust VFD (CHH10)</li> <li>7. HVAC; Retrofit / New-Exhaust / Ventilation - Garage Exhaust-</li> </ol>

	VFD & Controls (CHH22) 8. Pools; Retrofit / New-Pumps - Variable Flow (CWA10)
<b>Project Description</b>	This project is a retro-commissioning (RCx) and non-residential retrofitting (NRR) endeavor for a large hotel building, involving multiple EEMs including guestroom control systems, VFD controls on fans and pumps, temperature and pressure reset controls, and re-commissioning the economizer controls.
<b>Date of ED Review(s)</b>	07/20/2012
<b>Primary Reviewer and Firm</b>	Chris Williams / DNV KEMA
<b>Review Supervisor and Firm</b>	Leonel Campoy & Joseph Ball/Itron
<b>Type of Review (Desk, On-site, Full M&amp;V, Tool)</b>	Desk Review
<b>ED Recommendation</b>	Savings not approved. Unable to substantiate savings approach and individual measure savings, pending clarification and additional information for some of the savings approach assumptions, savings calculations revisions based on issues outlined in this review, and subsequent opportunity for ED to re-evaluate the project savings.

## **Measure Description**

The measures planned for implementation according to the Phase 2 Energy Efficiency Preliminary Report dated July 3, 2012 are:

- EEM-01 – Static Pressure Reset for all VAV air handlers. This measure applies to air handlers AC 1-5, AC 7-15, and AC 201-208. This is claimed to be an RCx measure per the Report.
- EEM-02 – Install VFD on AHU-6. This would retrofit the 20-hp supply fan motor with VFD controls. This is claimed to be an RCx measure per the Report.
- EEM-03 – Re-commission the Economizer Controls. The economizers for four (4) air handling units, AH-4, AH-6, AH-11, and AH-202, are not functioning properly. Air handler AH-4 and AH-6 have locked dampers at 10% open, and air handler AH-11 and AH-202 are locked at 100% open. The measure will replace either the broken linkages or the malfunctioning actuators, or both, and re-commission the operation of the economizers. This is claimed to be an RCx measure per the Report.
- EEM-04 – Implement Chilled Water Supply Temperature Reset. The chiller is currently set at a fixed set point of 42 °F. The building Energy Management System (EMS) is capable of a reset strategy. The EMS needs to be re-programmed with the possible requirement of setting additional control points. This is claimed to be an RCx measure per the Report.
- 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. This is claimed to be a NRR measure per the Report.
- EEM-06 – Install Variable Frequency Drives (VFD) on Exhaust Fans. This measure would install VFDs on 22 exhaust fan motors: EX-1, -2, -3, -4, -5, -6, -11, -12, -13, -15, -20, -21, -22, -23, -201, -202, -203, -204, -205, -206, -207, and -208. This is claimed to be an RCx measure per the Report.
- EEM-07 – Isolate the Parking Structure Exhaust System and Install an Exhaust Fan to Serve the Corridor and Laundry Areas. There are two ventilation exhaust fans, 40-hp EF-24 and 50-hp EF-25, serving both the hotel parking structures, and the corridor and laundry areas. The exhaust fans are equipped with CO sensor controls that are meant to modulate the fan operation. However, they operate continuously to serve the corridor and laundry rooms which represent a smaller, more constant exhaust load. This measure separates and isolates the ventilation exhaust systems, dedicating the EF-24 and EF-25 exhaust fans to serve the parking structures only. The measure installs a new 5-hp

ventilation exhaust fan to serve the corridor and laundry areas. This is claimed to be an RCx measure per the Report.

- EEM-08 – Install VFDs on the Swimming Pool Pumps. There are two 3-hp circulation pumps serving the swimming pool and spa continuously (24/7), operating at full speed. This measure installs VFD controls on the pump motors and allows them to match the required flow rate and pressure during the open pool/spa hours (6:00 am – 11:00 pm), and reduces their flow rate during closed hours. This is claimed to be a NRR measure per the Report.

