Phase II Ex Ante Review Final Findings

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

IOU	Pacific Gas and Electric Company
Application ID	W099-1303
Application Date	2/27/2013
Program ID	PGE2233
Program Name	Wine Industry Energy Solutions (WIES) Program
Program Year	2013
Itron Project ID	X345
IOU Ex Ante Savings Date	8/2/2013
CPUC Staff Measure Name	Refrigeration System Expansion & , Controls, Lighting
Project Description	Prior to implementation the customer operated all of their refrigeration processes off of a single suction group consisting of three glycol chillers. This project modified and expanded the existing refrigeration system with three high efficiency glycol chillers, separating the system into two suction groups. Additionally, the customer implemented floating head pressure control on the new low temperature group, retrofitted glycol pumps with VFDs, and installed new, better than code lighting in previously under lit warehouse spaces.
Date of CPUC Staff Review	12/17/2013
Primary Reviewer / Firm	Brandon Gill/DNV KEMA
Review Supervisor / Firm	Joseph Ball / Itron
CPUC Staff Project Manager	[redacted] / California Public Utilities Commission, Energy Division
CPUC Policy Authorization (as needed)	
Type of Review (Desk, On-site, Full M&V, Tool)	Desk
CPUC Staff Recommendation	CPUC staff-revised final energy savings are approved at the following values: 365,255 kWh and 21.47 kW. Based on this revision the final estimated incentive was reduced to $48,644.25.

Measure Description

The facility is a small to medium sized winery. Prior to project implementation, they used three Trane RTHD glycol chillers to meet both space cooling and winery process loads. Space cooling is typically required during the summer months only. Process loads peak from August through October during the harvest season and crush period when grape juice is stored at low temperatures to prevent premature fermentation. The fermentation process, which takes place year round, additionally generates heat that is removed by the refrigeration system. Lastly, the winery uses a cold stabilization process that requires chilling white wines to between 25F and 35F to remove tartrate crystals. Prior to measure implementation, the coldest process occurring at any time dictated the glycol temperature and the suction temperature of the chillers. As such, the SST set point varied from approximately 20°F to 30°F.

Note: The project report does not explicitly assign EEM numbers to the various measures, but they have been assigned numbers here for ease of tracking throughout this document.

(EEM1) The customer plans to expand production and needed to increase their refrigeration capacity to accommodate that expansion. To maximize efficiency under increased operations, the customer added an additional low temperature suction circuit and raised the suction temperature of their existing circuit. The existing circuit was expanded with two additional Trane RTHD chillers. The new low temperature circuit consists of one new Trane RTHD chiller operating with floating head pressure control down to a minimum SDT of 75°F.

The baseline chosen for the expanded high temperature circuit (30 SST) consisted of adding two standard practice Carlyle reciprocating compressors to the pre-existing circuit, while maintaining the existing SST (estimated at an average temperature of 25°F). The existing system already had floating head pressure control (FHP); the baseline system was therefore modeled with FHP control using the same minimum SDT and wet bulb offset as the proposed system. For the new low temperature circuit, the baseline system consisted of a standard practice Carlyle compressor operating at a fixed SDT of 90°F.

(EEM2) To meet the additional projected load, the customer added two new, variable-speed, 30 HP glycol pumps to their system. The baseline controls for these pumps were identified as constant speed.

(EEM3) Lastly, the customer altered and expanded new lighting in two storage areas of their facility. In the space that has become their barrel room the customer did not have sufficient lighting for the intended use. They therefore added (36) 4-lamp T5-54W fixtures and (9) 6-lamp T5-54W fixtures to the space. Since the space was repurposed, and its LPD remains significantly below code, this constituted an energy savings measure. In a second space that was turned into a tank area, the customer had no lighting. The customer added (109) 48W CFL flood lights, (47) 2-lamp 117W T5-54W fixtures, and (15) 35W ceiling mounted CFLs to the space to make it usable for production purposes. The LPD in the space is under code requirements, making it eligible for an incentive.

Summary of Review

The Investor-Owned-Utility (IOU) submitted the following documents on 12/6/2013 and 12/17/2013 for this Phase 2 review:

- A post-installation project report prepared by the IOU's third party implementer explaining the project scope, general savings calculation approaches, and adjustments to the pre-installation savings calculation made as a result of the post-installation site visit and M&V;
- The analysis workbooks utilized to generate savings estimates for all EEMs, as well as the supporting compressor/chiller software run outputs used to inform the savings calculations;
- Project cost documentation and cost analyses;
- Billing data; and
- Program influence documentation.

EEM1 Review:

The baseline used in the savings analysis was first assessed. Since this capacity expansion project affects process equipment that is not governed by Title 24 (the loads are predominantly process and the facility does not fall under the Title 24 refrigerated warehouse classification), the industry standard practice baseline used in the analysis was appropriate.

