Phase I Ex Ante Review Findings

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

IOU	Pacific Gas and Electric (PG&E)
Application ID	2K13182291
Application Date	SOW/Budget agreement signed May 24 and May 29, 2013
Program ID	PGE21021
Program Name	RCx Program - Calculated Incentives
Program Year	2013
Itron Project ID	X362
IOU Ex Ante Savings Date	Investigation Phase Technical Review completed 11/12/2013
CPUC Staff Measure Name	RCx Measures
Project Description	The customer proposes to implement four RCx measures at a large office building in order to improve the operational efficiency of the HVAC system.
Date of CPUC Staff Review	12/13/2013
Primary Reviewer / Firm	Chris Williams / DNV GL Energy
Review Supervisor / Firm	Keith Rothenberg / Energy Metrics
CPUC Staff Project Manager	[redacted] / California Public Utilities Commission, Energy Division
CPUC Staff Policy Authorization (as needed)	
Type of Review (Desk, On-site, Full M&V, Tool)	Desk Review
CPUC Staff Recommendation	CPUC conditionally approves the ex ante savings subject to the IOU making baseline adjustments (i.e., remove the claimed leaky valve savings) on RCx-2 and trueing up savings of all measures after post-installation M&V is completed.

Measure Description

Based on the Investigation Report, the following measures are proposed to be implemented:

- RCx-1: Move Chiller 1 Operation from Thursday to Saturday – Chiller 1 is a backup 1,100 ton water-cooled fixed-speed chiller run as the primary chiller one day per week to maintain sufficient working order. The chiller is less efficient than the normal primary lead/lag chillers. This measure proposes to move weekly operation of the chiller from Thursday to Saturday in order to reduce the peak demand associated with its use on Thursdays.
- RCx-2: Implement Chiller Plant Resets and Rebalance CWP Flows – This measure involves multiple solutions, including:
    - Replacing all non-functional pneumatic ("leaky") air handler unit (AHU) chilled water valves (affecting 17 AHUs) with DDC-actuated valves with proportional or floating control with position feedback. Most of the AHUs have either 15 or 20 hp fan motors;
    - Implement a chilled water supply temperature (CHWST) reset strategy based on CHW valve position on AHU (i.e., trim and respond strategy). The reset strategy would be implemented for "CH-2" and "CH-3" – the primary lead/lag 800-ton and 338-ton water-cooled York chillers, respectively;
    - Balance condenser water pump (CWP) speed to match rated chiller CW flow of chiller "CH-2" by installing a VFD on the primary 75 hp CWP "TP-2; and
    - Reset condenser water supply temperature (CWST) based on CHW load and chiller staging.

  This measure also claims gas savings because replacing the leaky AHU valves will reduce the amount of reheating necessary for the over-cooled zones. The building contains two types of boilers for HHW. There are four (4) Thermal Solutions boilers with a rated input of 2,000 kBtu/hr and two (2) older Thermo Pak boilers with a rated input of 7,000 kBtu/hr.
- RCx-3: Improve Energy Efficiency of Heating Hot Water System – This measure involves multiple solutions, including:
    - Replace the existing broken three-way HHW bypass valve with a new DDC valve and connect to new the Alerton control system. This will prevent HHW from unintentionally bypassing the boilers and will increase the HHWST provided to the AHUs to the programmed set point;
    - Implement an Optimum Start Program that will determine the start time of each AHU independently. This will optimize AHU start times for the building's morning warm up period. Additionally, the outside air transfer fans and the

chilled water valves will be verified to be closed during the morning warm-up periods;

  - Install a (differential pressure) DP sensor between supply and return HHW pipes (worst-case location i.e., near bottom of building) and control existing HHW pump VFDs to maintain a DP set point. There are two 25 hp HHW pumps piped in parallel that operate (and will operate) at a common speed; and
  - Implement a demand-based DP and HHW temperature reset strategy based on HHW valve positions. The minimum DP set point will be based on the minimum flow for a single boiler and the DP necessary to operate the pump VFD at its minimum speed. The maximum DP set point will be based achieving the design flow rate through the “worst-case” HHW valve.

