Customer Energy Efficiency Program
Measurement and Evaluation Program

EVALUATION OF PACIFIC GAS & ELECTRIC COMPANY'S 1995 NONRESIDENTIAL ENERGY EFFICIENCY INCENTIVES PROGRAM FOR COMMERCIAL SECTOR REFRIGERATION TECHNOLOGIES APPENDICES

PG&E Study ID number: 330

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VOLUME I: ANALYSIS APPENDICES

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Appendix A
Sample Design

A. SAMPLE DESIGN

This appendix presents the sample design for the evaluation of Pacific Gas and Electric Company's (PG&E's) 1995 Nonresidential Energy Efficiency Incentive (EEI) Programs, Commercial Sector (the Commercial program). An integrated sample design was implemented for the Lighting, HVAC, and Refrigeration end uses. First, the sample design approach and resulting sample allocation are presented. This appendix then concludes with a discussion of the California Public Utilities Commission (CPUC) Evaluation and Measurement Protocols (the Protocols) requirements.

A.1 EXISTING DATA SOURCES FOR SAMPLE DESIGN

The participant tracking system for the Retrofit Express (RE), Retrofit Efficiency Options (REO), and Customized Incentives Programs is maintained as part of the PG&E Management Decision Support System (MDSS). Henceforth, the RE and REO program components are referred to as simply Retrofit. The MDSS contains program application, rebate, and technical information regarding installed measures, including measure descriptions, quantities, rebate amounts, and ex ante demand, energy and therm saving estimates. The MDSS extract used in this evaluation is consistent with data used in the PG&E Annual Earning Assessment Proceedings (AEAP) Report.

For the Retrofit and Customized Incentives programs, participation was tracked at both application and measure levels. They are linked by application code and program year. Each application can cover multiple measures and accounts, and each measure is linked to a PG&E electrical or gas service location where the measures are supposed to be installed. The account location is identified by its account number, or a unique seven-digit identification number (PG&E's control number). Unlike customer accounts, control numbers are used to identify service locations and serve as stable identifiers for linking datasets.

QC's existing PG&E commercial population files, assembled in support of prior evaluations, cover the period from January 1992 to September 1995. The billing series for October 1995 through September 1996 were extended only for customers in the analysis dataset. PG&E's billing data contain monthly energy-consumption as well as other customer information, such as customer name, service location, rate schedule, and Standard Industrial Classification (SIC) code.

A.2 SAMPLE DESIGN OVERVIEW

The objectives of the sample design were to

- Determine the optimal sample allocation for first-year gross impact analysis, based upon sample size and evaluation accuracy requirements of the Protocols and available project resources.
- Allocate sufficient sample points to meet net-to-gross (NTG) objectives.
- Reallocate available resources, wherever feasible, to focus on measures and/or program features deemed most important by PG&E staff for future program design while not compromising the overall accuracy of the evaluation.

The sample design is based upon a nested sample design approach. This approach consists of nesting samples of customer data so that the most expensive and detailed primary data can be leveraged to the population. The largest customer group includes all of the commercial customers with monthly PG&E billing data and participant tracking data who were rebated for eligible lighting, HVAC and refrigeration technologies in 1995 (the "participant population"). The smallest group is the metered (TOU loggered or end-use metered) participants, who have the most comprehensive information available. These participants have lighting logger (for the Lighting end use) or end-use metering (for the HVAC end use) data, on-site audit data, telephone survey data, participant tracking data, and billing data.

The advantage of a nested sample design is that the overlapping samples of primary data can be used to improve the accuracy of the engineering and statistical analysis for the population, rather than just for the customers for which the data are available. For example, logger and metered data are used to establish accurate measures of operating hours by key business types that are then used to improve the reliability of estimates for all customers in the survey sample.

A.3 SAMPLE SEGMENTATION

Evaluation of the Commercial program at the participant segment level allows more precise, and insightful, analyses than those undertaken at the aggregate PG&E system level. The program segmentation consists of two components: participant segmentation and technology segmentation. A key feature of the sample design is that the sampling unit is a unique customer site. Significant effort was undertaken to aggregate billing and participation records to this level.

The first step in the participant segmentation process grouped firms by business type, as defined in the MDSS. There are a total of 12 business types and 34 technology groups, as defined below. Exhibit A-1 presents the distribution of unique customer sites across the business type and technology group segmentation.

Annual energy consumption values were used to group customers into five usage/size strata based upon a Dalenius-Hodges procedure. The comparison group customers are then selected to mirror the underlying distribution of the participant target population by size and business type. (For the customers in the largest size strata, a census was attempted both for among participants and nonparticipants.)

Exhibit A-1
1995 Commercial Segmentation and Distribution of Unique Participant Sites