Post-installation modifications to the savings analysis were next evaluated. During the Phase I review, the CPUC reviewer suggested M&V consisting of multiple trend points, including: chiller power (or amperage), condenser fan amperage, load for both plants (as determined from glycol flow, supply temperature, and return temperature), SST and SDT. The CPUC reviewer suggested that these data be used to (1) update the load profile included in the model and (2) devise custom performance curves for the installed chillers based on trended power, load, SST, and SDT. No other M&V modifications were requested for this analysis.

The implementer ultimately chose to only monitor glycol loop flow rates and temperatures during the month of September 2013. These data were then used to estimate the average plant load during the month of September for both the medium and low temperature loops. For the much larger medium temperature loop, the observed September loads were projected to correspond to the highest load month of the year; this is borne out in utility data from 2012, which dictate that facility energy use peaks during September. For the low temperature cold stabilization loop, September was estimated to be one of the lowest load months of the year per discussion with facility staff. Cold stabilization loads were claimed to increase outside of the August through October crush period when loads are at their lowest.

For the medium temperature suction group calculations, monthly loads were estimated using the assumption that refrigeration load scales proportionally to monthly facility energy usage. For instance, the medium temperature system was projected to be 60% loaded during the peak energy usage month (September); in other months, the load was estimated as 60%*(kWh_month_i) /(kWh_month_peak). Loads for the much smaller cold stabilization loop during the nine months outside of crush period were estimated to be 40% of design capacity. Average cold stabilization loop loads during the crush period were estimated to be 11%, 15%, and 11% in August, September, and October respectively. The CPUC reviewer would have preferred utilization of more concrete data to support the loop load estimates (either in the form of production records or additional trending outside of the single month trending period), but recognizes the limitations that go into making these estimates in terms of project timing and budget. For the cold stabilization loop load estimates, which are supported by the least concrete data, the 40% load factor is reasonably conservative.

Under ideal circumstances, the CPUC reviewer would have preferred that the implementer generate custom chiller curves based on more extensive trending and create an hourly load profile as opposed to a monthly load profile. However, the remainder of the analysis was robust and had sufficient analytical rigor. The implementer's deviations from the CPUC reviewer's suggested M&V plan likely yielded less than a 20% change in the claimed savings. As such, the claimed savings for this measure (271,789.0 kWh, 0.0 kW) are accepted without requested modification.

For future projects subject to ex ante review, the CPUC reviewer requests that the implementer make the CPUC aware of planned deviations from approved M&V plans. Approval of projects may be held up if the requested M&V is ignored without sufficient supporting rationale.

In addition to the post-installation savings analysis, invoices and an incremental cost analysis were reviewed for this EEM. The claimed incremental costs were determined to be consistent with provided invoices and RSMeans data. No additional issues were identified with this EEM.

EEM 2 Review:

During the Phase I review, the CPUC reviewer noted that the claimed savings were based on the assumption that the new glycol pumps would operate 80% of the time at 70% speed and 20% of the time at 100% speed. The CPUC reviewer suggested that the implementer monitor pump amperage and/or collect VFD speed trends for a few weeks post-implementation to generate a more robust load profile. The implementer ultimately installed amperage loggers on the two new pumps for approximately two weeks.

The implementer then conducted a savings analysis with a few shortcomings. The data indicate that the pumps generally operate within a narrow speed band; the amperage fluctuates between approximately 21A and 24A for both pumps. The implementer reasonably chose to estimate pumps savings based on average run conditions (instead of generating a profile). However, after determining the average amperage, the implementer divided the average value by full load amperage and used this fraction as a proxy for % VFD speed. This is not a valid approach. Line side amperage generally varies nearly linearly with power (assuming a constant power factor), but power *does not* vary linearly with speed for centrifugal pumping applications. The % VFD speed value calculated using the above method was therefore biased low and should not have been used to calculate power in an exponential "fan law" type equation as it was in the implementer's analysis. Instead, the implementer should have used the average observed amperage, and a spot measured (or nameplate) power factor value to estimate average pump power. This value could then have been multiplied by annual run hours to estimate pump energy use. The CPUC reviewer implemented this basic approach for the proposed case in a revised analysis. The CPUC reviewer also adjusted the number of run hours used in the analysis. While the implementer determined annual run hours by multiplying the percentage of loaded hours *from one pump* during the monitoring period by 8,760, the CPUC reviewer used the percentage of loaded hours from *both pumps* in the same calculation. This change reduced annual run hours from 3,066 to 2,860. Together, the pump power and run hour adjustments reduced the estimated measure savings by over 60% from 66,967 kWh to 26,390 kWh. The CPUC reviewer analysis revisions are documents in the workbook titled "EEM2 Analysis_BG Modified.xlsx". The savings indicated by this revised analysis are approved.