- RCx-4: Convert Constant Volume Air Handlers to Variable Volume – This measure involves multiple solutions, including:
  - Install variable frequency drives (VFDs) on existing AHU fan motors that do not have variable speed control already. The fan speed will be controlled to maintain a duct static pressure (DSP) set point. There are a total of 48 AHUs (2 on each of the 24 floors) that are currently constant volume;
  - Install DSP sensors in the hot and cold decks in “worst case” locations (near the dual duct terminal boxes);
  - Convert terminal boxes to variable volume. This conversion involves splitting the pneumatic thermostat line to connect to both hot and cold deck controllers in each terminal box. There are approximately six terminal boxes on each floor, serving perimeter spaces;
  - Implement a temperature deadband for the floors’ multi-zone thermostat set points; and
  - Implement a DSP and deck temperature reset control strategy based on demand.

The following table presents the IOU-claimed project savings and cost categorized by measure.

Measure ID	Peak Demand Savings (kW)	Electric Savings (kWh)	Gas Savings (Therms)	Cost ($)	Incentive ($)
RCx-1 (Chiller Scheduling)	0	47,518	0	$0	$4,277
RCx-2 (Chiller Plant	88.5	202,333	13,349	$90,850	$40,407

Upgrades)					
RCx-3 (HHW Upgrades)	17.9	165,002	0	$62,675	$16,644
RCx-4 (CAV to VAV)	431.0	878,238	32,224	$679,650	$154,363
Total	**537.4**	**1,293,091**	**45,573**	**$833,175**	**$215,690**

Summary of Review

The Investor-Owned-Utility (IOU) submitted the following documents for Data Request (DR) 422 on December 6, 2013 for this Phase I review:

- Project tracking workbook;
- RCx Investigation savings calculation workbook;
- Investigation Report;
- IOU Technical Reviewer notes with implementer's response comments;
- Utility monthly usage history report spreadsheet;
- Project kickoff meeting minutes document;
- Raw time-interval portable logger CHW and CW flow data;
- Raw EMS trend data containing the available building trend points for chillers, pumps, CT fans, boilers, AHUs, and zone temperatures; and
- Previously submitted pre-investigation phase documentation (submitted to CMPA in June 2013) that included the project application, signed SOW document, rough cut budgeting spreadsheet, RCx scoping audit document, and preliminary pictures of HVAC equipment.

Review of Investigation Phase Pre-M&V Data Collection and Analyses

The Implementer collected a variety of data that were used in the custom savings calculation worksheets to estimate measure savings. Data included design specifications of all HVAC equipment potentially affected by the measures, 15-minute interval demand (InterAct) data, monthly electric and gas consumption data dating back to January 2012, descriptions of the CHW & HHW plant sequencing and controls, spot power measurements of a sample of AHU supply fan motors, EMS trend data for all data points available for historical recording[1]

[1] Many trend points, some important points include: CHWST, CHWRT, CHWSTSP, Chiller amperage, CHW & CW pump status (on/off), CTST, CTRT, CT fan status, CT fan speed, HHWST, HHWRT, HHWSTSP, HHW bypass valve position, HWP flow, HWP VFD speed, OSAT, CD & HD temperatures & set points for sampled

(approximately three weeks of 15-minute interval data), time-interval flow measurements on CHW and CW flow, and pictures of affected equipment.

Sufficient site-specific data were collected to reasonably model plant cooling load with linear correlation to OAT. The modeled CHW plant load was visually calibrated to the trended plant data over a reasonably wide outside air temperature range (52-80 °F). The plant load's linear relationship to outside air temperature was scrutinized because the monthly electric consumption shows that the building has a nearly constant electric load profile, suggesting that the building may be core-load dominated; the building also has minimum outside air requirements that influence the observed load. Despite the discrepancy between the actual relatively flat monthly electric load profile and the plant load model's linear relationship to outside air temperature, it appears that the trended plant loads collected from the building EMS support this linear relationship.

