Ex Ante Review Findings-Phase-I

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

IOU	Pacific Gas and Electric Company
Application ID	FFP 1261-12-781
Application Date	TBD
Program ID	TBD
Program Name	Comprehensive Food Processing Audit and Resource Efficiency Program
Program Year	2013
Itron Project ID	X296
IOU Ex Ante Savings Date	TBD
ED Measure Name	TBD (Process Optimization, Industrial Customized Refrigeration)
Project Description	The customer operates a poultry processing plant. This project affects three refrigeration circuits at the plant. Proposed measures include floating head pressure for all three circuits, evaporator fan VFDs for one circuit, suction pressure optimization for two circuits, and VFD compressor controls for one circuit.
Date of ED Review(s)	3/25/2013
Primary Reviewer and Firm	Brandon Gill/DNV KEMA
Review Supervisor and Firm	Amit Kanungo/DNV KEMA
Type of Review (Desk, On-site, Full M&V, Tool)	Desk
ED Recommendation	ED conditionally approves the proposed project, with the exceptions of EEMs A.4 and C.4, pending clarification and updates to the savings calculations.

Measure Description

The facility processes poultry products from initial product cooling through packaging and cold storage. Product packaging and storage utilizes a 12^{o}F SST circuit. The facility uses two processes for initial product cooling: blast freezing and water cooling (red water chilling). Blast chilling uses a low temperature -30^{o}F SST circuit, while water cooling uses a red water chiller circuit at 20^{o}F SST. The following compressor equipment serves each circuit:

- Processing and Storage (Med/High Temp, 12^{o}F SST, 2.2 mmBtuh)
  - 5 – Carlyle 5H60 with 60HP Motors
  - 1 – Carlyle 5H40 with 40HP Motors
- Blast Freezer (Low Temperature, -30^{o}F SST, 785 kBtuh)
  - 2 - Carlyle 5H80 with 40HP Motors
  - 1 - Heat Craft LDD 7000M6D
  - 1 - TSI Century DS30L4
  - 1 - Heat Craft LVD 3000 M6D
  - 1 - Heat Craft BBV22M6D
- Red Water Chiller (20^{o}F SST, 1.65 mmBtuh)
  - 2 – Mycom F4WB HE

A 20 HP evaporative condenser with a 7.5 HP sump pump serves the process/storage circuit; a 5 HP evaporative condenser with a 1.5 HP sump pump serves the blast freezer circuit; and a 30 HP evaporative condenser with a 15 HP sump pump serves the red water chiller.

According to project documentation, cold storage, receiving, and shipping operations take place continuously throughout the year (8,760 h/year), while the processing operations take place for 50 weeks per year, 6 days a week, 16 hours per day (4,800 h/year). To reduce energy consumption, the following EEMs are proposed:

- A. Processing and Storage Circuit
  - EEM A.1: Implement floating head pressure control. Currently (per the available calculations), the facility uses a fixed SCT of 90^{o}F. The proposed strategy involves allowing the SCT to float with a 10 F wet bulb offset TD down to an unspecified minimum. (Although the project documentation does not specify a minimum SCT, a minimum value of 60 F is used in the savings analysis).
  - EEM A.3: Retrofit 22 evaporator units (90 fans, .75 HP each) with variable frequency drives. Presently, the fans utilize cycling control.
  - EEM A.4: Implement suction pressure optimization. Currently the circuit uses a fixed SST of 12^{o}F. The facility intends to raise the SST to 25^{o}F.
- B. Blast Freezing Circuit
  - EEM B.1: Implement floating head pressure control. Currently (per the available calculations), the facility uses a fixed SCT of 90^{o}F. The proposed strategy involves allowing the SCT to float with a 10 ^{o}F wet bulb offset TD down to an

unspecified minimum. (Although the project documentation does not specify a minimum SCT, a minimum value of 60 F is used in the savings analysis).

- C. Red Water Chilling Circuit
  - EEM C.1: Implement floating head pressure control. Currently (per the available calculations), the facility uses a fixed SCT of 85^{o}F. The proposed strategy involves allowing the SCT to float with a 10^{o}F wet bulb offset TD down to an unspecified minimum. (Although the project documentation does not specify a minimum SCT, a minimum value of 60 F is used in the savings analysis).
  - EEM C.2: Install variable frequency drives on the screw compressors serving the circuit. Presently, the drives modulate capacity using slide valves. The customer proposes to retrofit the existing compressors with VFDs. Following measure implementation, capacity modulation will first be achieved using VFDs, followed by slide valve control at low loads.
  - EEM C.4: Implement suction pressure optimization. Presently the circuit uses a fixed 20^{o}F SST. The customer proposes to raise the SST to 25^{o}F.

