Phase I Ex Ante Review Findings

Table 1-1: Project Information

IOU	Pacific Gas and Electric Company
Application ID	W099-1303
Application Date	TBD
Program ID	PGE2233
Program Name	Wine Industry Energy Solutions (WIES) Program
Program Year	2013
Itron Project ID	X345
IOU Ex Ante Savings Date	TBD
ED Measure Name	Refrigeration System Expansion, Refrigeration Controls, Commercial Lighting
Project Description	The customer operates a winery. They currently operate all refrigeration processes off of a single suction group consisting of three glycol chillers. This project involves expanding the existing refrigeration system with three additional high efficiency glycol chillers and separating the system into two suction groups. Additionally, the customer is implementing floating head pressure control on the new low temperature group, retrofitting glycol pumps with VFDs, and installing better than code lighting in warehouse spaces.
Date of ED Review(s)	5/31/2013
Primary Reviewer and Firm	Brandon Gill/DNV KEMA
Review Supervisor and Firm	Amit Kanungo/DNV KEMA
ED Project Manager	[redacted] / California Public Utilities Commission, Energy Division
ED Policy Authorization (as needed)	
Type of Review (Desk, On-site, Full M&V, Tool)	Desk
ED Recommendation	Conditionally approved pending post-install

	M&V and IOU true-up and corrections to minor calculation errors noted in this disposition.

Measure Description

The facility is a small to medium sized winery. They use their current refrigeration system, which consists of three Trane RTHD glycol chillers, to meet both space cooling and winery process loads. Space cooling loads generally occur during summer months only, while process loads peak from August through October during the harvest season 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. The coldest process occurring at any time therefore dictates the glycol temperature and the suction temperature of the chillers. As such, the SST set point currently varies 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 the ease of tracking throughout this document.

(EEM1) The customer plans to expand and needs to increase their refrigeration capacity. To maximize efficiency during the expansion, the customer intends to add an additional low temperature suction circuit and raise the suction temperature of their existing circuit. The existing circuit will be expanded with two additional Trane RTHD chillers. The new low temperature circuit will consist of one new Trane RTHD chiller operating with floating head pressure control down to a minimum SDT of 75 F.

Since this is a capacity expansion project not subject to code requirements, industry standard practice constitutes the appropriate baseline. The baseline for the expanded high temperature circuit (30 SST) therefore consists of adding two additional standard practice Carlyle reciprocating compressors to the pre-existing circuit, while maintaining the existing SST (estimated at an average temperature of 25 F). Because the existing system already has floating head pressure control (FHP), the baseline system is 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 consists of a standard practice Carlyle compressor operating at a fixed SDT of 90 F.

(EEM2) To meet the projected additional load, the customer is adding two new, variable speeds, 30 HP glycol pumps to their system. The baseline for these pumps is constant speed control.

(EEM3) Lastly, the customer is retrofitting the lighting in two storage areas of their facility. In the space that will become their barrel room, the customer currently does not have sufficient lighting for the space’s intended use. They are therefore adding 36 4-lamp T5-54W fixtures and

9 6-lamp T5-54W fixtures to the space. Since the space is being repurposed, and its LPD will remain significantly below code, this constitutes an energy savings measure. In a second space that will become a tank room, the customer currently has no lighting. The customer is adding 127 46W CFL flood lights and 47 2-lamp T5-54W fixtures to the space to make the space usable for production purposes. The LPD in the space will remain under code requirements, thereby making it eligible for an incentive.

Summary of Review

The following documents were reviewed during the ex-ante review process:

- A project report prepared by the IOU's technical consultant explaining the project scope, general savings calculation approaches, and proposed M&V activities.
- 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.

EEM1 Review:

The customer calculated savings using two analysis spreadsheets: one that compared the new high temperature (30 SST) system to the expanded pre-existing system and another that compared the new low temperature system to a standard practice low temperature system.

For the purposes of both calculations, the loads on the two systems were estimated on the assumption that refrigeration load scales proportionally to monthly facility energy usage. For instance, the low temperature system was projected to be 85% loaded during the peak energy usage month; in other months, the load was estimated as 85%*(kWh_month_i) /(KWh_month_peak).