The boiler plant load was estimated using building & equipment design load specifications and hot deck supply temperatures based on site observations. The boiler plant efficiency is assumed to be 84%, based on the average thermal efficiency of the existing boilers. Trended HHW load was not collected for calibration purposes in the reheat savings analyses (in RCx-2 and RCx-4). Still, the savings estimates are sufficient for the Investigation phase estimates and post-implementation M&V plans to collect HHW trend data that can be utilized to enhance the boiler plant load model.

2°F incremental temperature bin analyses were then used to estimate measure savings; the modeled cooling load and building & equipment design load specifications were used to estimate the corresponding plant (chiller, boiler, CT fan, and pump) and AHU fan electric loads necessary to satisfy the modeled cooling load[2]. Chiller design specifications were adjusted using DOE-2 capacity and part load ratio curves to estimate chiller electric load over the OAT and corresponding cooling load bin range. The custom savings calculation workbook is sufficiently comprehensive to estimate the RCx measures addressed in this project. It allows detailed input parameters and equipment sequence methods for developing temperature bin load and energy consumption for all plant components (chiller, boiler, pumps, CT fans), and AHU fans. The measures were sequentially applied in the savings calculations to avoid double counting interactive savings, specifically for the measure components of RCx-2.

AHUs, multi zone (floor) thermostat set points and temperatures for sampled AHUs, multi zone and dual duct terminal unit damper positions for sampled AHUs, HHW and CHW valve position (% open/closed) for sampled AHUs, RAT for sampled AHUs.

[2] Except for RCx-1 which used billing analysis; and RCx-3 which used both billing analysis and a bin analysis that did not utilize the calibrated plant load model.

Review of RCx-1

The savings analysis for RCx-1 uses the building's 15-minute interval kW data to create daily average kWh usages during occupied periods for specific weekday groups. Since the major operational difference between Thursday and other weekdays[3] lies exclusively with operating Chiller 1 (the less efficient back up chiller), the difference between the average kWh usage on Thursday and the average kWh usage on other weekdays (i.e., excluding Monday and Thursday) was taken to be the energy savings associated with moving Chiller 1 operation from Thursday to Saturday. The energy penalty associated with the operational move was calculated by representing energy savings as the percent usage above the typical base weekday (Tuesday, Wednesday, and Friday) usage (5%) and then adding the percent usage on to the base Saturday usage. The difference between the energy savings and the energy penalty is the net energy savings for RCx-1. Peak demand savings was not claimed for this measure despite the initial intention to do so. The implementer's analysis showed that there were none of the expected peak demand savings; the analysis showed that Thursday had, on average, a lower max peak during summer months.

While this savings analysis method does not attempt to directly measure and estimate the difference in Chiller 1 load between Thursdays and Saturdays, the expected building load does not change, thus the expected savings is derived from the difference between the operating efficiencies (kW/ton) of Chiller 1 and the primary chiller, and the difference in operating times of Chiller 1 between Thursday (12 P.M. to 6 P.M.) and Saturday (8 A.M. to 12 P.M.). For the potential magnitude of savings achievable from this measure, this form of savings analysis was considered reasonable by CPUC Staff. Verification of measure implementation will be confirmed using interval data. This form of verification was also considered acceptable but should be supplemented with an analysis similar to that completed in the Investigation Report. The post-implementation verification results should also be used to true-up the claimed savings for RCx-1.

The estimated cost for implementing RCx-1 is $0 since it is simply an operational (schedule) change. The operational change is programmed into the existing EMS and is not a manual operation.

Review of RCx-2

Savings analyses of the individual measure components started with developing a baseline HVAC electric load (chiller, CHW & CW pumps, CT fans, and AHU fans) model that was calibrated to building design temperatures, AHU design flow rates, plant design parameters, trended plant cooling load data, and power & EMS spot measurements. There were no specific

[3] Tuesday, Wednesday, and Friday – excluding Monday because of building start up energy consumption from reduced schedules on the weekend

calibration targets; the modeled cooling load was visually calibrated to fall in line with the trended plant cooling loads. The modeled cooling load appears to reasonably match the trended plant cooling load over the measured outside air temperature range (52 to 80°F).