The intended date of measure implementation is unknown.

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 workbook utilized to generate savings estimates for all EEMs, as well as the supporting compressor software run outputs used to inform the savings calculations.
- Question and answer correspondence between the IOU's internal reviewer and the technical consultant regarding the proposed savings calculations.

EEM A.1 Analysis:

The IOU utilized Carlyle compressor selection software to estimate full load compressor performance at SCTs ranging from 55^{o}F to 110^{o}F for the compressors serving the process/storage circuit. The software was also used to estimate compressor sequencing as a function of ambient temperature (and thus head pressure) under nearly fixed load conditions (1.5 mmBtu/h, adjusted slightly by bin for weather dependent effects). Weather bins created with *BinMaker* were then assigned baseline and proposed head pressure values. Baseline and proposed compressor power estimates were then assigned to these bins based on sequencing and head pressure. Compressor load factors were calculated for each bin based on the power draw of the operating compressors relative to the power draw of *all* compressors if they were operating at the bin's SCT conditions.

For each bin, condenser fan power draw was estimated by scaling the fan's full load power draw by the compressor load factor. For the post-retrofit scenario, these values were further scaled by a factor of 1.1 to account for the fact that FHP control effectively reduces condenser capacity at a given ambient temperature, leading to higher fan speeds and thus greater condenser power draw.

The following issues were identified with the above analysis:

- The baseline scenario was developed using dry bulb binning, while the post-retrofit scenario was developed using wet bulb binning. The loads (mmBtu/h) corresponding to these two binnings are *not* identical. As such, the baseline and post-retrofit annual energy use estimates are not based on identical process loads. The baseline binning should also be based on wet-bulb conditions.
- The baseline scenario compressor software runs were based on R-404a refrigerant, while the post-retrofit runs were based on R-507 refrigerant. The project scope document does not indicate a refrigerant change out.
- Both compressor software runs were based on the assumption that the compressors on the affected circuit do not have unloading or capacity controls of any kind. This should be confirmed.
- The condenser fan load factors were assumed to be identical to the compressor load factors. This is likely not a reasonable assumption given that the compressor load factors quantify the percentage of full load compressor power for a given temperature bin. Condenser fan load factors should be determined based on (1) the condenser's capacity at a given wet bulb temperature, (2) the heat rejection load corresponding to a given temperature bin, and (3) the condenser airflow necessary to meet the heat rejection load.
- The post-retrofit scenario shows *condenser fan* savings relative to the base case. By definition, FHP control should require increased fan usage in order to draw off heat at the lower SCT-WB TD required of the control strategy. This suggests that the condenser load factor penalty of 1.1 used in the analysis is too low. If the above bullet point is addressed, and condenser fan usage is modeled as a function of heat rejection load and condenser capacity at a given WBT, this issue should resolve itself.
- The block load of 1.5 mmBtuh used as the basis of this analysis is not discussed, explained, or derived anywhere in the project report or savings analysis.
- Compressor performance was modeled at a SST of 10 F instead of the presently implemented SST of 12 F. The difference is small, but there is no reason the correct inputs cannot be placed in the Carlyle software.
- The analysis should consider whether or not the minimum SCT used in the calculation (60 F) will yield a sufficient pressure drop across the expansion valves once EEM A.4 is

also implemented and the SST is raised to 25 F. A minimum pressure differential may therefore have to be included in the analysis.

EEM A.3 Analysis:

Evaporator fan savings were estimated using the following assumptions:

- In the baseline scenario, the fans cycle on 80% of the time and operate with an 80% load factor.
- In the post-retrofit scenario, the fans operate constantly, albeit with a 55% load factor.

The difference in heat load between the baseline and installed scenarios was used to estimate interactive savings with the refrigeration system.

The following issues were identified with the analysis:

- In calculating the baseline fan energy use, the load factor mentioned above was omitted, thereby overestimating the baseline energy use by 25%.
- In calculating the baseline refrigeration system energy use corresponding to fan heat gain, the cycling factor was omitted, thereby overestimating baseline measure-specific refrigeration system energy use by 25%.