Technology	Business Type	Commercial												
		Office	Retail	College/Univ	School	Grocery	Restaurant	Health Care	Hotel/Motel	Warehouse	Personal Serv.	Comm. Serv.	Misc.	Total
Indoor Lighting	Halogen	47	46	8	17	2	26	10	16	9	4	24	8	217
	Compact Fluorescent Lamps	323	106	19	175	38	136	107	136	36	31	156	39	1,301
	Incandescent to Fluorescent Fixture	14	2	2	16	0	12	2	7	2	0	10	5	72
	Exit Signs	175	60	10	107	18	80	35	9	11	9	73	10	596
	Efficient Ballasts Changeouts	33	20	6	26	17	6	10	3	10	2	18	5	156
	T8 Lamps and Electronic Ballasts	728	620	33	345	229	194	187	41	135	152	271	126	3,055
	Delamp Fluorescent Fixtures	280	155	14	106	58	80	42	9	42	39	48	26	898
	High Intensity Discharge	40	42	4	30	11	2	1	2	67	14	34	82	329
	Reduced Wattage Lighting	2	1	0	1	0	0	0	0	1	1	1	0	7
	Controls	113	48	15	80	10	12	29	18	25	12	52	28	442
	Customized Lighting Measures	7	1	1	0	42	0	0	0	6	0	6	1	64
	Indoor Lighting End Use Total	890	726	43	401	294	260	215	158	208	183	379	222	3,968
HVAC	Central A/C	179	65	3	49	13	38	66	7	31	25	71	14	558
	Adjustable Speed Drives	35	27	2	2	12	0	2	2	1	9	2	2	96
	Package Terminal A/C	1	1	2	8	0	2	2	42	1	0	2	0	61
	Set-Back Thermostat	90	32	2	24	3	18	19	3	16	12	39	12	269
	Reflective Window Film	90	23	6	5	11	9	33	5	22	20	25	13	262
	Water Chillers	6	4	0	1	0	0	4	0	0	0	3	0	18
	Customized EMS	10	0	2	30	5	0	7	2	1	1	0	0	58
	Customized Controls	3	0	1	1	0	0	1	0	0	1	2	0	9
	Chiller Optimization	1	0	0	0	0	0	1	0	0	0	0	0	2
	Convert to VAV	3	0	0	1	0	0	2	0	0	0	0	0	6
	Other Customized Equipment	3	0	0	0	0	0	5	0	1	0	0	0	9
	Other HVAC Technologies	19	2	0	10	3	3	8	1	3	1	4	1	55
	HVAC End Use Total	354	123	17	114	43	53	123	59	59	57	116	34	1,149
Refrigeration	Customized Measures	1	0	0	0	61	0	0	0	1	0	0	5	68
	Standardized Measures	13	75	3	4	193	208	2	6	10	1	18	12	545
	Refrigeration End Use Total	14	75	3	4	253	208	2	6	11	1	18	17	612
Misc.	Outdoor Lighting	87	47	12	101	19	22	35	30	35	16	72	42	518
	Energy Efficient Motors	19	4	4	2	3	0	9	1	6	3	6	23	80
	Heat Recovery & Hot Water	0	0	1	0	1	1	0	1	0	1	2	0	7
	AG Pumping	1	0	0	0	0	0	0	0	0	2	1	13	17
	AG Other	0	0	0	0	0	0	0	0	1	0	0	1	2
	Cooking Equipment	4	2	0	12	29	50	1	4	2	0	3	0	107
	Non-Process Boilers	0	0	1	0	0	0	2	0	0	0	2	0	5
	Process Boilers	0	0	0	0	0	1	0	0	1	1	1	0	4
	Process	2	0	0	0	0	0	0	0	2	2	2	15	23
	Misc. End Uses Total	113	53	15	112	52	73	46	36	46	23	88	90	747
Program Total		1,231	869	61	518	544	558	336	218	289	239	528	321	5,694

Data Source: 1995 PG&E Frozen MDSS Database Received on July 25 1996.

A.4 TECHNOLOGY SEGMENTATION

Program measures are classified into technology groups through combining technologies with similar energy reduction characteristics. This grouping strengthens the analysis by creating homogenous analysis segments in terms of electricity use. The three elements of the technology segmentation are as follows:

Technology Groups consist of those measures that comprise, in the case of the Lighting end use, those specific measures that are expected to have similar energy saving characteristics. For example, all T12 to T8 retrofit measures are grouped together. The projected energy savings differences will be accounted for in the engineering estimates, yielding similar per-unit estimates.

Measure Group, the second level of segmentation, groups measures by the PG&E program measure description.

Measure, the highest level of segmentation presented, is the actual measure offered by the PG&E program.

The technology segmentation presented in Exhibit A-1 shows the highest level of segmentation, at the measure level for all end uses in the commercial sector. While the engineering analysis was conducted at the measure level, the statistical billing data analysis was conducted at a much coarser level, that is, at the technology-group level or at an even higher level of aggregation.

A.5 SAMPLE FRAME

The first step in sample design is to determine the sampling frame. In general, the sampling frame includes only those customers who are program participants, or likely targets of the program, rather than all customers in the population. It sets the stage for all data collection activities that follow, and determines the availability of billing data for the remainder of the analysis.

In this evaluation, different analyses (e.g., impact analysis, free-rider analysis, and spillover analysis) use different sampling frames, which are defined by analyzing what possible actions a customer in PG&E's service territory could have taken during the study period. This classification provides the basis for the sample design. Without this kind of control, the Statistically Adjusted Engineering (SAE) analysis change model cannot be estimated, since nonprogram-induced changes cannot be separated from changes between periods attributable to other factors, such as weather and economic trends.

A.6 PARTICIPANT SAMPLE FRAME

This section details the reduction of the eligible participant population to a sample frame suitable for impact analysis. None of the criteria used to screen the sample are believed to have adverse impacts on the sample representativeness; therefore, the screening criteria preserve the transferability of the impact results to the population.

The final participant sample frame for the Lighting and HVAC end uses consists of 2,560 commercial customers drawn from the eligible population of 5,694 program participants paid in 1995. In addition, there were 322 pretest and 78 multisite participants that were added to the 2,560 unique sites to form the final fielding sample frame. Criteria considered in the assessment of the quality of participant account billing data are as follows:

Presence of a billing rate schedule for the customer: Customers are required to have a rate schedule code for all years spanned by the billing data.

Quality of usage readings for the customer for the period of January 1993 through September 1995: Customers are required to have non-missing, non-zero usage values for all months spanned by the billing data. Customers are also required to have realistic PG&E revenues for the period. Realistic revenues are defined as revenues of at least $0.03 per kWh, but no greater than $0.25 per kWh.

Cohesion of billing data across years: The original billing data was received by year, i.e., the billing data for each calendar year was stored on a separate data tape. Data from different billing tapes was checked to ensure that the first month on each tape was immediately after the last month of the previous year's tape.

PG&E division representative deletion requests: Lists of customers in the sample frame were sent to the appropriate PG&E division representative for approval. Based upon responses from the representatives, some customers were deleted from the sample frame.

Reasonable usage across years and populated telephone numbers: Accounts are screened to ensure that the mean usage on the account for 1994 and 1995 is no more than twice (or less than half) the mean usage on the account for 1993 and 1994, respectively. Accounts are also screened to ensure they have reasonable phone numbers, and any accounts with no telephone number, or zeros in place of a number, are rejected from the sample frame.

For the Refrigeration end use, the entire participant sample was drawn for the sample frame because only 612 participant sites were available.

A.7 COMPARISON GROUP SAMPLE FRAME

The comparison group sample frame consists of 4,153 commercial customers drawn from the eligible population of 801,561 nonparticipants (Lighting and HVAC end uses) in the Commercial program. Since comparison group surveys were conducted only for customers in the commercial sector, the first step in creation of the sample frame is to limit eligibility to only those accounts having SIC codes representing commercial business activities. Note that similar screen criteria were used:

- Excessive changes in usage between 1993 and 1994 billing years: Accounts are screened to ensure that the mean usage on the account for 1994 and 1995 is no more than twice (or less than half) the mean usage on the account for 1993 and 1994, respectively.

- Geographic location of customers: Accounts are screened to insure that they fall within the geographic regions targeted for comparison group telephone survey and on-site survey data collection.