The measure's AHU CHW valve replacement/repair component savings over the existing baseline ("leaky") condition cannot be claimed. CPUC staff considers repairing leaky valves as normal maintenance expected to be performed by the customer to address age-related performance degradation. These types of repairs are not reflective of shifted building loads or conditions that require readjustment of controls for performance optimization. Therefore, staff recommends that PG&E use functioning valves as the baseline condition and claim only incremental savings from adjustment of controls for RCx-2.

The measure's CHWST reset strategy component savings was estimated by adjusting the baseline CHWST set point from the constant value of 42 °F to a reset strategy that adjusts the CHWST set point linearly with outside air temperature.[4] The implementation team actually suggests a "trim and respond" strategy which responds to DSP rather than OAT, but spreadsheet modeling typically uses the implementer's method for the CHWST reset measure[5]. The constant baseline value of 42 °F is based on site-specific manually adjusted set points entered by building engineers. This method was also considered acceptable by the CPUC reviewer.

Savings from flow balancing the "TP-2" condenser water pump were estimated by assuming that the baseline pump is constant volume and the CWST set point is constant at 68 °F. These assumptions are supported with EMS set points and EMS trend data. The installed case assumes pump speed is constantly held at 80% using a VFD; the CWST follows a reset schedule based on OAT[6]. The CWST is reset linearly with the OAT in the savings spreadsheet. The implementer's team intends to actually implement a reset strategy based on the differential CHW temperatures, but the current model using OAT is typically utilized in spreadsheet calculations and provides a reasonable estimate. The assumption to use a fixed CW pump speed of 80% was not explained but it appears that this speed was chosen to align the estimated CW pump flow with the design flow rate for the chillers. The calculation also estimates the CT fan penalty for resetting the CWST. The implementer's savings method reasonably estimates the savings potential of RCx-2.

The post-implementation M&V plan for RCx-2 intends to verify proper measure implementation by reviewing trends of CHW valve positions, SATs, SAT set points, CHWST, CHWSTSPs,

---

[4] Low OAT/CHWST = 50 °F/50 °F; High OAT/CHWST = 70 °F / 42 °F

[5] Trim and respond is likely better modeled as a load reset based CHWST strategy than an OAT reset based strategy. This could be implemented in the spreadsheet. Then again, if the load model is linear with respect to OAT, it won't matter and both approaches will give the same result.

[6] Low OAT.CWST = 45 °F / 60 °F; High OAT/CWST = 71 °F / 68 °F is the reset schedule used in the calculation workbook. Actual reset will be based on differential CHW temperature: Low ΔCHWT = 3 °F corresponds to CH-2 CWST = 60 °F; high ΔCHWT = 8 °F corresponds to CH-2 CWST = 68 °F

CWST, and CWSTSPs. The review will ensure that the expected CHW and CW set point reset strategies are functioning as intended. CT staging, chiller turning vane position, and chiller VFD speeds will be reviewed to verify chiller capacity is being modulated primarily with compressor speed. The analysis will compare the chiller efficiency savings from reduced condenser water temperature to the corresponding energy penalty from increased cooling tower fan usage. The plan intends to collect the following trend data: OAT, chiller status, chiller current, CHWST, CHWSTSP, CHWRT, CHWP status, CHWP flow, CWP status, CWP flow, CWP current, CT fan status, CT fan speed, CWST, CWSTSP, and CWRT. CHWP amperage will be collected using spot measurements. CPUC Staff recommends that the post-implementation review should additionally be used to true up the estimated measure savings by adjusting the assumed post-install values in the savings calculation workbook with actual values. An example of this true up would be to revise the OAT-based CWST reset schedule temperature input values with actual OAT and CWST temperature data so that the calculation model corresponds to the actual CWST reset operation as accurately as possible.