Savings were calculated on an hourly basis. For each time stamp, baseline and installed chiller compressor demand were calculated as a function of % load and SDT, taking into account compressor sequencing and part load efficiencies. Cooling tower fan demand was calculated for each time stamp in both the baseline and post-retrofit scenarios based on heat rejection load (as determined from the cooling load and compressor demand) and cooling tower fan staging. Peak demand savings were appropriately calculated according to the DEER defined peak period in climate zone 12.

The key differences between the baseline and installed systems in the existing/high temperature model were: (1) the SST—25 F in the baseline model, 30 F in the installed model—and (2) the additional chillers/compressors constituting the expanded parts of the plant. The key differences between the baseline and installed systems in the lower temperature model were: (1) the post-retrofit model included wet bulb offset based floating head pressure control while the baseline model did not, (2) the proposed cooling tower was equipped with a variable speed drive, whereas the existing baseline was assumed to use cycling control, and (3) the chiller/compressor serving the loop was different.

Upon initial review of the model and available project files, ED's concerns included:

(1) The chosen head pressure (90 F SDT) for the baseline low temperature system.

(2) The inputs used in the performance curves for the new compressors.

(3) The baseline compressors chosen for the expansion.

(4) The exclusion of cooling tower capacity variation as a function of wet bulb temperature and head pressure (and thus chiller leaving condenser water temperature).

(5) Lack of documentation substantiating the expected project cost.

(6) The chosen project cost basis.

ED’s reviewer communicated directly with the 3rd part implementer to address these concerns and reached the following resolutions:

(1) The head pressure for the baseline low temperature system was chosen based on an estimated 20 F wet bulb approach at design conditions for climate zone 12. ED’s reviewer deemed this reasonable based on standard practice design guidelines noted in the 2007 Codes and Standards Enhancement Initiative “Final Report Refrigerated Warehouses” document.

(2) The reviewer’s chiller/compressor full load performance curves were developed as a function of SST and SDT. Based on the provided performance documents for the proposed Trane chillers, the implementer made the reasonable assumption that SST is 5 F less than the supply glycol temperature. The implementer however incorrectly estimated that the SDT is equivalent to the entering condenser water temperature (ECWT). In practice, the SDT is typically within three degrees of the *leaving* condenser water temperature (LCWT). At the ED reviewer’s request, the implementer revised the performance curves to correct for this discrepancy.

(3) The implementer chose Carlyle 5H series reciprocating compressors as the additional compressors for the baseline expanded high temperature system and the baseline compressor for the low temperature system. The 3rd party implementer stated that these compressors were chosen because they are commonly encountered at wineries they have visited through the program. Given the lack of an available industry standard practice reference document, ED’s reviewer accepted this rationale.

(4) ED requested that variable cooling tower capacity be accounted for in the savings analysis. This modification was particularly important for the low temperature circuit because the implementation of FHP control entails a condenser fan usage penalty that must be properly accounted for. The implementer added cooling tower capacity

modulation to their models as a function of ambient wet bulb temperature and SCT. The capacity factors the implementer used to implement this change were for an evaporative condenser as opposed to a cooling tower. Nonetheless, ED's reviewer deemed this approach reasonable because of the lack of readily available capacity factor tables for cooling towers (these must be custom built using selection software).

(5) The third party implementer noted that cost documentation is currently unavailable because of the project's early stage. No quotes have yet been made, so the project cost in the provided project report was simply an estimate based on similar past projects. ED's reviewer believed that this was reasonable given the project's present status.

(6) The implementer currently has the project specified on a full cost basis. Since this is a capacity expansion project, project costs should be documented on an incremental cost basis.

The lone remaining unaddressed issue in the implementer's models was the load profiles used to project savings. Since this is a capacity expansion project, the load profiles must show an increase from present conditions. The loads in the two models ED's reviewer evaluated were estimated based on present facility conditions. ED's reviewer discussed this factor with the implementation team, who has stated that the load estimate will be revised based on post-installation verification and M&V.

EEM2 Review:

The glycol pump VFD analysis was conducted on the assumption that the new pumps would operate 80% of the time at 70% speed and 20% of the time at 100% speed in the proposed scenario. A conservative affinity exponent of 2 was used the analysis and drive losses were accounted for in the proposed case. The provided analysis was simple yet appropriate given the project's current stage. It should be revised based on post-installation M&V activities.

EEM3 Review:

Lighting savings were calculated using a space LPD baseline from ASHRAE (.63 W/sqft). The baseline square footage should have been based on Title 24, which specifies an LPD of .6 for commercial and industrial storage. Although the tanks held in the storage spaces may be refrigerated, the spaces themselves are not, therefore the refrigerated space baseline LPD of .7 W/sqft is not applicable.

