

## Final Ex Ante Review Findings

**Table 1-1: Project Information**

<b>PA</b>	Pacific Gas & Electric (PG&E)
<b>Application ID</b>	2K13202231
<b>Application Date</b>	March 22, 2013
<b>Program ID</b>	PGE 21011
<b>Program Name</b>	Retro-commissioning (RCx)
<b>Program Year</b>	2013
<b>CPUC Project ID</b>	X399
<b>PA Ex Ante Savings Date</b>	March 26, 2015
<b>Measure Name</b>	RCx
<b>Project Description</b>	The customer completed a retro-commissioning project in an 11-story multi-tenant office building. The project implemented three measures: (1) revised hot deck OA reset scheduling, (2) optimum start/stop AHU controls, and (3) OA damper repairs to allow airside economizing.
<b>Date of CPUC Staff Review</b>	07/30/2015
<b>Primary Reviewer / Firm</b>	Brandon Gill/DNV KEMA, EAR I Susan Haselhorst ERS, Final EAR
<b>Review Supervisor / Firm</b>	Leonel Campoy/Itron
<b>CPUC Staff Project Manager</b>	[REDACTED]
<b>CPUC Staff Policy Authorization (as needed)</b>	
<b>Type of Review (Desk, On-site, Full M&amp;V, Tool)</b>	Desk Review
<b>CPUC Staff Recommendation</b>	The ex-ante impacts are approved at the PA submitted values of 58,675 kWh and 15,236 Therms saved annually with no peak electrical demand reduction (0 kW). The PA shall upload final completed project documentation to this project's CMPA folder in the project's Claim IDs and the quarter and year in which the project is claimed.

## **Measure Description**

This retro-commissioning project aimed primarily to correct deficiencies in the central HVAC systems serving an 11-story multi-tenant office building in San Francisco constructed in 1970. The first three floors of the 220,000 square foot building are primarily unconditioned parking areas; floors 4 through 8 contain general office space; and floors 9 through 11 contain radio station tenants with more substantial electronic loads. The Building Energy Management System (BMS) was replaced in 2011.

A dual-duct, dual-fan air handler with a 50 HP cold deck fan and a 50 HP hot deck fan provides space cooling and heating for the majority of the building. Dedicated DX systems provide 24-hour cooling to the radio station's information technology loads on the top floor. The main AHU fans, though equipped with VFDs, do not modulate, operating as a constant volume system at 80% speed due to pre-existing building pressurization issues. Three (3) 125 HP, Carrier 5H120 DX reciprocating compressors connected to an evaporative condenser provide mechanical cooling to the AHUs. An Ajax WNG 4000, 2.56 MMBtuh (output), 80% efficient boiler provides hot water to the AHUs. The building HVAC systems are active between 6:00 AM and 6:00 PM, Monday through Friday.

The following measures were implemented and verified by the PA, metered, and modeled using the eQuest building energy simulation tool. The measures contributing to claimed savings are described below, along with a description of the verification activity and modeling.

- (1) Proposed: Enable variable airflow for both the hot deck and cold deck. At minimum, allow airflow to vary between 50% and 80%.

This measure could not be made to work; no savings were claimed for this measure.

- (2) Proposed: Change the reset temperature range on the hot deck to 75 °F (at 60 °F outdoor) to 110 °F (at 40 °F outdoor). Change the reset on the cold deck from between 60 °F (at 60 °F outdoor) and 55 °F (at 80 °F outdoor) to between 65 °F (at 60 °F outdoor) and 55 °F (at 80 °F outdoor).

This measure was implemented with a slight adjustment from the original plan with the hot deck minimum set to 80 °F rather than 75 °F as had been planned. The measure was verified through inspection of the BMS control sequences and monitoring of deck temperatures spanning about twenty weeks. The metered data shows the deck temperatures varying as planned.

- (3) Proposed: Implement optimum start and stop controls for the building HVAC systems.

This measure was implemented with the optimum start feature only due to some ventilation concerns. The measure was verified through inspection of the BMS control sequence and with 17 days of monitoring. The start times of the system varied between 5:45AM and 7:40AM during the metering period.