RCx-2 measure costs of $90,850 were estimated using rough order of magnitude (ROM) estimates from the proposed vendor for the EMS logic programming, CHW valve replacements, and the VFD installation on the CW pump. The estimated cost appears to be reasonable considering the commissioning process will likely be lengthy and complex. Third party commissioning costs and a 15% general contingency rate was also applied to the vendor estimates. Upon completion of the implementation, the CPUC Staff requests that specific material and labor costs are retained and documented for subsequent CPUC review.

Review of RCx-3

The measure components of RCx-3 were modeled in the savings calculation workbook using an (1) expanded HHWST set point reset schedule based on OAT, (2) constant speed (baseline) and typical VFD (installed) DOE pump curves, and (3) a modified morning warm-up schedule. It should be noted that RCx-3 only claims electric savings derived from the reduced AHU fan operation during morning warm-up periods and reduced HHW pump speeds due to claimed higher HHWST delivered to AHUs[7]. The higher HHWST does not introduce gas penalties because the building's heating load and the boilers' heating efficiencies do not change substantially with the adjusted warm up period and HHW controls; the estimated time to satisfy the building's heating load (during morning warm-up) is reduced.

The baseline morning warm-up electrical energy usage was estimated by analyzing interval billing data between 1:15 A.M. and 5:30 A.M. and calculating the average energy difference between the summer months (May – October) and the winter months (November – April) over

[7] Higher HHWST than observed in the pre-existing condition with the leaky boiler bypass valve. The zone set points are expected to remain the same

the 4.75 hour period. The analysis assumes that the warm-up period of 4.75 hours could be reduced to half that time if the measure were properly implemented. This assumption was considered conservative by the implementer based on their professional judgment that morning warm-up periods for high rise office buildings in the San Francisco area typically take around 2 hours. This billing analysis method is considered reasonable because of the relatively constant load profile that the building exhibits.

The HHW reset schedule and pump VFD savings are estimated by comparing the baseline reset set points and “constant speed” HHW pump controls to the proposed set points and variable speed pump control[8]. The analysis uses the baseline heating load and HHWST set points to determine the expected HHW pump flow and subsequent pump kW necessary for the baseline and measure load scenarios to be satisfied. The baseline heating load appears to be “calibrated” to site-specific equipment (pump) specifications, a single HHW pump and OAT spot measurement (HHW pump was pulling 11.2 kW when the OAT was 68°F) and heating design OAT and OA boiler lockout temperature; the heating load decreases linearly with OAT. The implementer notes that the available flow trend data was not used in the flow & pump power calculations because it appeared that the flow parameter in the EMS was not calibrated properly. While the heating load was not calibrated to trend data, the CPUC reviewer considered the model to be sufficient for the purpose of estimating pump energy savings for this measure.

After implementation of the RCx-3 measure components, the implementation team plans to review trend points to verify that the measure has been successfully implemented as intended. The following building EMS trend points are planned to be collected in order to verify proper implementation of RCx-3: OAT, boiler status, boiler isolation valve status, boiler isolation valve position, boiler bypass valve position, HHWST, HHWSTSP, HHWRT, HHWP status, and HHWP speed. Spot power measurements will also be taken on the primary HHW pump. CPUC Staff recommends that the post-implementation review also be used to true up the estimated measure savings by adjusting the assumed post-install values in the savings calculation workbook with actual values observed in the trend data.