In drawing the sample frame, targets are established for each business type and usage segment, so that the sample frame distribution, by business type and usage segment, is the same as that of the surveyed program participant population. The drawing is conducted in this manner to ensure sufficient representation of each business type/usage segment combination in the sample frame and allow survey data collection in accordance with the sample design.

For the Refrigeration end use, a supplemental nonparticipant sample frame consisting 836 customers divided among small grocery (574), supermarkets (154), agricultural preparation (65), and refrigerated warehouses (43) was drawn to supplement the Lighting and HVAC comparison group.

Finally, the canvass survey sample frame of 6,000 is drawn randomly from a frame of 172,354 customers based upon geographic targets for this survey.

A.8 SAMPLE ALLOCATION APPROACH

The sample design complies with the Protocols and meets the program evaluation objectives. In this evaluation, the sampling unit is a customer site, which defines a unique service address. Applications in the MDSS database can cover more than one control number.

The final sample sizes for the telephone, on-site, lighting logger, and end-use metering are summarized in Exhibit A-2 by end-use element.

Exhibit A-2
Data Collected by Program and End Use

Program	End Use	Commercial: Telephone Surveys	On-Site Audits	End-Use Metering	Time-of-Use (TOU) Loggers	Combination
Custom	Lighting	18	1	0	0	0
	HVAC	58	32	0	0	0
	Refrigeration	7	16	0	1	1
Retrofit	Lighting	600	227	5	108	112
	HVAC	434	107	20	13	31
	Refrigeration	235	16	0	1	1
Total	Lighting	614	228	5	108	112
	HVAC	487	137	20	13	31
	Refrigeration	241	18	0	2	2
Total Participants (Unique Sites)		1,217	380	20	108	126
Total Nonparticipants (Unique Sites)		808	36	0	0	0
Total (Unique Sites)		2,025	416	20	108	126

Telephone Survey Sample - For each segment, the retrofit program sample design allocated the sample in proportion to the program-avoided cost by segment. This sample design concentrates sample points to segments that represent highest impact, in order to obtain the best estimate of impact for the largest portion of the population. In addition, a census was attempted for the largest customers. This sample allocation, combined with the random sampling techniques within each segment, produces a stratified random telephone survey sample representing the program-participant population (paid in 1995). A nonparticipant sample is developed based upon on the business type and usage strata distribution resulting from the participant sample allocation.

Telephone surveys were collected for a total of 2,025 customers, 1,217 of which are participants, and the remaining 808 are in the comparison group (451 as the original lighting and HVAC comparison group, 201 as the supplemental refrigeration comparison group, and 156 outside the program retrofitters found through the canvass survey).

On-site Audit Sample - Similar to the telephone survey sample, this sample was also structured to be approximately proportional to the program segment-level avoided cost estimates. A total of 416 on-site surveys were conducted for the commercial sector, with 380 participants and 36 comparison group customers.

Lighting Logger and End-Use Metering - This sample is not intended to be a random sample, nor strictly proportional to the program-avoided cost. The sample allocations were manipulated in order to assure adequate sample sizes for calibration of engineering models. A total of 108 and 20 participant sites were loggered or end-use metered.

A.9 RELATIVE PRECISION

Given a sample design, the relative precision, based upon total annual energy use, reflects the uncertainty regarding the extent to which the allocated sample sizes are large enough to control for the population variance in terms of annual energy usage. Precision for the telephone sample is calculated using the following procedure. First, the 1994 annual energy consumption is computed for all participants in the analysis dataset.

Next, five strata are constructed based on customers' annual usage using the Delanius-Hodges procedure. Exhibit A-3 presents the stratum-level sample size, sample weight, sample mean, and estimated standard errors for each end-use element. Note that since a census was attempted for the largest customers, participants with consumption greater than 10,000,000 kWh were excluded from this step. Overall, there were 73 participants in the population with usage at or above this level; 37 were successfully surveyed and included in the analysis dataset. (If these 37 were included in the variance calculation—using the surveyed sample—the oversampling of large customers would explode the variance far beyond that of the true variance in the population.)

Then, the program level mean and standard error are calculated using classic stratified sample techniques. [1] Finally, the relative precision at 90 percent confidence level is calculated as a two-tailed test.

By end-use element, the following relative precisions were achieved:

- For indoor lighting, the relative precision is 4.7 percent based upon a survey sample of 592. For the largest customers, 22 surveys were completed out of a participant population of 49.

- For HVAC, the relative precision is 6.0 percent based upon a survey sample of 473. For the largest customers, 14 surveys were completed out of a participant population of 21.

- For refrigeration, the relative precision is 4.6 percent based upon a survey sample of 240. For the largest customers, 1 survey was completed out of a participant population of 3.

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[1] Cochran, W.G., *Sampling Techniques*, Third Edition, John Wiley & Sons, 1977. pp 91-95.

Exhibit A-3
Telephone Sample
Relative Precision Levels

LIGHTING

Weight	**n**	**mean**	**Standard Error**	**Relative Prec.**
52.8%	205	60,757	4,746	12.8%
24.5%	153	218,522	6,452	4.9%
11.5%	99	575,245	20,564	5.9%
6.9%	78	1,586,348	58,156	6.0%
4.3%	57	4,918,699	287,212	9.6%
100.0%				
TOTAL	592	471,990	13,460	4.7%
Usage > 10,000,000 kWh in 1994			49	
Surveyed			22	
TOTAL Surveyed = 614				

REFRIGERATION

Weight	**n**	**mean**	**Standard Error**	**Relative Prec.**
59.1%	168	45,814	2,759	9.9%
22.7%	41	227,111	13,980	10.1%
3.9%	13	631,164	50,908	13.3%
12.3%	12	1,533,060	55,581	6.0%
2.0%	6	4,068,986	339,006	13.7%
100.0%				
TOTAL	240	372,375	10,401	4.6%
Usage > 10,000,000 kWh in 1994			3	
Surveyed			1	
TOTAL Surveyed = 241				

HVAC

Weight	**n**	**mean**	**Standard Error**	**Relative Prec.**
53.9%	231	51,141	3,357	10.8%
19.5%	96	211,135	8,474	6.6%
10.7%	58	610,891	28,876	7.8%
10.1%	51	1,654,388	79,836	7.9%
5.7%	37	4,660,035	327,280	11.6%
100.0%				
TOTAL	473	566,376	20,647	6.0%
Usage > 10,000,000 kWh in 1994			21	
Surveyed			14	
TOTAL Surveyed = 487				

It follows that the 808 surveys that comprise the comparison group sample yield a relative precision of at least that obtained by the corresponding participant samples. Since the expected precision is based upon the annual energy usage, this does not imply that these levels of precision can be obtained for the impact analysis.