EEM A.4 Analysis:

Carlyle compressor selection software was used to estimate compressor performance using a baseline SST of 10^{o}F (why the claimed baseline SST of 12 F from the project documentation was not used is unknown) and the proposed fixed SST (25^{o}F) across a range of SCTs (55^{o}F to 80^{o}F). The software was also used to estimate compressor sequencing as a function of ambient wet bulb temperature (and thus head pressure) under nearly fixed load conditions (1.5 mmBtu/h, adjusted slightly by bin for weather dependent effects). Weather bins created with *BinMaker* were then assigned baseline and proposed head pressure values. Baseline and proposed compressor power estimates were then assigned to these bins based on sequencing, head pressure, and SST. Note that the proposed case from EEM A.1 served as the base case for this EEM to avoid double counting savings.

For each bin, compressor load factors were calculated based on the power draw of the operating compressors relative to the power draw of *all* compressors if they were operating at the bin's SCT and SST conditions.

The following issue was identified with this measure definition:

- If suction pressure optimization only requires that the facility change their fixed SST set point and not implement any additional controls, then this does not constitute an eligible measure. This action could be implemented at little to no cost in the absence of the program with a less than 1-year payback. Additionally, there would be nothing (e.g. new controls) to prevent the facility from immediately reverting to their pre-existing set point.

If, on the other hand, the measure actually involves SST reset, then the analysis and report need to be updated to account for a variable SST control strategy.

As currently constituted, the following issues were identified with the analysis:

- Both the baseline compressor software run (which was the post-retrofit run for EEM A.1) and the proposed case run were performed using R-507 refrigerant. Project documents indicate that the facility uses R-404a refrigerant.
- For the <50^{o}F WBT bin in the proposed case, the savings analysis indicates that 3 compressors (of 6) are required. The compressor software outputs however show that only two compressors are required under these conditions.
- Both compressor software runs were based on the assumption that the compressors on this circuit do not have unloading or capacity controls of any kind. This should be confirmed.
- The block load of 1.5 mmBtuh used as the basis of this analysis is not discussed, explained, or derived anywhere in the project report or savings analysis.
- Compressor performance was modeled at a SST of 10 F instead of the presently implemented SST of 12 F. The difference is small, but there is no reason the correct inputs cannot be placed in the Carlyle software.
- On the "Q-Analysis" tab of the workbook, a final storage temperature of 27 F is assumed. If the SST is increased to 25 F, the evaporator TD decreases to 2 F, which significantly reduces evaporator capacity. Either the final storage temperature is higher, or the proposed SST is likely overly aggressive.

EEM B.1 Analysis:

The savings analysis for this EEM was conducted identically to the savings analysis for EEM A.1, albeit using different compressors and a SST of -30^{o}F instead of 12^{o}F.

The following issues were identified with the analysis:

- The baseline scenario was developed using dry bulb binning, while the post-retrofit scenario was developed using wet-bulb binning. The loads (mmBtu/h) corresponding to these two binnings are *not* identical. As such, the baseline and post-retrofit annual energy use estimates are not based on identical process loads. Wet bulb binning should be used for the base case as well.
- The baseline scenario compressor software runs were based on R-404a refrigerant, while the post-retrofit runs were based on R-507 refrigerant. The project scope document does not indicate a compressor change out.

- Both compressor software runs were based on the assumption that the compressors on this circuit do not have unloading or capacity controls of any kind. This should be confirmed.
- The condenser fan load factors were assumed to be identical to the condenser load factors. This is likely not a reasonable assumption given that the compressor load factors quantify the percentage of full load compressor power for a given temperature bin. Condenser fan load factors should be determined based on (1) the condenser's capacity at a given wet bulb temperature, (2) the heat rejection load corresponding to a given temperature bin, and (3) the condenser airflow necessary to meet the heat rejection load. While this EEM shows a condenser fan penalty (as opposed to savings as with EEM A.1), the ED suggests using a more robust methodology based on the above principles instead of assuming a 1.1 energy use penalty factor.
- Savings were calculated on the basis of Carlyle compressor software outputs even though the circuit is comprised of two Carlyle compressors, one TSI compressor, and three Heat Craft compressors. The performance of the four non-Carlyle compressors was assumed identical to the performance of the Carlyle compressors. This assumption should be modified only if it can be supported with more applicable manufacturer's data.
- A block load of 0.36 mmBtuh was used as the basis of this analysis. This value is not documented, explained, or derived anywhere in the project report or savings analysis.
- The analysis was conducted based on 8,760 hours of operation while the project report states that the poultry processing equipment (blast freezers, red water chillers) only operate 4,800 hours per year.