The Phase II preliminary report lists annual energy savings of 1,728,068 kWh and an on-peak demand reduction of 194.69 kW. A total incentive amount of \$174,995 was calculated for all eight measures. The total incentive amount was based on the Lodging Savers Program incentive rates of \$0.09/kWh and \$100/kW.

## **Summary of Review**

Documents provided for review include the following:

- Phase I and Phase II Energy Efficiency Preliminary Reports dated June 15, 2012 and July 3, 2012, respectively. These reports provide general building and zone descriptions, square footage, age of building, number of various rooms and uses, mechanical systems, and plant equipment as well as proposed measures and tabulated savings estimates for each. The report's appendix section documents the pre-installation measurement and verification (M&V) efforts in the form of equipment nameplate photos and current control strategies per EMS interface screenshots, and measure simulation descriptions using eQUEST building energy simulation parameter changes.
- eQUEST building energy simulation models with parametric runs and associated savings for each individual measure
- Spreadsheet savings calculations in an Excel workbook showing individual measure savings, costs, incentive amounts, and savings methods and calculations for measures that were not simulated using eQUEST.

The review focused primarily on the reports, the supplied eQUEST model, the associated parametric runs contained within the eQUEST project file, the spreadsheet savings calculations and the savings assumptions documented within the Excel workbook. The supplied documents did not include the actual program application form showing what the program is claiming for this project.

The reports outline the general building characteristics, the central plant equipment and their performance specifications, operating conditions and set-points, high-level information on zonal mechanical systems, VAV and FC units and what they serve, how they are controlled, etc. In

addition, the reports document the annual whole building electricity and gas consumption for 2011 and provide a brief description of the building's electric and gas consumption profiles on a monthly basis. The reports describe the individual measures (EEMs), what equipment they affect and how the affected site-specific equipment maps to the equipment simulated in the eQUEST model. The reports present the proposed M&V plan to be carried out for both the pre- and post-implementation time periods. Lastly, the appendix sections contain photographs showing the pre-implementation equipment and control conditions.

While the reports are fairly comprehensive, there is a lack of detail on how the eQUEST building energy simulation model was generated and what site-specific inputs were used to inform the model. The simulation model does contain site-specific inputs for the plant equipment (chillers, boilers, cooling towers, and their associated ancillary pumps and fans) and operating conditions that are documented in the Section 4.2 of the report. However, some of the site-specific information was not carried over into the simulation model. The reports do not state whether the baseline simulation model was calibrated to any site-specific energy usage that was adjusted for the normalized weather data used in the simulation. These issues are discussed in the "Summary of ED Requested Action by the IOU" section.

## **Review Conclusion**

The Energy Division (ED) reviewers are unable to verify the project savings with the submitted information. The ED will complete the review pending fulfillment of the requested data and subsequent opportunity to re-evaluate the claimed project savings.

## **Summary of ED Requested Action by the IOU**

To complete the ex ante review, the ED recommends that the utility provide the following additional documentation by **August 11, 2012** (14 days from submittal date to the utility):

1. Provide a completed program application form that shows the current claimed savings for this project.
2. Provide background reasoning for EEM 7 and EEM 8 (VFD Exhaust Fan and VFD Pool Pump) duty cycle distribution determinations, specifically the proposed duty cycle distribution for the VFD exhaust fans and the proposed open-hours duty cycle distribution for the VFD pool and spa pumps.
3. Provide evidence that the current proposed open-hours duty cycle distribution of the pool pump satisfies the required 6-hour turnover time<sup>1</sup> for this specific pool volume.

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<sup>1</sup> As required per Title 24 Chapter 31B – Public Swimming Pools, Section 3124B – Turnover Time