In addition to reviewing the post-installation savings analysis, invoices and a cost analysis were also reviewed for this EEM. The implementer claimed measure costs on a full cost basis for the installed VFDs. Since the VFDs are an "add-on" measure to the baseline pumps, full cost was the appropriate cost basis.

EEM 3 Review:

The implementer correctly modified the lighting savings analysis based on adjusted as-found conditions. LPD baselines were correctly assigned and care was taken not to assign peak demand savings to lights that only operate for short periods outside of the DEER defined peak period. No issues were identified with the savings calculations. The claimed savings of 67,076.0 kWh and 21.47 kW are approved.

In addition to the post-installation savings analysis, invoices and an incremental cost analysis were reviewed for this EEM. The claimed incremental costs were determined to be consistent with provided invoices and the incremental cost analysis. No issues were identified with this EEM.

Between the original CMPA project data submission and this final phase II post-install review the original energy savings and incentive estimates have been modified as shown in the table below.

Total Project Description	Original IOU Ex Ante Claim (CMPA)	Phase I IOU Adjusted Ex Ante Claim	Phase II post-install IOU Ex Ante Claim	Phase II CPUC-Revised Ex Ante Claim
First Year kWh Savings	512,725	490,055	405,832	365,255
First Year Peak kW Savings	133.46	95.71	21.47	21.47
Project Incentive Amount	$73,106.27	$65,930.77	$52,296.18	$48,644.25

Review Conclusion

CPUC staff-revised final energy savings are approved at the following values: 365,255 kWh and 21.47 kW. Based on this revision the final estimated incentive was reduced to $48,644.25.

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: (EEM1) "New Equipment Addition – Increased Load" (i.e. Capacity Expansion); (EEM2) Retrofit Add-on; (EEM3) "New Equipment Addition – Increased Load" (i.e. Capacity Expansion)
	CPUC Staff Assessment: (EEM1) Capacity Expansion is the appropriate baseline type; (EEM2) Add-On is the appropriate baseline type; (EEM3) Capacity Expansion
	CPUC Staff Recommendation: No recommendation.
Project Baseline Technology (in situ equipment, Title 24 (specify year), other code or other efficiency level (specify), industry standard practice - ISP)	IOU Proposal: (EEM1) Industry Standard Practice; (EEM2) In situ; (EEM3) Title 24
	CPUC Staff Assessment: (EEM1) ISP is appropriate; (EEM2) In situ conditions are appropriate; (EEM 3) Title 24 2008 requirements are appropriate.
	CPUC Staff Recommendation: No recommendation.
Project Cost Basis (Full Incremental, or Both. Note: For early retirement projects, include RUL through EUL cost basis treatment)	IOU Proposal: Incremental cost for the chillers (EEM1); total cost for the glycol pump VFDs (EEM2); incremental cost for the lighting (EEM3)
	CPUC Staff Assessment: The correct cost basis was used for all EEMs.
	CPUC Staff Recommendation: No recommendation.
RUL (required for early retirement projects only, otherwise N/A)	IOU Proposal: N/A
	CPUC Staff Assessment: RUL is not relevant for this project.
	CPUC Staff Recommendation: No recommendation.
EUL (for each measure)	IOU Proposal: EULs are not discussed in the IOU implementer's report.
	CPUC Staff Assessment: EULs should be specified for all EEMs
	CPUC Staff Recommendation: 2011 DEER specifies an EUL of 20 years for chillers (EEM1); 15 years for VFDs (EEM2); and 12 years for CFL fixtures and 15 years for T-5 fixtures in warehouse applications (EEM3).
Savings Assumptions	IOU Proposal: 1. For the purposes of both the medium temperature loop EEM 1 calculations, loads were estimated on the assumption that refrigeration load scales proportionally to monthly facility energy usage. For instance, the medium temperature system was projected to be 60% loaded during the