Savings were correctly calculated based on the differing wattages of the baseline and proposed lighting and expected operating hours. The implementer also made an appropriate adjustment to account for the fact that one of the two affected rooms (the "Barrel Room") already had pre-existing lighting. The calculation was therefore adjusted such that savings credit was only given in proportion to the percentage of the space with new lighting. The fraction of new lighting (as a percentage of total wattage) in the barrel room was used as a proxy for the affected percentage of the floor area.

In addition to using the incorrect baseline LPD, the implementer also appears to have incorrectly added the demand (kW) values for the baseline "Barrel Room" lighting system in their calculation, thereby underestimating baseline demand. This error led to a reduction in the estimated demand savings for this measure and should be corrected; gross energy savings were unaffected.

Review Conclusion

ED approves the project as currently constituted. The remaining issues with the project relate to minor calculation errors and modifications that can and will be made following project implementation during the M&V phase.

Summary of ED Requested Action by the IOU

ED requests that the following actions be taken by the IOU and/or their third party implementer:

1. The lighting calculation should be modified to account for the identified issues with the baseline LPD and demand savings calculation.
2. ED requests that the following actions be taken during the post-installation M&V phase to revise and calibrate the savings estimate:

   Monitoring

   - Monitor all chillers comprising central plant for 2 to 3 weeks following project completion and ramp up. To save on monitoring costs, amperage loggers may be used on all chillers of a given type except the first one, which should be monitored with an RMS power logger. This approach saves on monitoring costs, while allowing relationships between amperage and power factor to be developed for all chillers from the one chiller with power monitoring.
   - Monitor all operating glycol pumps with amperage loggers for 2 to 3 weeks. Take spot power readings at various drive speeds to correlate power with amperage.
   - Monitor all cooling tower fans with amperage loggers for 2 to 3 weeks.
   - If available, collect SCADA trends of glycol loop flow, supply temperature, and return temperature for the time period coincident with monitoring to determine loop loads.
   - Collect SCADA trends of SST and SDT (or, alternatively, leaving glycol temperature and leaving condenser water temperature) to confirm that the proposed operating strategies are implemented and FHP is working as proposed for the low temperature system. If SCADA trends are not available for these parameters, they should be spot checked during the initial metering installation site visit and during the meter removal site visit.

   Savings Analysis Revision

- If load data were available via the glycol loops, cross-reference these data with production records if feasible to update the load profile utilized in the savings analysis. Alternatively, utilize the trended compressor/chiller power data together with performance curves/maps to estimate load.
- If it is not possible to correlate load with production data, instead revise the load profile by correlating load with facility kWh data (as determined from interval Smart Meter data).
- Update the EEM1 savings model with the revised load profile, revised performance curves (if possible from the available monitored data), and implemented operating points (SST set point for both circuits, wet-bulb offset for FHP, minimum SDT set point).
- Utilize the glycol pump trend data to revise the schedule and speed estimates used in the original EEM2 analysis.
- Update the lighting savings calculation based upon verification of the implemented lighting and confirmation of the proposed operating schedule.

3. In the revised savings analysis and the project report clearly indicate any key savings parameters that changed from the project application period to the project review period.
4. Provide baseline project cost documentation for the Carlyle compressors and associated equipment and labor with the initial project submittal.
5. After implementation, provide actual project costs in the form of contractor invoices and internal costs for material and labor. Additionally, perform the project cost analysis on an incremental cost basis.

Table 1-2: Project Overview

Description	IOU Proposed Ex Ante Data	ED Recommendations
Project Baseline Type (Early Replacement, Normal Replacement, Capacity Expansion, New Construction, System Optimization, Add-on Measures)	Capacity Expansion	Capacity Expansion
Project Cost Basis (Full Cost, Incremental Cost)	Total Cost	Incremental Cost
RUL (Early retirement projects only, otherwise N/A (not applicable))	N/A	N/A
EUL	15 years for the refrigeration capacity expansion (chiller) portion of the project. EULs not specified for the other EEMs.	DEER specifies an EUL of 20 years for chillers, 15 years for VFDs, and 15 years for lighting.
First Year kWh Savings	[EEM1] 292,413 [EEM2] 65,393 [EEM3] 132,249 [Total] 490,055	TBD
First Year Peak kW Savings	[EEM1] 64.48 [EEM2] 0.00 [EEM3] 31.23 [Total] 95.71	TBD
First Year Therms Savings	0	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)	[EEM1] 292,413 [EEM2] 65,393	N/A