A.10 DEMONSTRATION OF PROTOCOL COMPLIANCE

A.10.1 Sampling Procedures Adopted

The sample design follows the rules established by the CPUC in the January 1995 revisions to the "Protocols and Procedures for the Verification of Costs, Benefits and Shareholder Earning from Demand Side Management Programs." Recent revisions to the Protocols—a draft dated 6/27/95—were incorporated wherever appropriate. The purpose of this section of the report is to identify compliance with these Protocols, with respect to the 1995 Commercial Sector Program Evaluation activities.

A.10.2 Sample Definitions

The following definitions are provided to introduce the primary segments targeted—both a participant sample and a comparison group—to ensure experiment control:

Participants - According to Table 5, part C, paragraph 1 of the Protocols, participants are defined as "those who received utility financial assistance to install a measure or group of measures during the program year."

Comparison Group - A control group is defined as a group of customers that represents what would have happened in the absence of the program. According to Table 5, part D, paragraphs 3 & 4, the comparison groups include both "customers who installed applicable measures" and "customers who did not install applicable measures," with no preference for either group (i.e., random or stratified random sample). This sample is therefore representative of the population, excluding only program participants during the evaluation year.

A.10.3 Overall Sampling Procedures

The commercial customer samples are driven by a primary data collection activity; in this case, the telephone surveys serve as the primary site-specific data collection elements that contribute to the analysis dataset. The commercial telephone sample was drawn to achieve a stratified random sample and optimally distribute the allocated sample points.

A.10.4 Detailed Protocol Sample Requirement

The commercial participant and comparison group samples are designed to meet the Protocol requirements in terms of analysis dataset sample size, precision of the results, availability of pre- and post-billing data contributing to the analysis dataset, and in ensuring cost-effective use of measured data.

Analysis Dataset Sample for Commercial Participants: The Protocols require that a program with more than 450 participants has a randomly drawn sample sufficiently large to achieve minimum energy use precision of ±10 percent at the 90 percent confidence level, and at least 450 contributing points in the analysis dataset. *(This was the requirement at the time of the sample design; this requirement was relaxed to 350 subsequent to the completion of the data collection activities conducted for this evaluation.)*

Data collection protocols are met regarding minimum analysis dataset size, if primary site-specific data are collected on-site, as per Table 5, part C, paragraph 4 of the Protocols. Data collection efforts are further strengthened during on-site activities through the installation of lighting loggers. These devices record specific fixture operating profiles during the monitoring period, and serve to calibrate self-reported lighting operating schedules. Data collected in this way follows the participant protocol recommendations set forth in Table C-4, paragraph 1 of the Protocols.

As discussed earlier, the sample collected for the commercial section, all end uses achieve a relative precision of at least 6 percent at a 90 percent confidence level, well below the 10 percent required by the Protocols, Table 5, part C, paragraph 4. Each participant chosen for the telephone sample is required to have at least nine months of post-installation billing data, and 12 months of pre-installation data, as per the Protocols, Table 5, part D, paragraphs 2 and 1, respectively.

Analysis Dataset Sample for Commercial Comparison Group - The Protocols require that the comparison group sample "be drawn using the same criteria for participants," as per Table 5, part C, paragraph 6.

The analysis dataset meets the sample size requirement in Table 5, part C, paragraph 3. The calculated relative precision meets the precision requirement in Table 5, part C, paragraph 4. The commercial comparison group telephone sample is drawn based upon the similar distribution of participant sample, in terms of their business types and annual usage.

To ensure compliance with comparison group protocols, the telephone survey sample frame is drawn to meet the billing data requirements of Table 5, part D, paragraphs 3 and 4 of the Protocols. All customers in the analysis dataset have billing data from January 1991 to September 1996, which ensures an adequate pre- and post-installation billing periods for customers who installed applicable measures between 1993 and 1995.

Appendix B
Engineering Detailed Computational Methods

B. ENGINEERING DETAILED COMPUTATIONAL METHODS

The technical approach and engineering results that support realized gross impacts in the evaluation of Pacific Gas and Electric Company's (PG&E's) 1995 Commercial Refrigeration Program are presented in this appendix. The purpose of a presentation of the engineering computations is to provide detailed intermediate results that either verify or contradict the methods used to generate program design demand and energy impact estimates. Results are presented to ensure that future program design and evaluation activities will benefit from the engineering parameters generated during the 1995 program evaluation effort.

B.1 APPENDIX B STRUCTURE

The appendix is structured as follows:

First, an overview of the evaluation approach is presented.

Then, the methods used and the engineering estimates developed for refrigeration measures covered by the Retrofit Express (RE) Program are discussed.

Next, the methods used and the engineering estimates developed for the Customized Incentives Program are summarized.

The final two sections of the appendix contain detailed calculations, assumptions, and analyses used in the development of engineering estimates for the RE and the Customized Incentives programs.

B.2 OVERVIEW OF THE EVALUATION APPROACH

The Commercial Refrigeration Evaluation consisted of the analysis of two separate PG&E programs, RE and Customized Incentives. The level of analysis for each program was tailored to its relative importance in generating program impacts.

For each of the RE measures which had paid incentives in 1995, a detailed review was performed of the algorithms and assumptions used to develop ex ante impacts.

Customized Incentive participants accounted for 82 percent and 73 percent of the gross ex ante energy and demand savings calculated for this program, respectively (see Exhibit B-1). For this reason, a detailed review of each application submitted by a Customized Incentives participants was performed. Thirty-nine of the 53 applications submitted for the Customized Incentives Program are from a single supermarket chain, with seven additional applications from other supermarkets that had retrofit work completed. The remaining seven applications are from various sites, including refrigerated warehouses, shipping facilities, and crop cold storage facilities.

Exhibit B-1
Distribution of Commercial Refrigeration Impacts by Program

PG&E Refrigeration Program	Percentage of Total Gross Ex Ante Impacts	
	Demand	**Energy**
Retrofit Express	27%	18%
Customized Incentives	73%	82%

B.3 EVALUATION APPROACH, RETROFIT EXPRESS

The engineering algorithms used by PG&E to develop ex ante impacts for RE measures were reviewed thoroughly (algorithms were taken from the 1995 Advice Filing[1]). The aim of the evaluation was to either confirm or correct the methods and inputs used in the ex ante estimates. For each measure, the following analysis steps were performed:

First, ex ante impacts were re-calculated using methods and inputs listed in the Advice Filing.