Reviewed Parameter	Analysis
	peak energy usage month; in other months, the load was estimated as 60%*(kWh_month_i)/(KWh_month_peak). For the low temperature loop outside of the three crush months, loads were estimated strictly based on customer input. 2. (EEM1) The baseline medium temperature system was assumed to utilize floating head pressure control (since it had been in place already in the existing system). The baseline low temperature system was assumed to utilize a fixed head pressure set point based on industry standard practice. Both proposed systems have floating head pressure control. Compressor sequencing was assumed to be identical in the baseline and proposed cases. 3. The new glycol pumps (EEM2) were estimated to operate 3,066 per year. 4. (EEM2) The average monitored percent of full load pump amperage was used as a proxy for VFD % speed. This % speed was then used to estimate pump power. 5. (EEM3) Barrel room lights were assumed to operate 10 hours per day, 5 days per week, 52 weeks per year (2,600 hours annually); tank are lights were assumed to operate 6 hours per day, 6 days per week, 3 months per year (432 hours annually). The available documentation does not indicate whether these operating hour estimates were based on fixed timer control schedules or assumed manual operations.
	CPUC Staff Assessment: *Note: There is a one-to-one correspondence between the list above and the list below.* 1. 2012 billing data, which correspond to the period before project implementation, were used for the medium temperature loop analysis. Since this is a capacity expansion project, it is likely that energy use will increase in the future. As such, the chosen load profile may not be representative of expected future operations and is likely conservative since load is anticipated to increase (and savings should increase with load). Nonetheless, given the chosen analysis method, the implementer had no other recourse since the facility has yet to operate a full year with its expanded capacity. CPUC staff also have concerns regarding the limited data that went into generating the loop load estimates, but realize that budgetary and project timing constraints likely limited further effort beyond the monitoring undertaken in September, 2013. 2. All baseline system control assumptions are valid and consistent with pre-existing conditions and ISP baseline requirements. 3. A review of the metered pump data revealed that operating hours were estimated based on data from only one of the two monitored pumps. Data from both pumps should have been used. 4. Line side amperage and VFD speed do not vary linearly; the above assumption was not valid. The metered amperage data should instead have

Reviewed Parameter	Analysis
	been used to estimate the average power draw directly. 5. Documentation should have been provided to indicate whether the estimated operating hours were based on a fixed (controlled) schedule or assumed occupant usage profiles.
	CPUC Staff Recommendation: *Note: There is a one-to-one correspondence between the list above and the list below.* 1. No recommendation. 2. No recommendation. 3. Operating hours were adjusted during review to account for metered data collected from both pumps. 4. The analysis was adjusted to more directly estimate pump power from the available amperage data. 5. More substantiation for estimated operating hour should be provided in future project submittals.
Calculation Methods/Tool review	IOU Proposal: Custom spreadsheet analysis informed by manufacturer's performance data.
	CPUC Staff Assessment: The chosen calculation method is appropriate and the savings analysis is sufficiently thorough. An error was identified in the EEM2 measure analysis however related to the estimation of installed variable speed pump power draw.
	CPUC Staff Recommendation: CPUC staff has revised the savings analysis for EEM2 based on the error identified and described in this review.
Pre- or Post-Installation M&V Plan	IOU Proposal: The implementer conducted a post-installation verification visit and collected time series glycol loop load data for both the medium and low temperature plants for approximately two weeks. The implementer additionally logged amperage off of the two new glycol pumps for two weeks.
	CPUC Staff Assessment: Although the implemented M&V was not as robust and detailed as that suggested in the Phase I ex ante review, the collected data were nonetheless sufficient to estimate savings within an acceptable error bound.
	CPUC Staff Recommendation: No recommendation.
Net-to-Gross Review	IOU Proposal: Not discussed.
	CPUC Staff Assessment: Not discussed.
	CPUC Staff Recommendation: NTG interview may be warranted.

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

Description	IOU Ex Ante Claim	CPUC Staff Recommendations
First Year kWh Savings	[EEM1] 271,789.0 [EEM2] 66,967.0 [EEM3] 67,076.0 **[Total] 405,832**	[EEM1] 271,789.0 [EEM2] **26,390.0** [EEM3] 67,076.0 [Total] **365,255**
First Year Peak kW Savings	[EEM1] 0.00 [EEM2] 0.00 [EEM3] 21.47 **[Total] 21.47**	[EEM1] 0.00 [EEM2] 0.00 [EEM3] 21.47 **[Total] 21.47**
First Year Therms Savings	0.0	0.0
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)	[EEM1] 271,789.0 [EEM2] 66,967.0 [EEM3] 67,076.0 **[Total] 405,832**	[EEM1] 271,789.0 [EEM2] **26,390.0** [EEM3] 67,076.0 [Total] **365,255**
Peak kW Savings (RUL thru EUL Period)	[EEM1] 0.00 [EEM2] 0.00 [EEM3] 21.47 **[Total] 21.47**	[EEM1] 0.00 [EEM2] 0.00 [EEM3] 21.47 **[Total] 21.47**
Therms Savings (RUL thru EUL Period)	0.0	0.0
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	[EEM1] $175,321.59	[EEM1] $175,321.59

Description	IOU Ex Ante Claim	CPUC Staff Recommendations
EUL)	[EEM2] $8,810.70 [EEM3] $29,508.98	[EEM2] $8,810.70 [EEM3] $29,508.98
Project Costs for Baseline #2 (EUL minus RUL period)	N/A	N/A
Project Incentive Amount	[EEM1] $40,768.35 [EEM2] $6,027.03 [EEM3] $5,500.80 **[Total] $52,296.18**	[EEM1] $40,768.35 [EEM2] **$2,375.10** (based on revised savings estimated generated during the CPUC review) [EEM3] $5,500.80 **[Total] $48,644.25**