- (4) Proposed: Repair the outdoor air damper actuator to allow modulation between 10% and 100% outdoor air. Implement single point temperature based OA economizer control.

This measure was not fully implemented. The dampers were made operational, but are either 100% open or 100% closed. The dampers are open during the occupied period. Savings are claimed when the optimum start-up begins before 7:00 AM, when the dampers are kept in the closed position. Metering data was available from a period spanning twenty weeks.

- (5) Proposed: Implement a condenser head pressure reset control strategy. The RCx consultant suggests lowering the condensing temperature set point to a minimum set point of 90 °F when the ambient dry bulb temperature decreases to 80 °F and a maximum of 100 °F when the outdoor temperature reaches 90 °F.

This measure was not implemented due to concerns expressed by the HVAC contractor about operating the discharge temperature below the current setpoint.

The table below summarizes the final impacts, proposed incentives, and simple paybacks without incentives as submitted in PG&E’s RCx Verification workbook, “4.2\_VerifRept\_Review” spreadsheet tab.

Measure	Achieved Electricity Savings (kWh/yr)	Achieved Peak Demand Reduction (kW/yr)	Achieved Natural Gas Savings (Therms/yr)	Documented Measure Installation Costs	IOU Incentives	Simple Payback Without Incentives (Years)
EEM-1: VSD Re-automation	0	0	0	\$0	\$0	NA
EEM-2: Optimum Deck Temperature Reset	54,574	0	13,471	\$1,760	\$18,382	0.09
EEM-3: Optimum Start/Stop Controls	5,392	0	714	\$1,760	\$1,199	1.19
EEM-4: Outside Air Damper Repair	-1,291	0	1,051	\$12,728	\$1,051	16.74
EEM-5: Condenser Temperature Reset	0	0	0	\$0	\$0	NA
<b>Totals</b>	<b>58,675</b>	<b>0</b>	<b>15,236</b>	<b>\$16,248</b>	<b>\$8,124*</b>	<b>0.71</b>

\* Capped at 50% of the total project cost.

## **Summary of Review**

### *Phase I Ex Ante Review*

The initial submittal for this application proposed the same measures as described above. The ex ante savings were conditionally approved pending final verification. The IOU was instructed as follows:

- Modify the model for Measure 4, economizer control, to reflect single point dry-bulb control, not enthalpy economizer control as currently represented in the model.
- Modify the model for Measure 5 to better reflect head pressure reset, working within the constraints of the eQuest model.
- Extend the metering period from two weeks to six to eight weeks to better characterize system operations.
- Provide RUL values.

### *Final EAR Review*

The Investor-Owned-Utility (IOU) submitted the following documents on April 24, 2015:

- 2K13202231-RCC AESC VR FINAL.zip. This zip file contained, among about 40 documents, spreadsheets and models:

The RCx Verification report: 2K13202231-RCC AESC VR FINAL\2K13202231 Verification Report (032515) POST.pdf

The eQUEST savings model used to develop initial savings estimates: \2K13202231-RCC AESC VR FINAL\2K13202231 VR eQUEST Model POST.zip

A number of EMS trend data and screenshots used to support the savings analysis and measure development.

The applicant determined the energy savings using eQuest simulation modeling of the implemented measures. The applicant submitted an RCx Verification Report which inventoried the key measures, reported on their installed disposition, documented strategies with screen shots, and provided metered data, models, and invoices.

CPUC staff reviewed the metered data and the eQuest model to confirm that the data was reflected in the model and that the model matches the descriptions in the RCx Verification Report. CPUC staff concludes that the model accurately represents the as-built facility.

The applicant provided the requested RUL values and invoices.

Eligibility & Program Rules Review

The Phase I Ex Ante Review (EAR) disposition considered the measures *eligible* because they were listed as such in the PG&E RCx Policy & Procedures Manual. The Phase I review did not closely examine the proposed measures code requirements. In this final review, CPUC staff will not scrutinize the implemented measure baselines further since the first disposition considered the measures eligible with existing equipment and operating practice baselines. However, going forward, CPUC staff advises that all measures, including those in RCx programs, must exceed either mandated code requirements or industry standard practice (ISP).