Then, evaluation impacts were developed using revised methods and inputs when applicable. When possible, inputs and methods were verified using either sources referenced in the Advice Filing or alternate sources, including the following references:

- ASHRAE Handbooks, American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. Atlanta, GA
  - Refrigeration Systems and Applications, 1994
  - Fundamentals, 1989
  - HVAC Systems and Applications, 1992
- EPRI Report TR-100984, V1, "Engineering Methods for Estimating the Impacts of Demand-Side Management Programs" Volume 1; Fundamentals of Engineering Simulations for Residential and Commercial End Uses; Electric Power Research Institute, Palo Alto, CA
- Foster Miller, 1989 "Supermarket Refrigeration Modeling and Field Demonstration" EPRI Report CU-6268, Waltham, MA, 1989
- Shepherd, Michael, Amory Lovins, et al. 1990 "The State of the Art: Appliances" Competitek, Rocky Mountain Institute, Snowmass, CO
- Usibelli, A. et al. Commercial Sector Conservation Technologies Lawrence Berkeley Laboratory, LBL 18543, Berkeley CA, 1985

Section B.5 contains detailed information regarding the development of impacts for each RE measure. Exhibit B-2 provides a summary of the per-unit impacts developed for each RE measure.

[1] PG&E 1995 Customer Energy Efficiency Programs Advice Letter No. 1867-G/1481-E, filed October 1994.

Exhibit B-2
Summary of Per-Unit Impacts for Retrofit Express Measures

PG&E Measure Code	Measure Code Description	Unit of Impact	Advice Filing Impacts		Evaluation Impacts					
					Recalculated Advice Filing Impacts		Evaluation Impacts		Final Impacts Used to Develop Estimates	
			kWh/yr	kW	kWh/yr	kW	kWh/yr	kW	kWh/yr	kW
R1	A (1995). Night Cover for Display Case	Linear Feet	136.6	0	136.6	0	.	.	136.6	0
R2	B (1995). Strip Curtains for Walk-in	Square Feet	37	0.0035	37	0.0035	386	0.0441	386	0.0441
R3	C (1995). Glass or Acrylic Doors (Low Temperature Case)	Linear Feet	894	0.0846	894	0.0848	1473	0.168	1473	0.168
R4	D (1995). New Refrigeration Case with Doors (Low-Temperature Case)	Linear Feet	894	0.0846	894	0.0848	1473	0.168	1473	0.168
R5	E (1995). New Refrigeration Case with Doors (Medium-Temperature Case)	Linear Feet	345	0.0326	347	0.0328	403	0.0460	403	0.046
R6	F (1995). Low Heat/No Heat Refrigeration Case Door	Linear Feet	312.8	0.0146	312.9	0.0146	181	0.0206	181	0.0206
R7	G (1995). Humidistat Control	Linear Feet	280.5	0.0184	280.5	0.0184	389	0.0449	389	0.0449
R10	H (1995). Case Lighting Electronic Ballast	Lamp(s)	87.5	0.0072	87.5	0.0072	102	0.0125	102	0.0125
R11	I (1995). Insulate Bare Suction Line	Linear Feet	16.02	0	16.67	0	16.31	0.00186	16.31	0.00186
R12	J (1995). Mutilplex Compressor System	Tons	1516.1	0.3754	1516	0.375	1404	0.16	1404	0.16
R20	K (1995). Electronic Adjustable Speed Compressor	hp	462.5	0	462.5	0	514	0.0587	514	0.0587
R14	M (1995). Mechanical Subcooler	THR*	589.7	0.3288	589.7	0.3288	.	.	589.7	0.3288
R19	N (1995). Floating Head Pressure Controller	Tons	548.22	0	548.22	0	.	.	548.22	0
R50	O (1995). Cooler or Freezer Door Gasket	Gasket(s)	1035	0.097	1032	0.097	2091	0.239	2091	0.239
R51	P (1995). Auto-Closer for Cooler or Freezer	Closer(s)	2304	0.65	2304	0.65	3535	0.57	3535	0.57
R52	Q (1995). Cooler or Freezer with Non-Electric Condensate Evaporator	Refrigeration Unit(s)	1681	0.102	1681	0.102	.	0.188	1681	0.188
R15	1994. High Capacity Oversized Condenser, Air-Cooled	THR*-ΔF	71.38	0.0078	71.38	0.0078	.	0.0081	71.38	0.0081
R18	1994. High Capacity Oversized Condenser, Evaporative-Cooled (Ammonia)	THR*	28.19	0.0051	28.19	0.0051	28.23	0.0032	28.23	0.0032
R8	1993. Energy Efficienct Evaporator Motor, Display	Linear Feet	121.22	0.00475	121.22	0.00475	.	0.0138	121.22	0.0138
R9	1993. Energy Efficienct Evaporator Motor, Walk-in	hp	8355	0.368	8355	0.368	.	0.954	8355	0.954

B.4 EVALUATION APPROACH, CUSTOMIZED INCENTIVES

Each application filed for the Customized Incentives Program was thoroughly reviewed. The analysis methods used for each review varied from application to application, depending on the measures covered, additional data gathered, and the application calculations submitted. However, the following analyses were performed for each application:

Application Review – The methods and inputs used to derive impacts for each application were reviewed.

Billing Data Review – Impacts claimed by applicants were compared with billing data to verify that the impacts were reasonable. For example, impacts greater than 30 percent of the total energy usage of the premise were noted as "suspect."

On-Site Audit – Whenever possible, an on-site audit was performed in order to verify installed measures and to gather detailed engineering data. A single grocery chain that represented 39 of the 53 Customized Incentives applications refused to participate in these on-site investigations. According to ex post evaluation results, this customer accounted for 61 percent of gross energy impacts within the refrigeration end-use and 30 percent of demand. Of the remaining 14 participants, 13 on-site audits were completed.

In addition to the analysis methods described above, some or all of the following were performed for selected applications:

Monitoring Records -- On-site monitoring records were often collected and reviewed. Examples of these records include measured fan loads, condensate temperatures, and energy management system (EMS) downloads.

Billing Comparisons – Pre- and post-retrofit billing data were analyzed to substantiate claimed energy or demand savings.

Estimate Revisions -- If necessary, impact estimates that were derived in each application were revised using updated assumptions and/or methods.

Section B.6 contains detailed information regarding the development of impacts for each Customized Incentives participant. Exhibit B-3 provides a summary of the premise-specific impacts developed for the Customized Incentives Program.