RCx-3 measure costs of $62,675 were estimated using rough order of magnitude (ROM) estimates from the proposed vendor for the EMS logic programming, bypass valve replacement, installation of differential pressure transducers & subsequent commissioning of the HHW pump VFD, and implementation of the building warm-up (Optimum Start Program) algorithm. Third party commissioning costs and a 15% general contingency rate was also applied to the vendor estimates. The estimated cost appears to be reasonable considering the commissioning process

[8] The existing HHW pumps have VFDs installed but are controlled manually and currently operate at full speed. The savings analysis takes this in to account by including VFD losses in both the baseline and proposed scenarios. Baseline HHWST reset schedule: Low OAT/HHWST = 55°F/170°F; high OAT/HHWST = 70°F/160°F. Proposed HHWST reset schedule: Low OAT/HHWST = 55°F/180°F; high OAT/HHWST = 75°F/160°F

will likely be lengthy and complex. Upon completion of the implementation, the CPUC Staff requests that specific material and labor costs are retained and documented for subsequent CPUC review.

Review of RCx-4

RCx-4 savings are estimated by adjusting the cold deck & hot deck SAT reset schedules, implementing a ± 1°F deadband in the zone temperature set point, and converting the modeled fan flow control from constant volume to variable volume. The average of the AHU fan spot power measurements is used as the constant baseline AHU fan load; the modeled variable volume fan control assumes a minimum flow ratio of 0.6 and uses a fan curve based on a 1.0" minimum DSP control[9]. The minimum flow ratio of 0.6 is not unreasonable and may have been chosen to align the average modeled flow percentage (74%) with the average observed VFD speed (75-80%) of AHU supply fans for the floors that were previously converted to variable volume. The custom calculation workbook uses an OAT-based SAT reset strategy; however, the implementers propose that the actual reset strategy will be based on DSP at "worst-case" locations on each floor (e.g. perimeter terminal boxes). The savings method is reasonable considering the cooling load was visually calibrated to trended plant cooling load data over a sufficient OAT range. The baseline cold deck and hot deck SAT range is based on an analysis that plotted CD/HD SAT against OAT trend data; SAT and OAT reset ranges were chosen based on this plot. The proposed CD/HD SAT set points were slightly more aggressive than the baseline but not unreasonable[10]. The zone temperature set point is adjusted from the baseline temperature of 73 °F (for heating and cooling) to 72°F heating and 74° cooling.

The baseline AHU cooling load was calibrated to the trended plant cooling load and then used cooling plant efficiency and performance data assuming that RCx-1 through RCx-3 had been implemented to avoid double counting interactive savings.

After implementation of the RCx-4 measure components, the implementation team plans to review trend points from a sample (10) of affected AHUs to verify that the measure has been successfully implemented as intended. The following building EMS trend points are planned to be collected in order to verify proper implementation of RCx-4: OAT, RAT, MAT, space temperature, space temperature set points, HD SAT, HD SATSP, CD SAT, CD SATSP, CHW valve position, HHW valve position, supply fan VFD speed, HD/CD DSP, HD/CD DSP set points, and multi zone damper position. Spot power measurements are also proposed to be

[9] DSP curve obtained from Appendix 5 of "Advanced Variable Air Volume VAV System Design Guide" by Energy Design Resources, December 2009.

[10] Baseline: CD Low OAT/SAT = 55°F/58°F; CD High OAT/SAT = 75°F/56°F; HD Low OAT/SAT = 45°F/88°F; HD High OAT/SAT = 75°F/82.5°F. Proposed: CD Low OAT/SAT = 55°F/56°F; CD High OAT/SAT = 75°F/54°F; HD Low OAT/SAT = 55°F/90°F; HD High OAT/SAT = 75°F/82°F

collected for (10) AHU fans. The CPUC Staff recommends that AHU fan spot power measurements should be expanded to include data points at different VFD speeds while maintaining the DSP set point. Collecting this data can help to develop custom fan curves that can be used to true up the estimated AHU fan loads. The sample of AHU fans spot measured should include all fan motor sizes (15 hp and 20 hp).

RCx-4 measure costs of $679,650 were estimated using rough order of magnitude (ROM) estimates from the proposed vendor for the EMS logic programming, VFD drives, DSP digital sensors, and terminal box VAV conversion. Third party commissioning costs and a 15% general contingency rate was also applied to the vendor estimates. The estimated cost appears to be reasonable considering the number of VFD drives (48); also, the commissioning process will likely be lengthy and complex. Upon completion of the implementation, the CPUC Staff requests that specific material and labor costs are retained and documented for subsequent CPUC review.