EEM C.1 Analysis:

Mycom compressor selection software was used to estimate the full load power draw of the existing Mycom compressors as a function of SCT in 5^{o}F increments from 60^{o}F to 85^{o}F. These power draw estimates were then assigned to wet bulb temperature bins in 5^{o}F increments. For all base case bins, the power draw was based on a fixed SCT of 85^{o}F; for the installed case bins, the SCT was set to float 10 ^{o}F above the bin WBT.

In both the baseline and proposed scenarios, the two affected compressors were assigned load factors of 75% for all WBT temperatures at or above 60^{o}F; below 60^{o}F, all bins were assigned load factors of 50%. These load factors were multiplied by the full load power draw of the compressors in each bin to estimate energy usage.

For each bin, condenser fan power draw was estimated by scaling the fan's full load power draw by the compressor load factor. For the post-retrofit scenario, these values were further scaled by a factor of 1.1 to account for the fact that FHP control effectively reduces condenser capacity at a given ambient temperature, leading to higher fan speeds and thus greater condenser power draw.

The following issues were identified with this analysis:

- The basis of the compressor load factors used in the analysis is not discussed anywhere in the project file.
- The compressor load factors for the base case should be greater than those for the proposed case since the capacity of the proposed case compressors is greater due to the lower SCT in each bin. This is necessary so that the baseline and proposed compressors are modeled to meet identical loads.
- The condenser fan load factors were assumed to be identical to the compressor load factors. This is likely not a reasonable assumption given that the compressor load factors quantify the percentage of full load compressor power for a given temperature bin. Condenser fan load factors should be determined based on (1) the condenser's capacity at a given wet bulb temperature, (2) the heat rejection load corresponding to a given temperature bin, and (3) the condenser airflow necessary to meet the heat rejection load. While this EEM shows a condenser fan penalty (as opposed to savings as with EEM A.1), the ED suggests using a more robust methodology based on the above principles instead of assuming a 1.1 energy use penalty factor.
- The analysis for this EEM is based on a 5 HP condenser fan; all other EEMs for this circuit (C.2 and C.4) are based on a 30 HP condenser fan. Based on the system size, this input is likely incorrect.
- In this EEM, as with the preceding EEMs, the compressors were assumed to operate only at full load, without any unloading ability. This may be true for the preceding circuits (EEMs A and B), but it is likely untrue for this circuit since the project documentation specifically states that these compressors currently use slide valve unloading capacity control.
- The analysis was conducted based on 8,760 hours of operation while the project report states that the poultry processing equipment (blast freezers, red water chillers) only operate 4,800 hours per year.

EEM C.2 Savings Analysis:

Mycom compressor selection software was used to estimate compressor power draw as a function of SCT (60^{o}F to 85^{o}F) and part load (% capacity) using both slide valve control (the baseline scenario) and variable speed control (the proposed scenario).

The proposed energy use from EEM C.1 was used as the baseline for EEM C.2 to avoid double-dipping for measure savings. For the EEM C.2 proposed case, the load factor and SCT corresponding to each WBT bin was used to determine the VSD compressor power draw from the compressor selection software outputs. This power draw was then multiplied by the load factor to estimate the power draw corresponding to a given bin for the proposed case.

The following issues were identified with the analysis:

- Even though power draw as a function of % load and SCT was calculated for the baseline slide valve control scenario, these data were *not* used to estimate base case energy use. Since the EEM C.1 proposed usage was taken as the EEM C.2 baseline—and the EEM C.1 calculation effectively assumed cycling control—the part load performance of slide valve controlled compressors was not assessed.
- The proposed case calculation double counts the impact of the load factor. Since the load factor is used to determine the part load compressor power draw, it does not then have to be multiplied by the part load power draw to calculate the proposed power draw; doing so is tantamount to modeling the compressor as cycling at reduced speed.
- As with EEM C.1, the basis of the compressor load factors used in the analysis is not discussed anywhere in the project file.
- The analysis was conducted based on 8,760 hours of operation while the project report states that the poultry processing equipment (blast freezers, red water chillers) only operate 4,800 hours per year.

EEM C.4 Savings Analysis:

As with the preceding EEM, the Mycom compressor selection software was used to estimate the part load performance of the compressors with VSD control at varying SCTs, albeit this time at 25 ^{o}F SST as opposed to 20 ^{o}F SST. The proposed energy use from EEM C.2 was the baseline energy use for EEM C.4. For the EEM C.4 proposed case, the load factor and SCT corresponding to each WBT bin was used to determine the VSD compressor power draw from the compressor selection software outputs. This power draw was then multiplied by the load factor to estimate the power draw corresponding to a given bin for the proposed case.