Description	IOU Proposed Ex Ante Data	ED Recommendations
	[EEM3] 132,249 [Total] 490,055	
Peak kW Savings (EUL thru RUL Period)	[EEM1] 64.48 [EEM2] 0.00 [EEM3] 31.23 [Total] 95.71	N/A
Therms Savings (EUL thru RUL Period)	0	N/A
Annual Non-IOU Fuel Impact (RUL Period)	N/A	N/A
Annual Non-IOU Fuel Impact (EUL thru RUL Period)	N/A	N/A
Net-to-Gross Ratio	Not provided	Not assessed

Table 1-3: Detailed Review Findings

Reviewed Parameter	Analysis
Project Gross Savings Baseline (for early retirement projects only, include RUL through EUL baseline)	IOU Proposal: The IOU formulated a standard practice baseline for this capacity expansion project since code does not dictate equipment for process refrigeration. The IOU chose to add Carlyle reciprocating compressors to the existing refrigeration system to formulate the baseline for the high temperature circuit. Carlyle reciprocating compressors with fixed head pressure control were used to define the baseline system for the low temperature circuit.
	ED Assessment: The chosen baselines were appropriate.
	ED Recommendation: Retain the chosen baselines.
Project Cost Basis (for early retirement projects only, include RUL through EUL cost basis treatment)	IOU Proposal: Full cost
	ED Assessment: Full cost is not appropriate. Since this is a capacity expansion project, some other standard practice equipment would have been presumably installed instead of the chosen equipment.
	ED recommendation: Savings should be calculated on an incremental cost basis using the standard practice baseline equipment chosen for the savings calculation to form the reference project cost.
RUL (required for early retirement projects only, otherwise n/a)	IOU Proposal: N/A
	ED Assessment: N/A
	ED recommendation: N/A
EUL	IOU Proposal: 15 years for the refrigeration capacity expansion (chiller) portion of the project (EEM1). EULs were not specified for the other EEMs.
	ED Assessment: EULs should be specified for all EEMs. The one specified EUL is shorter than that specified for the equivalent measure in DEER.
	ED Recommendation: DEER specifies an EUL of 20 years for chillers (EEM1), 15 years for VFDs (EEM2), and 15 years for lighting (EEM3).
Savings Assumptions	IOU Proposal: For the purposes of both calculations, the loads on the two systems were estimated on the assumption that refrigeration load scales proportionally to monthly facility energy usage. For instance, the low temperature system was projected to be 85% loaded during the peak energy usage month; in other months, the load was estimated as 85%*(kWh_month_i)/(KWh_month_peak).
	ED Assessment: Since this is a capacity expansion project, savings should

Reviewed Parameter	Analysis
	have been estimated based on a load greater than that currently met by the facility. Nonetheless, given that the project is currently in the pre-retrofit phase and the load estimate will be revised during the post-implementation M&V period, this issue is non-critical.
	ED Recommendation: Revise the load profile estimate based on post-retrofit M&V data collection.
Calculation Methods/Tool review	IOU Proposal: Custom spreadsheet analysis informed by manufacturer's performance data.
	ED Assessment: The chosen calculation method is appropriate and the savings analysis is sufficiently thorough.
	ED Recommendation: Revise the savings analysis for all EEMs based upon post-retrofit M&V data collection and monitoring (see the summary of requested activities for details).
Pre- or Post-Installation M&V Plan	IOU Proposal: The provided documents do not reference any proposed M&V activities.
	ED Assessment: No assessment was possible since an M&V plan was not included in the provided documentation.
	ED Recommendation: The ED reviewer believes that post-implementation monitoring of the entire refrigeration system, including compressors, glycol pumps, and cooling tower fans is warranted. In addition, SCADA trending of parameters including glycol flow, supply temperature, return temperature, SST, and SDT should be conducted as possible. These data should be used together with data gathered during on site verification activities to revise the load profile, equipment performance trends, and key savings input parameters utilized in the initial pre-retrofit analysis.
Net-to-Gross Review	IOU Proposal: Not discussed
	ED Assessment: Not assessed
	ED Recommendation: NTG interview may be warranted