4. Provide any available documentation describing in detail what site-specific inputs were used to develop and build the eQUEST model. If the model was calibrated to a site-specific consumption, provide documentation on for the calibration details. It appears that the eQUEST model building shell was custom built for this specific site; any further background information describing how the eQUEST model was built is requested.
5. Provide the proposed guestroom controls equipment specifications. In particular, provide documentation for the setback options that the guestroom system and thermostat has over the FCUs during unoccupied periods i.e., does the guestroom system have different setback temperature ranges for vacant rooms and non-vacant but unoccupied rooms.
6. Provide effective useful life (EUL) estimates for the proposed equipment with supporting or referenced documentation, if available.
7. Provide documentation to support that the CO sensors for the parking structures are operational.
8. Provide performance specifications (i.e., nameplate information including make, model number, nominal hp, efficiency, FLA, etc.) for all the exhaust motors in EEM 07. This includes the two (2) existing garage exhaust fans (EF-24 and EF-25 per the Report) and the proposed 5-hp exhaust motor intended to serve the laundry and corridor space.
9. Provide documentation for the disaggregated project cost estimates as currently tabulated in the “Summary” worksheet of the savings summary workbook, “XXXXXXXXXX Energy Analysis for LodgingSavers RCx 07-02-12.xlsx”, as currently available.

In addition to the data requests listed above, the following issues were noted in the review and should be addressed:

1. EEM 06 savings calculations incorporate existing motor efficiency losses in the existing motor energy consumption. However, the proposed motor energy consumption (motors controlled by VFD) does not include motor efficiency losses (it does include VFD control losses). The proposed motor energy consumption should also include the existing motor efficiency losses.
2. EEM 08 savings calculations do not incorporate VFD control efficiency losses (typically 2-5%). EEM 06 uses a 2% efficiency loss for VFD controls. This assumed 2% efficiency loss for VFD controls should be carried over in to the EEM 08 savings calculations.
3. Develop a pre- and post- implementation M&V plan for EEM 05 (Guestroom Controls) and develop a new savings approach. This measure has large uncertainty in savings due to the inherent behavioral and occupancy rate components. The M&V plan should include hotel staff interviews to estimate occupancy and vacancy rates (i.e., FCU operating schedules) before and after implementation of the guestroom controls. Larger

hotels sometimes have guestroom management systems that can provide vacancy rates (i.e., how often an average room is rented out and average rental periods). The staff interviews should also include questions to identify the expected setback temperatures during unoccupied periods and existing hotel protocol for turning off or setting back the thermostat of FCUs in vacant rooms. Recommend using these data to revise the “existing” occupant and fan schedules in the eQUEST model. Savings can then be calculated using eQUEST results for both the pre- and post-implementation conditions.

4. In the reports, the hot water (HW) loop is claimed to distribute hot water (for space heating) at 200 °F. However, the design HW loop temperature in eQUEST is set at 180 °F. Recommend changing the design HW loop temperature in eQUEST to 200 °F to follow site-specific conditions.
5. Similar to the hot water loop temperature issue, the reports claims that the HW loop is pumped through a heat exchanger and heats up the domestic hot water (DHW) loop to about 140 °F. However, the eQUEST model design HW temp for the DHW loop is set at 120 °F. Recommend changing the DHW loop temperature to 140 °F to follow the site-specific conditions.
6. EEM 07 (Garage exhaust measure) – The current pre- and post-installation M&V plan includes metering the garage exhaust fans (EF-24 and EF-25) over a 2-week period (run times and energy usage, kWh). The 2-week post-installation monitoring period should be during representative periods of average occupancy (i.e., number of parked cars) and peak “occupancy flow rate” (i.e., during periods when the number of cars entering/leaving the parking structure is at its highest)
7. The VFD-related measures (EEMs 02 and 06) should be classified as NRR measures since they are add-on controls to existing equipment