Exhibit B-3
Summary of Per-Site Impacts for Customized Incentives Participants

	Gross Energy Impacts		Gross Demand Impacts	
Site ID	Ex Ante Impacts (kWh)	Ex Post Unadjusted Impacts (kWh)	Ex Ante Impacts (kW)	Ex Post Unadjusted Impacts (kW)
3110	75,781	82,660	0.00	8.65
3103	264,878	264,878	0.00	8.65
2862	903,671	903,671	268.00	186.00
2909	213,119	175,202	9.20	79.94
396	244,994	244,994	24.70	24.70
390	188,633	188,633	0.94	0.94
5499	213,981	213,981	10.20	10.20
3970	107,048	147,887	0.00	0.00
4519	527,473	527,473	61.00	61.00
2888	369,200	0	101.00	0.00
657	900,322	0	24.00	0.00
3946	484,156	484,156	0.00	0.00
4521	165,042	165,042	0.00	0.00
2396	85,673	85,673	0.00	0.00
Large Supermarket Chain†	13,830,203	14,683,233	605.80	505.98
Total	18,574,174	18,167,483	1104.84	886.06
Realization Rate		98%		80%

† One supermarket chain contributed of 39 distinct applications that were paid in 1995.

For details surrounding the large supermarket chain impacts, refer to Section B.4.1 and supporting calculations in B.6.1 and B.6.2. For other Site ID records, refer to Sections B.4.2 and B.6.3.

B.4.1 Customized Incentives Program—Supermarket Refrigeration

Thirty-nine Customized Incentives applications were submitted for refrigeration retrofit measures installed within one large supermarket chain. The total savings claimed for this chain made up 40 percent of the gross demand[2] and 61 percent of the gross energy savings claimed under the refrigeration end use.

Application review has shown that HVAC and lighting retrofits were also performed at these sites and were often submitted as part of a refrigeration measure in the MDSS.

- All such lighting savings were recorded in the MDSS under a refrigeration classification.
- Eight of the applications had HVAC records in the MDSS for Variable Speed Drive (VSD) installations, while 30 applications claimed these savings under a refrigeration end-use classification. One site did not install a VSD.

All claimed Customized Incentives refrigeration retrofits are evaluated in this section of the appendix.

Each application contained spreadsheet models that simulate the primary end uses at each site. Applications were reviewed in detail, and impact results (by measure and refrigeration component affected) and related engineering parameters were entered into a database. This database contains information for the following store systems:

- HVAC systems including fans, compressors, and condensers
- Lighting systems including outdoor, overhead, and refrigerated case lights
- Refrigeration end-uses including refrigerated cases and anti-sweat devices
- Refrigeration compressors and condensers

The development of this database provided a means for assessing the accuracy of each application record. Impacts were calculated, where possible, using models already developed for the HVAC and lighting retrofits. Revised impact estimates are presented for each of the following components:

- VSD Impacts
- Lighting Impacts
- Refrigeration Impacts

The following were assessed:

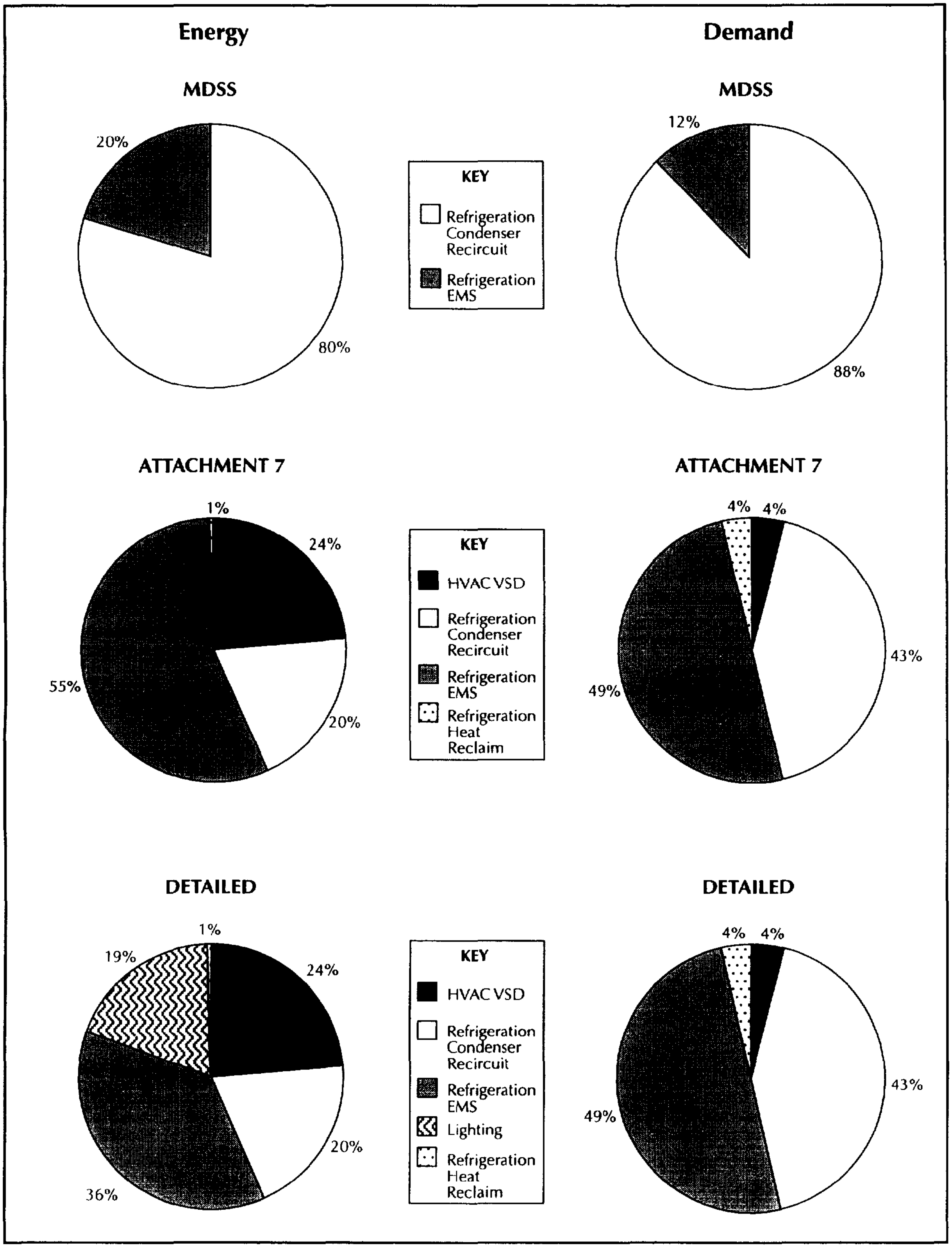
MDSS records accuracy—whether or not application records were appropriately transferred to the MDSS.