The following issue was identified with this measure definition:

- If suction pressure optimization only requires that the facility change their fixed SST set point and not implement any additional controls, then this does not constitute an eligible measure. This action could be implemented at little to no cost in the absence of the program with a less than 1-year payback. Additionally, there would be nothing (e.g. new controls) to prevent the facility from immediately reverting to their pre-existing set point. If, on the other hand, the measure actually involves SST reset, then the analysis and report need to be updated to account for a variable SST control strategy.

As currently constituted, the following issues were identified with the analysis:

- The baseline and proposed case calculations double count the impact of the load factor. Since the load factor is used to determine the part load power draw of the compressor, it does not then have to be multiplied by the part load power draw to estimate the proposed power draw; doing so it tantamount to modeling the compressor as cycling at reduced speed.

- As with EEMs C.1 and C.2, the basis of the compressor load factors used in the analysis is not discussed anywhere in the project file.
- The analysis was conducted based on 8,760 hours of operation while the project report states that the poultry processing equipment (blast freezers, red water chillers) only operate 4,800 hours per year.
- On the "Q-Analysis" tab, the temperature of the process load exiting the red water chilling process is 25 F. If this temperature is correct, then at the proposed SST, there is not any temperature differential between the coils and the temperature of the cooled process load. Therefore, either the assumed final process temperature is too high, or the proposed SST is not feasible.

Project Costs:

Project cost documents were not provided from review. The IOU's technical consultant has nonetheless indicated that the customer has received a quote for $450,000.00.

Review Conclusion

ED does not approve the project as currently constituted. However, ED will conditionally approve the proposed project, with the exceptions of EEMs A.4 and C.4, pending clarification and updates to the savings calculations. Each of the issues identified above must be addressed in the savings calculation before approval. Although many specific issues are identified above, the overarching issue pertinent to all EEMs relates to the load estimates assigned to each compressor circuit. While the analysis contains a tab with product load estimates, these figures do not appear to feed into the savings calculations in any way. ED requires justification for the load estimates for full approval.

EEMs A.4 and C.4 must either be removed, or redefined to meet program rules. As it stands, the proposed fixed SST set point adjustments are not eligible.

Summary of ED Requested Action by the IOU

ED requests that the following actions be taken by the IOU:

1. Each of the issues identified above should be addressed in a revised version of the savings calculation. In cases where the IOU disputes the claimed issue, written justification is required.
2. M&V Plan – Prior to the retrofit, one week of trend data collection is requested for all compressors on all three compressor circuits in 15 minute integrated intervals, at minimum. To save costs, true power data loggers are only required on the first of any one model of compressor; amperage data loggers may be used on the remaining compressors

of the same model. These data are to be used with compressor maps (generated from the compressor selection software) to project load (btu/h) as a function of SST, SDT/SCT, and power. The load estimates (by temperature bin) used in the savings analysis should be revised using these data for all plant related EEMs.

In conjunction with compressor monitoring, data loggers should be installed to monitor condenser fan power draw. A weather station should also be installed on site to correlate fan power pre and post-retrofit with wet bulb temperature and compressor load.

Additionally, a small sample of evaporator fans should be monitored using amperage loggers to characterize fan cycling and full load power draw for the baseline scenario. The quantity should be dictated by the number of unique spaces and processes served by the evaporator units.

Following measure implementation, another week of data collection using identical parameters is requested. These data are to be used to verify that the proposed control EEMs have been implemented. Additionally, SCADA trends of SST, SDT, compressor VFD speed, and evaporator fan VFD speed should be collected as applicable (and possible) pre- and post-retrofit.

Spot measurements of evaporator fan power should be taken simultaneously with evaporator fan drive speed readings at various speeds to characterize the relationship between post-retrofit fan power and speed.

3. After implementation, provide actual project costs in the form of contractor invoices and internal costs for material and labor.
4. After implementation and data collection, revise the savings analysis workbook using the post-retrofit trend data. Clearly indicate any key savings parameters that changed from the project application period to the project review period.