**Table 1-2: Project Overview**

Description	IOU Proposed Ex Ante Data	ED Recommendations
<p><b>Project Baseline Type (Early Replacement, Normal Replacement, Capacity Expansion, New Construction, System Optimization, Add-on Measures)</b></p>	<p>All measures (EEM1 through 8) use existing equipment as the baseline since the measures are either RCx or retrofits. EEM 07 (Isolate Garage Exhaust and Install Exhaust for Corridor/Laundry) introduces a new exhaust motor which could be considered capacity expansion; however, the existing exhaust motors' load will be significantly reduced due to this additional motor and zonal changes and will function as intended after its initial commissioning.</p>	<p>EEM 1, 3, 4, 7 are System Optimization measures. EEM 2, 5, 6, and 8 are Add-on Measures. The baseline equipment used for these measures appear to be appropriate</p>
<p><b>Project Cost Basis (Full Cost, Incremental Cost)</b></p>	<p>\$844,823; This is the total estimated project cost per the phase II assessment report</p>	<p>TBD; provide documentation to substantiate individual measure and total project costs</p>
<p><b>RUL (Early retirement projects only, otherwise N/A (not applicable))</b></p>	<p>Not provided</p>	<p>NA</p>
<p><b>EUL</b></p>	<p>Not provided</p>	<p>TBD. Provide EUL of new equipment</p>
<p><b>First Year kWh Savings</b></p>	<p>1,728,068</p>	<p>TBD</p>
<p><b>First Year Peak kW Savings</b></p>	<p>194.69</p>	<p>TBD</p>
<p><b>First Year Therms Savings</b></p>	<p>5,448</p>	<p>TBD</p>
<p><b>kWh Savings (RUL Period)</b></p>	<p>N/A</p>	<p>N/A</p>



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<b>Description</b>	<b>IOU Proposed Ex Ante Data</b>	<b>ED Recommendations</b>
<b>Peak kW Savings (RUL Period)</b>	N/A	N/A
<b>Therms Impact (RUL Period)</b>	N/A	N/A
<b>kWh Savings (EUL thru RUL Period)</b>	N/A	N/A
<b>Peak kW Savings (EUL thru RUL Period)</b>	N/A	N/A
<b>Therms Savings (EUL thru RUL Period)</b>	N/A	N/A
<b>Annual Non-IOU Fuel Impact (RUL Period)</b>	N/A	N/A
<b>Annual Non-IOU Fuel Impact (EUL thru RUL Period)</b>	N/A	N/A
<b>Net-to-Gross Ratio</b>	Not provided	Assessment not completed

**Table 1-3: Detailed Review Findings**

Reviewed Parameter	Analysis
<p><b>Project Gross Savings Baseline</b> (for early retirement projects only, include RUL through EUL baseline)</p>	<p>IOU Proposal: Baseline equipment is existing equipment. The measures are RCx or retrofit measures</p>
	<p>ED Assessment: Baseline equipment appears to be appropriate for this project. EEM 07 should have an ISP (or better) motor proposed to serve the laundry and corridor zones</p>
	<p>ED Recommendation: For RCx and retrofit measures in this project, existing equipment is the appropriate baseline</p>
<p><b>Project Cost Basis</b> (for early retirement projects only, include RUL through EUL cost basis treatment)</p>	<p>IOU Proposal: Not provided, but appears to be full cost</p>
	<p>ED Assessment: RCx and NRR projects should use full cost basis</p>
	<p>ED recommendation: When project is complete, provide project cost documentation in the form of vendor quotes or estimates for equipment, labor, and materials, categorized by individual measure</p>
<p><b>RUL</b> (required for early retirement projects only, otherwise n/a)</p>	<p>IOU Proposal: Not provided</p>
	<p>ED Assessment: NA</p>
	<p>ED recommendation: NA</p>
<p><b>EUL</b></p>	<p>IOU Proposal: Not provided</p>
	<p>ED Assessment: Cannot be assessed at this time because EULs were not provided for the individual measures</p>
	<p>ED Recommendation: Provide EUL estimates for the eight individual measure categories. If EULs are not provided, use the following DEER EUL estimates:</p> <p>Repair Economizer – 5 years</p> <p>VSD Supply Fan Motors – 15 years</p> <p>Water Loop Reset – 10 years</p>