Application results accuracy—results summarized within the application were checked against aggregate intermediate results for both the appropriate end-use classification and the accuracy of the application-level record keeping.

Exhibit B-4 illustrates the result of this accuracy check. Clearly, the MDSS records mis-appropriate other end-use impacts within the refrigeration records for this grocery chain. Also, detailed intermediate results were often aggregated incorrectly, especially by end-use category.

[2] Summer On-Peak demand impacts are defined for weekdays during the hour 3:00 PM - 4:00 PM, May 1 - October 31.

Exhibit B-4
MDSS, Attachment 7, and Detailed Application Savings



Additionally, other numeric errors were detected within the application records. Analyses were conducted to evaluate the accuracy of the detailed calculation methodologies applied and the impacts derived. Those analyses follow in the remainder of this section.

Exhibit B-5 identifies the sites where extra demand impacts were claimed. In these instances, demand impacts claimed for a particular measure are not documented in the detailed calculations. In several cases these demand impacts were claimed in Attachment 7 of the PG&E application and then input into the MDSS. In some instances demand impacts were not claimed directly, but careful inspection of the forms revealed that demand impacts summarized for VSDs were rolled over to either the condenser recircuit or EMS measure. Calculations detailing these errors can be found in *Section B.6.1*.

Exhibit B-5
Extra Demand Savings Claimed in Attachment 7

Site ID	Check Number	Extra Demand Impacts (kW)
Demand Impacts Claimed for VSD		
3367	62761	2
3388	62526	2
3407	61756	12
5687	63889	5
Extra Demand Impacts Claimed		
3357	63778	3
3366	61063	6
3381	60593	7
3402	61060	8
3413	60724	5
3414	63776	5
3415	61066	9

Although the ex post impact methodology for many of the Customized Incentives applications made use of the impact calculation found in each application, the errors detected within this large supermarket chain required that the majority of the evaluation be based upon entirely revised methods. The evaluation approach is presented next -- first VSD methods are provided, then indoor lighting measures, followed by refrigeration measures (including one heat reclaim measure).

Variable Speed Drive Measure

VSDs were installed at all but one of the 39 grocery sites. The retrofit was performed to reduce constant volume supply fan loads. These fans were modeled in each application, assuming a continuous load.

Savings calculated in the applications demonstrated an overall annual kWh reduction of over 80 percent. Based on analysis of VSD savings for the RE program, these application savings estimates were higher than expected. In contrast, evaluation estimates using DOE-2 models have shown savings over baseline that are closer in magnitude to 50 percent.

Exhibit B-6 illustrates the site-by-site kWh savings claimed for VSD retrofits. Six sites are excluded from this table because either detailed calculations or actual applications were unavailable.

The methods used to assess these VSD supply air fan savings are consistent with the approach presented in the 1995 HVAC end-use evaluation (Study id # 326).

Exhibit B-6
Ex Ante and Ex Post VSD Energy Savings

Site ID	Application Check Number	Supply Fan Horsepower	Baseline Fan kWh per year	Ex Ante Savings kWh	Percent Savings (Ex Ante)	Ex-Post Savings (kWh)	Percent Savings (Ex Post)
3357	63626	25	150,754	125,022	83%	79,307	53%
3361	61063	25	150,516	118,459	79%	74,875	50%
3364	60590	30	181,008	143,917	80%	89,850	50%
3366	62985	20	120,672	97,467	81%	59,900	50%
3367	62761	20	120,603	93,908	78%	63,446	53%
3368	63776	20	123,283	103,208	84%	63,446	51%
3372	60724	25	150,840	115,799	77%	74,875	50%
3373	61060	20	90,504	72,969	81%	59,900	66%
3374	61067	30	123,283	101,799	83%	95,168	77%
3381	61070	25	150,840	129,919	86%	78,606	52%
3388	62526	20	120,603	102,767	85%	63,446	53%
3389	63624	20	120,413	90,698	75%	59,900	50%
3391	62986	15	90,310	66,797	74%	44,925	50%
3394	63625	20	120,672	91,915	76%	63,446	53%
3400	63775	30	180,905	152,227	84%	95,168	53%
3401	61061	25	150,840	114,384	76%	79,307	53%
3402	61069	25	150,840	119,242	79%	74,875	50%
3403	63621	30	180,905	99,023	55%	95,168	53%
3405	61066	30	181,008	147,871	82%	89,850	50%
3409	61058	25	150,516	117,940	78%	74,875	50%
3411	61068	20	120,603	99,023	82%	65,844	55%
3413	60960	20	120,672	93,739	78%	59,900	50%
3414	62390	25	150,840	115,078	76%	79,307	53%
3415	62391	25	150,840	119,782	79%	74,875	50%
3416	63619	25	150,840	123,047	82%	74,875	50%
5687	63889	25	150,754	127,327	84%	79,307	53%
3407	60593	30	Missing	Missing	N/A	98767	N/A
3359	63217	Missing	Missing	Missing	N/A	74,563	N/A
3371	61065	Missing	Missing	Missing	N/A	74,563	N/A
3386	61057	Missing	Missing	Missing	N/A	74,563	N/A

Evaluation VSD demand impacts were set to zero (several ex ante VSD application records claimed demand impacts) and energy savings were computed as follows:

VSD Model -- VSD modeling methods used to evaluate VSD impacts recorded under the HVAC end use (See Study 326) were used to calculate impacts. This method used DOE-2 models to simulate hourly per-horsepower savings by climate zone.

VSD Schedule -- Savings for all of these sites were based on a 24 hour per day supply fan operating schedule, according to application-based assumptions.

Mean Results -- Where fan horsepower was not available, savings for the site were set equal to the mean savings for all other stores.

Indoor Lighting Measure

The lighting savings are due to energy management system control of overhead lights (to shut off a portion of the lights for several hours during the night). Over half of the floor lights are shut down for approximately 6 hours per night. Outdoor lighting and office lighting were rarely affected.

Average energy savings amounted to 15.8 percent of the annual lighting use (based on application records), and no demand savings were claimed. These figures are acceptable, assuming that 92 percent of the lighting connected load is floor lighting, and 66 percent of these lights are shut off for 6 hours per day. (See Exhibit B-7). Because telephone surveys and on-site audits were rejected by this particular customer, these assumptions could not be directly verified.

Application estimates were adopted from each application for this particular measure.