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)	Add-on Measures	Add-on Measures
Project Cost Basis (Full Cost, Incremental Cost)	Full Cost	Full Cost
RUL (Early retirement projects only, otherwise N/A (not applicable))	N/A	N/A
EUL	20	DEER specifies an EUL of 15 years for VFD measures; 15 years is also specified in DEER for head and suction pressure control EEMs.
First Year kWh Savings	977,728.2	TBD
First Year Peak kW Savings	54.84	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 (EUL thru RUL Period)	977,728.2	TBD
Peak kW Savings (EUL thru RUL Period)	54.84	TBD
Therms Savings (EUL thru RUL Period)	0	TBD
Annual Non-IOU Fuel Impact (RUL Period)	N/A	N/A
Annual Non-IOU Fuel Impact (EUL thru RUL Period)	N/A	N/A

Description	IOU Proposed Ex Ante Data	ED Recommendations
Net-to-Gross Ratio	Not provided	Assessment not completed

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 proposed to use all pre-existing conditions as the baseline. Pre-existing conditions consisted of fixed head pressure for all circuits, lower SST temperatures than proposed, cycling control for evaporator fans, and slide valve control for screw compressors.
	ED Assessment: Since all measures are either control or equipment add-on measures, pre-existing conditions form the appropriate baseline.
	ED Recommendation: Retain the chosen baseline.
Project Cost Basis (for early retirement projects only, include RUL through EUL cost basis treatment)	IOU Proposal: Full cost
	ED Assessment: Full cost is appropriate since this is an add-on project.
	ED recommendation: Retain the chosen cost basis.
RUL (required for early retirement projects only, otherwise n/a)	IOU Proposal: RUL not specified.
	ED Assessment: RUL is not relevant since this is a controls/add-on measure project.
	ED recommendation: No recommendation.
EUL	IOU Proposal: 20 years
	ED Assessment: A rationale for the proposed EUL is not provided. DEER or another source should be cited when defining the proposed EUL.
	ED Recommendation: The two VFD control measures should be assigned a 15 year EUL per DEER. Suction and head pressure measures both have a 15 year EUL in DEER as well.
Savings Assumptions	IOU Proposal: The IOU made assumptions regarding the process loads

Reviewed Parameter	Analysis
	specific to each refrigeration circuit. The basis of the loads specified for each circuit was not explicitly explained. The IOU additionally assumed that the FHP control measures would operate with 10 F wet bulb offset and cause a 10% increase in condenser fan power in all cases. The IOU assumed that all evaporator fans presently cycle on 80% of the time and operate with an 80% load factor. Following the proposed retrofit, the IOU assumed that the fans would remain on constantly and operate with a 55% load factor.
	ED Assessment: The basis for the process load estimates used for all EEMs needs to be thoroughly explained. The FHP wet bulb offset assumed for the EEM is reasonable; the condenser fan penalty estimate is likely too low and should be investigated further with more detailed condenser load and capacity analysis. The assumed pre- and post-retrofit cycling rates and load factors are reasonable, but should be physically verified.
	ED Recommendation: The load estimates used for all EEMs should be updated with pre-retrofit M&V metered data collection (see the proposed activities above). The condenser fan penalty should be reinvestigated with more robust analysis. Cycling and power draw estimates for the pre- and post-retrofit periods should be verified using short term interval metering (see the proposed activities above).
Calculation Methods/Tool review	IOU Proposal: Spreadsheet bin analysis supplemented with compressor selection software outputs were used to estimate savings.
	ED Assessment: A bin savings analysis is reasonable for the proposed EEMs, but the IOU's analysis is limited by a number of calculation flaws. See the "Summary of Review".
	ED Recommendation: Revise the submitted calculations based on the

Reviewed Parameter	Analysis
	findings documented in the "Summary of Review" section above. Use proposed pre- and post-retrofit M&V activities to inform analysis inputs.
Pre- or Post-Installation M&V Plan	IOU Proposal: The IOU's proposed M&V activities include measure installation verification for all measures, spot measurements for the compressor measures (FHP, SST optimization, VFD), and short term (1 week, 15 minute interval) monitoring for the VFD evaporator fan measure. All proposed M&V activities proposed only for the post-retrofit period. The project report notes that utility meter instrumentation and "existing and newly installed plant instrumentation" will also be used to assess savings, but does not provide specific details regarding what plant parameters can/will be collected or how they will be leveraged in the analysis.
	ED Assessment: ED believes that more extensive compressor monitoring is necessary to properly establish the facility's process loads, which are a key source of uncertainty in the analysis as presently constituted.
	ED Recommendation: ED requests that the compressors for all three refrigeration circuits be monitored for one week prior to the retrofit, and one week following the retrofit. See the M&V Plan discussion in the Requested Action section for more details regarding the requested monitoring.
Net-to-Gross Review	IOU Proposal: Not discussed.
	ED Assessment: Not assessed.
	ED Recommendation: NTG interview may be warranted