<b>Reviewed Parameter</b>	<b>Analysis</b>
	<p>Variable Flow Water Loop, VSD Pump – 15 years (For VSD Pool Pump)</p> <p>Energy Management System – 15 years (For the Guestroom Controls)</p> <p>Premium Efficiency Motors – 15 years (For proposed new exhaust fan motor in the Garage Exhaust measure)</p>
<b>Savings Assumptions</b>	<p>IOU Proposal: Uses a combination of site-specific inputs for plant equipment, building characteristics, and equipment performance specifications for EEMs 1 through 4. EEMs 1 through 4 savings are derived from the eQUEST model. EEM 5 (Guestroom controls) uses eQUEST baseline model HVAC end-use consumption results, 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 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) EEM 06 and 08 (VFD on exhaust fans and VFD on pool/spa pumps) use an assumed (post-installation) duty cycle distribution and site specific run time hours, motor hp, and motor efficiency to estimate measure savings. EEM 07 (Garage exhaust fans measure) uses a statewide savings calculation tool for CO Mitigation for Parking Structures.</p>
	<p>ED Assessment: Some of the measures’ savings assumptions cannot be fully assessed at this time due to some missing information either for specific existing equipment or for the proposed equipment. Additionally, reasoning to substantiate some savings assumptions are not provided in the current documentation.</p> <p>EEM 05 (Guestroom controls) – 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) over-simplifies the estimated measure savings. For very large lodging spaces with multiple space functions such as restaurants, conference rooms, and fitness rooms zonal HVAC load requirements can vary significantly. Because of this variation, the distribution of HVAC load and consumption throughout the entire hotel space should not be linear.</p>
	<p>ED Recommendation: TBD, pending data request response</p> <p>EEM 05 (Guestroom Controls) – See the “Summary of ED Requested Action” Section, above, for recommendations to improve this measure’s savings assumptions and approach</p>

Reviewed Parameter	Analysis
<b>Calculation Methods/Tool review</b>	IOU Proposal: Uses a combination of eQUEST model results and spreadsheet calculation tools to derive individual measure savings
	ED Assessment: IOU approach is appropriate for these types of measures and magnitude of savings
	ED Recommendation: While the savings methods and tools used are appropriate, see the savings assumptions section for information regarding the reasonableness and documentation of some of the savings assumptions
<b>Pre- or Post-Installation M&amp;V Plan</b>	<p>IOU Proposal: Pre- and post-installation M&amp;V plans are briefly given for each measure in the Report. For measures whose savings are less than 75,000 kWh (EEMs 01, 02, 03, and 08), plans include collecting photos of affected equipment (motors, pumps, etc.) pre- and post-installation of the measure for verification of installation purposes. For measures whose savings are more than 75,000 kWh (EEMs 04, 05, 06, and 07):</p> <ul style="list-style-type: none"> <li>• EEM 04 (CHW Loop Reset) – EMS screen shots of the existing fixed CHWST and the proposed CHWST logic will be provided. Post implementation trend data (CHWST versus outside air temperature over a 2-week period) will also be supplied to support the CHWST logic is functioning</li> <li>• EEM 05 (Guestroom controls) – 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</li> <li>• EEM 06 (VFDs on Exhaust fans) – Pre- and post-installation photos of the existing exhaust fan motors, with pre-installation photos showing direct motor control and post-installation photos showing VFD controls</li> <li>• EEM 07 (Garage exhaust measure) – Pre- and post-installation M&amp;V plan includes metering the garage exhaust fans (EF-24 and EF-25) over a 2-week period (run times and energy usage, kWh). Also, photos will be taken (post-installation) of the new exhaust fan installed along with the supporting ductwork, for verification purposes.</li> </ul>
	ED Assessment: EEM 05 (Guestroom Controls) has substantial savings with very little M&V efforts. EEM 06 (VFD Exhaust fans) can take advantage of

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Reviewed Parameter	Analysis
	<p>the planned M&amp;V for EEM 07 (Garage Exhaust Fans) to expand the M&amp;V for this measure</p> <hr/> <p>ED Recommendation:</p> <ul style="list-style-type: none"> <li>• EEM 06 should incorporate a 2-week metering period (time-series kW) for at least post-implementation M&amp;V to verify and revise the duty cycle distribution assumption used in the savings calculation</li> <li>• EEM 05 – See the “Summary of ED Requested Action by the IOU” section for details on M&amp;V Plan for EEM 05</li> <li>• EEM 07 – See the “Summary of ED Requested Action by the IOU” section for details on revisions to the post-installation M&amp;V plan for EEM 07</li> </ul>
<p><b>Net-to-Gross Review</b></p>	<p>IOU Proposal: Not provided</p>
	<p>ED Assessment: Assessment not completed</p>
	<p>ED Recommendation: No work is recommended at this time</p>