In addition, the Phase I disposition indicated that the RCx agent's initial measure costs were rough estimates, and noted concern that the final simple paybacks for the measures and project would remain less than one year. The 2010 PG&E RCx Policy & Procedures Manual explicitly states in Section 3.2 *Step 1 – Program Application and Scoping Audit* that:

*“By signing the Program Application, the Customer certifies that they have read and agree to the terms and conditions of the RCx program. Specifically, they agree to implement all discovered RCx measures with less than a 1 year simple payback within 1 year up to \$25,000 or the total cost of the measures, whichever is less.”*

Likewise, Section 3.4 *Implementation* states:

*“A condition of PG&E’s no cost to the customer Investigation, the Customer is required to implement all measures with a simple payback of one year or less, up to \$25,000 or the total of all RCx measures with the less than one year simple payback, whichever is less. If the customer does not implement these measures within 12 months of signing the Incentive Agreement, they are required to reimburse PG&E for the costs of the RCx Provider, up to \$25,000.”*

The implemented “*Optimum Deck Temperature Reset*” measure exhibits an extremely short simple payback period of just 33 days without incentives. Commission staff review of the current PA program policy finds that the language does not restrict the payment of additional program financial incentives for this measure on top of the RCx investigation payment the PA has already made on the customer's behalf. Commission staff found the same issue in Application ID 2K13182291 (CPUC Tracking ID X362) where a no cost measure was implemented and the PA declared that a financial incentive would be paid for the measure. Commission staff will further review these program policies outside of the present project and consider the need to address the issue in a separate statewide disposition.

### Final Savings Estimation Review

To determine the savings estimates for each measure, the RCx agent used an eQUEST simulation model of the baseline facility then performed parametric runs for the proposed measures. Baseline conditions were verified and modeled based on 36 days of EMS trending pre and intermittent data collection over a seven month period as the measures were implemented and debugged.

The baseline model was calibrated using monthly utility billing data to within -7.9% of annual consumption from the most recent year and to within -4% for the most recent two year average. The RCx agent properly utilized a cascading approach to savings estimation wherein the proposed case for one EEM became the base case for the next measure to avoid double-counting measure savings.

The following observations were made based on the calculation and true-up methods utilized for each measure:

- ***EEM1: VSD Re-automation***

This measure is no longer being claimed for savings.

- ***EEM2: Optimum Deck Temperature Reset***

The cold and hot deck temperature reset schedules modeled in eQuest were adjusted in accordance with the proposed schedules listed in the “Measure Description” Section above. No other adjustments are required for this measure.

- ***EEM3: Optimum Start/Stop Controls***

The eQUEST model shows the fan schedule for 6 AM to 7 AM has been assigned a value of -999 in the parametric runs. For the morning hour, this means that if the fans are needed to bring the space up to set point by 7 AM, then they will be activated. For evening shutdown, the value switches from 1 to 0 for the unoccupied hour since optimum stop has not been implemented.

- ***EEM4: Outside Air Damper Repair***

The eQuest models show the dampers operating in an opened or closed position consistent with the schedule.

- ***EEM5: Condenser Temperature Reset***

This measure is no longer being claimed for savings.

### Implemented M&V Review

CPUC staff recommended post-implementation trending for six to eight weeks in the first EAR disposition. In the seven months since the implementation of the measures, metered data was collected for a span of about twenty weeks, with individual periods in duration of between two to five weeks. CPUC staff considers metering efforts acceptable for this project.

### Measure Persistence

During the final review, CPUC Staff determined that a change in ownership recently occurred right after the project was completed and that a new tenant is slated to occupy close to half of the building. Since it is likely that significant tenant improvements have taken place, CPUC Staff is concerned whether the implemented measures will persist through the five year EUL period.

### **Review Conclusion**

The ex-ante impacts are approved at the PA submitted values of 58,675 kWh and 15,236 Therms saved annually with no peak electrical demand reduction (0 kW). The PA shall upload final completed project documentation to this project's CMPA folder along with the measure Claim IDs and the quarter and year in which the project is claimed.

### **Summary of CPUC Staff Requested Action by the PA**

CPUC staff requests that PG&E upload to the CMPA all final documentation and Claim IDs for this project upon savings claim.