Review Conclusion

CPUC conditionally approves the ex ante savings subject to the utility making baseline adjustments (i.e., remove the claimed leaky valve savings) on RCx-2 and trueing up savings of all measures after post-installation M&V is completed.

Summary of CPUC Staff Requested Action by the IOU

CPUC Staff requests that the IOU undertake the recommended steps and submit the following information upon completion of the Implementation Report and final savings estimates:

1. RCx-2 AHU CHW valve replacement/repair component savings over the existing baseline (“leaky”) condition cannot be claimed. CPUC staff considers repairing leaky valves as normal maintenance expected to be performed by the customer to address age-related performance degradation. These types of repairs are not reflective of shifted building loads or conditions that require readjustment of controls for performance optimization. Therefore, staff recommends that PG&E use functioning valves as the baseline condition and claim only incremental savings from adjustment of controls for RCx-2;

2. Retain actual cost documentation in the form of paid invoices identifying equipment, labor, and material costs that are applicable to the RCx-program measures. Retain cost information segregated by measure;

3. After project implementation, incorporate HHW plant trend data (pump speed, HHWST, and HHWRT) in to the analyses of RCx-2 and RCx-4 to improve the accuracy of the modeled heating load. The trend data can be used to calibrate the zone heating load model to actual HHW plant load data, similar to how the cooling load was calibrated to trended CHW plant load; and

4. Demand savings were not claimed or specifically provided for RCx-1 because negative savings were estimated. This penalty should be included in the net demand savings estimate for the final project application savings. Post-implementation hourly demand billing analysis similar to the pre-implementation phase analysis should be performed to verify the pre-implementation demand savings penalty from this measure.
5. Retain EUL values for each RCx measure that are weighted by the individual measure component EULs recommended by the CPUC Staff and their respective final ex ante savings. See the EUL section in Table 1-2 for more details.
6. During the commissioning phase of the project, collect additional fan and pump spot power measurements at different VFD speeds (e.g., 20 Hz through 60Hz in 10 Hz increments) while maintaining the chosen duct static pressure or differential pressure set point so that custom fan and pump PLR curves can be developed, respectively. These custom curves can replace the DOE-2 curves currently being used in the calculations.

Table 1-2 Review Findings

Reviewed Parameter	Analysis
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)	IOU Proposal: RCx measures involving system optimization and add-on measures.
	CPUC Staff Assessment: Accept.
	CPUC Staff Recommendation: None
Project Baseline Technology (in situ equipment, Title 24 (specify year), other code or other efficiency level (specify), industry standard practice - ISP)	IOU Proposal: in situ
	CPUC Staff Assessment: All of the proposed measures optimize existing equipment performance (and conditions) or are add-on components to existing equipment. The IOU proposal is appropriate except for RCx-2. RCx-2 AHU CHW valve replacement/repair component savings over the existing baseline ("leaky") condition cannot be claimed. CPUC staff considers repairing leaky valves as normal maintenance expected to be performed by the customer to address age-related performance degradation. These types of repairs are not reflective of shifted building loads or conditions that require readjustment of controls for performance optimization.