### **For all future projects (submitted after receipt of this review):**

1. CPUC policy requires that all proposed energy efficiency measures must exceed either current code requirements or ISP. The PA is to apply this policy to measures proposed in RCx projects.
2. CPUC Staff is concerned about the general persistence of implemented measures through the RCx process. CPUC Staff recommends that the PA better engage with customers and implementers to address and ensure measure persistence.

**Table 1-2 Review Findings**

Reviewed Parameter	Analysis
<p><b>Project Baseline Type</b> (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>	PA Proposal: System Optimization
	CPUC Staff Assessment: CPUC staff recommended “System Optimization” in the first EAR disposition along with in-situ conditions for the measure baselines. CPUC staff will not modify the original assessment to require code and ISP baselines for this project.
	CPUC Staff Recommendation: Acceptable
<p><b>Project Baseline Technology</b> (in situ equipment, Title 24 (specify year), other code or other efficiency level (specify), industry standard practice - ISP)</p>	PA Proposal: In situ equipment
	CPUC Staff Assessment: In situ equipment is appropriate.
	CPUC Staff Recommendation: Acceptable
<p><b>Project Cost Basis</b> (Full Incremental, or Both. Note: For early retirement projects, include RUL through EUL cost basis treatment)</p>	PA Proposal: Full Cost
	CPUC Staff Assessment: Full cost is appropriate for the implemented measures.
	CPUC Staff Recommendation: Acceptable
<p><b>RUL</b> (required for early retirement projects only, otherwise N/A)</p>	PA Proposal: 5 years for each of the implemented measures.
	CPUC Staff Assessment: The EMS was installed in 2011 and therefore at the time of the implementation, the EMS had an RUL of 12 years.
	CPUC Staff Recommendation: Acceptable
<p><b>EUL</b> (for each measure)</p>	PA Proposal: 5 years for each of the implemented measures.
	CPUC Staff Assessment: The EMS was installed in 2011 and therefore at the time of the implementation, the EMS had an RUL of 12 years. Per Appendix B in the “RCx Project Submittal Guidelines” document, the EUL of each of the proposed measures is five years. The lesser is 5 years.
	CPUC Staff Recommendation: Acceptable
<p><b>Savings Assumptions</b></p>	PA Proposal: For the implemented measures, the IOU proposed using eQuest.
	CPUC Staff Assessment: eQuest is acceptable for these measures.



<b>Reviewed Parameter</b>	<b>Analysis</b>
	CPUC Staff Recommendation: Acceptable
<b>Calculation Methods/Tool review</b>	PA Proposal: The IOU's RCx agent utilized a baseline eQUEST model modified with three cascading parametric runs to estimate project savings.
	CPUC Staff Assessment: The overall analysis approach utilized to estimate savings was appropriate.
	CPUC Staff Recommendation: Acceptable
<b>Pre- or Post-Installation M&amp;V Plan</b>	PA Proposal: The RCx agent conducted two weeks of baseline data collection to establish the existing operating conditions. The RCx agent acquired about twenty weeks of post-implementation data, although only seventeen days' worth was used in the analysis.
	CPUC Staff Assessment: The proposed M&V is consistent with program requirements. The metering data collected spanned a range of temperatures and operating conditions.
	CPUC Staff Recommendation: Acceptable
<b>Net-to-Gross Review</b>	PA Proposal: Net-to-gross issues were not discussed in the provided documentation.
	CPUC Staff Assessment: Waived
	CPUC Staff Recommendation: Waived

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

Description	PA Ex Ante Claim	CPUC Staff Recommendations
<b>First Year kWh Savings</b>	58,675	58,675
<b>First Year Peak kW Savings</b>	0	0
<b>First Year Therms Savings</b>	15,236	15,236
<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>	N/A	N/A
<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>	N/A	N/A
<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>	\$16,248	\$16,248
<b>Project Costs for Baseline #2 (EUL minus RUL period)</b>	N/A	N/A
<b>Project Incentive Amount</b>	\$8,124 (capped at 50% of estimated full project cost)	\$8,124 (capped at 50% of estimated full project cost)