Reviewed Parameter	Analysis
	CPUC Staff Recommendation: Staff recommends that PG&E use functioning valves as the baseline condition and claim only incremental savings from adjustment of controls for RCx-2.
Project Cost Basis (Full Incremental, or Both. Note: For early retirement projects, include RUL through EUL cost basis treatment)	IOU Proposal: Full cost
	CPUC Staff Assessment: All of the measures are RCx or retrofit (add-on), full cost basis for determining project costs is appropriate.
	CPUC Staff Recommendation: None
RUL (required for early retirement projects only, otherwise N/A)	IOU Proposal: N/A
	CPUC Staff Assessment: N/A
	CPUC Staff Recommendation: N/A
EUL (for each measure)	IOU Proposal: Not provided.
	CPUC Staff Assessment: The IOU should include individual measure EULs with project documentation.
	CPUC Staff Recommendation: The RCx measures have multiple components with different EULs. The following are the component EULs recommended: RCx-4: VSD Supply Fan Motors – 15 years (DEER 2011) RCx-3: Variable Flow Water Loop, VSD Pump – 15 years (DEER 2011) RCx-2 and RCx-3: Water Loop Reset – 10 years (DEER 2011) RCx-2 and RCx-3: Repair Hardware-HVAC Automation Hardware – 8 years (PG&E RCx Submittal Guidelines) RCx-1: Recode Controls-HVAC-Schedule Change – 5 years (PG&E RCx Submittal Guidelines) RCx-2, RCx-3, and RCx-4: HVAC Rebalance/Adjust – 5 years (PG&E RCx Submittal Guidelines) Further, CPUC Staff requests that each RCx measure have its single EUL weighted by the final savings numbers of each component. For example, RCx-3 has three components with identified EULs - a VSD pump component (15 years), a water loop reset component (10 years), and a automation hardware repair component (8 years). The final RCx measure EUL would be a value weighted on the component EULs mentioned above and their respective final ex ante savings values. It appears most components can be isolated using the project's calculation workbook so this effort should require little time.
Savings Assumptions	IOU Proposal:

Reviewed Parameter	Analysis
	Some of the notable savings assumptions include: • Boiler plant efficiency = 84% • Linear cooling/heating load profiles with respect to OAT • DOE-2 chiller capacity and PLR curves • DOE-2 open tower fan curve • DOE-2 pump curves • EDR Minimum DSP flow curve • CHW, HHW, CW, and CD/HD SAT reset schedules based on OAT
	CPUC Staff Assessment: The assumptions used are typical for these types of measures and calculation methods. The implementer improved accuracy of the modeled cooling load by visually calibrating to trended plant load data over a sufficiently broad OAT range. Heating load was not calibrated to actual plant trend data.
	CPUC Staff Recommendation: Incorporate HHW plant trend data (pump speed, HHWST, and HHWRT) in to the analyses of RCx-2 and RCx-4 to improve the accuracy of the modeled heating load. The trend data can be used to calibrate the zone heating load model to actual HHW plant load data, similar to how the cooling load was calibrated to trended CHW plant load.
Calculation Methods/Tool review	IOU Proposal: RCx-1 and a portion of RC-x3 savings use billing analysis; RCx-2, RCx-3, and RCx-4 use a custom spreadsheet to perform bin temperature analyses
	CPUC Staff Assessment: The custom savings calculations workbook is sufficiently comprehensive to perform energy savings calculations for the proposed RCx measures.
	CPUC Staff Recommendation: See the Savings Assumption recommendation, above.
Pre- or Post-Installation M&V Plan	IOU Proposal: See the Summary of Review section
	CPUC Staff Assessment: See the Summary of Review section
	CPUC Staff Recommendation: See the Summary of Review section and CPUC Requested Actions
Net-to-Gross Review	IOU Proposal: Not provided
	CPUC Staff Assessment: N/A
	CPUC Staff Recommendation: A NTG review may be warranted for this project

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

Description	IOU Ex Ante Claim	CPUC Staff Recommendations
First Year kWh Savings	1,293,091	TBD
First Year Peak kW Savings	537.4	TBD
First Year Therms Savings	45,573	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 (RUL thru EUL Period)	1,293,091	TBD
Peak kW Savings (RUL thru EUL Period)	537.4	TBD
Therms Savings (RUL thru EUL Period)	45,573	TBD
Annual Non-IOU Fuel Impact (RUL Period)	N/A	N/A
Annual Non-IOU Fuel Impact (RUL thru EUL Period)	N/A	N/A
Project Costs for Baseline #1 (RUL or EUL)	$833,175	TBD
Project Costs for Baseline #2 (EUL minus RUL period)	N/A	N/A
Project Incentive Amount	$215,691.19	TBD