Exhibit B-7
Indoor Lighting Impacts

Application			Evaluation			
Lighting Connected Load	1,807	kW	Lighting Connected Load		1,807	kW
Pre-Retrofit Lighting	15,202,161	kWh	Percent Controlled	x	61%	
Post-Retrofit Lighting	- 12,797,683	kWh				
			Lighting Connected Load Controlled		1,098	kW
			Hours off/year (6 hours per day x 365 days)	x	2190	
Annual Savings	2,404,478	kWh	Annual Savings		2,404,485	kWh

Refrigeration Measures

There were three modifications to the refrigeration systems that were analyzed for demand and energy impacts. These measures impacted energy consumption as follows:

Recircuit Condenser -- The Recircuit Condenser measure improves compressor efficiency (due to floating head pressure controls), and therefore reduces condenser loads.

EMS -- The EMS control of lights and anti-sweat door heaters results in reduced lighting load due to reduced operating hours, reduced anti-sweat load due to reduced operating hours, and reduced refrigerated case load as a result of lower gains from lights and door heaters.

Heat Reclaim -- The Heat Reclaim measure uses refrigerator waste heat to heat water, thereby eliminating the water heating load entirely (electric heating element is removed).

Recircuit Condensers

This retrofit was performed on refrigerated cases and on the air conditioning systems.

Within the original savings calculations, bin models were used to estimate the refrigerator and air conditioner energy consumption both pre- and post-retrofit. The models incorporated changes in the condensing temperature and corresponding efficiency improvements to the compressors.

The methodology used in each application to calculate the reduction in refrigeration energy usage was determined to be reasonable. There were, however, several inconsistencies identified including erroneous changes in load from the pre- to post-retrofit condition. In several cases application records applied savings calculated for VSDs within the Condenser Recircuit measure.

Savings for this measure were calculated as follows:

First, a random sample of 10 sites (26 percent of the applications submitted) were analyzed in detail. A bin model spreadsheet (used in each application) was recreated using pre-retrofit refrigeration and air conditioning loads from the applications. Bin hours, condensing temperatures and efficiencies were also taken from the applications. See *Section B.6.2* for the bin model calculations.

Then, a ratio of savings to maximum refrigeration plant load (total Btuh capacity for air conditioning and refrigerated cases) was created for peak demand and annual kWh impacts. Exhibit B-8 illustrates the results of this assessment.

Exhibit B-8
Bin Model Results

Site ID	Check Number	Maximum Refrigeration Plant Load (Btuh)	Ex-Post Demand Impacts (kW)	Ex-Post Energy Impacts (kWh)	Demand Impact Ratio *(Demand Impact / Refrigeration Load) x 1,000,000*	Energy Impact Ratio *Energy Impact / Refrigeration Load*
3402	61060	1,114,540	-2.18	57,576	-1.954	0.052
3372	61061	1,226,259	9.23	134,621	7.527	0.110
3361	61067	894;449	1.80	66,399	2.015	0.074
3409	61068	1,467,973	5.39	182,491	3.675	0.124
3391	61069	1,218,793	7.32	112,366	6.004	0.092
3373	61070	1,023,750	1.48	33,106	1.445	0.032
3364	62985	1,176,645	0.04	30,865	0.033	0.026
3401	63621	1,209,900	8.38	59,058	6.923	0.049
3368	63624	845,679	2.13	145,754	2.523	0.172
3374	63625	893,034	5.01	142,215	5.609	0.159
				Average Ratio	**3.380**	**0.089**

Lastly, maximum refrigeration plant load for all remaining sites, and the average savings ratio shown in Exhibit B-8, were used to leverage savings on a site-by-site basis. Where plant load from the applications was unavailable a mean savings was applied. Exhibit B-9 illustrates the savings determined for all sites.

Exhibit B-9
Refrigerated Case Load to Demand and Energy Impacts

Site ID	Check Number	Maximum Refrigeration Plant Load (Btuh)	Ex-Post Demand Impacts (kW)	Ex-Post Energy Impacts (kWh)
3357	63778	922,192	3.12	82,183
3359	63217	631,950	2.14	56,317
3361	61067	1,300,000	1.80	66,399
3363	63619	1,397,935	4.73	124,579
3364	62985	1,500,000	0.04	30,865
3366	61063	1,698,920	5.74	151,402
3367	63889	785,807	2.66	70,028
3368	63624	2,552,000	2.13	145,754
3371	61065	Missing	3.97	80,039
3372	61061	1,917,000	9.23	134,621
3373	61070	1,150,000	1.48	33,106
3374	63625	2,552,000	5.01	142,215
3378	62526	813,000	2.75	72,452
3379	61064	1,616,460	5.46	144,053
3381	60593	1,895,360	6.41	168,908
3384	63218	1,059,449	3.58	94,415
3386	61057	Missing	3.97	80,039
3388	63627	819,100	2.77	72,995
3389	60590	843,810	2.85	75,198
3391	61069	2,425,000	7.32	112,366
3394	63775	1,001,162	**3.38**	89,220
3395	62761	890,570	3.01	79,365
3399	63216	1,086,600	3.67	96,834
3400	62391	1,019,261	3.45	90,833
3401	63621	1,764,000	8.38	59,058
3402	61060	1,984,500	-2.18	57,576
3403	62390	1,099,662	3.72	97,998
3404	62759	1,658,140	5.60	147,768
3405	61058	1,698,920	5.74	151,402
3407	61756	1,413,333	4.78	125,951
3408	62987	Missing	3.97	80,039
3409	61068	2,425,000	5.39	182,491
3411	60960	1,335,331	4.51	119,000
3412	62986	1,032,700	3.49	92,031
3413	60724	1,774,031	6.00	158,096
3414	63776	1,239,950	4.19	110,500
3415	61066	1,221,500	4.13	108,856
3416	62098	1,916,150	6.48	170,761
5687	63626	1,461,448	4.94	130,239

EMS Control of Refrigerated Case Lights and Anti-Sweat Door Heaters

The Energy Management Systems cycle the anti-sweat heaters and shut off the lighting in the refrigerated case displays during selected periods. This had the effect of directly reducing the energy consumption of the controlled technology, and secondarily reducing the refrigerated case cooling load. Each of these components were calculated in detail.

Case Lights -- Refrigeration case lights were cycled off for 6 to 8 hours per night. This results in an energy savings, although no demand savings can be claimed since all the impacts occur during near-peak or off-peak periods. The connected load for refrigerator case lighting was estimated using applications records for each site. Savings were calculated assuming 7 hours per night reduction in run time. Applications for 3 sites were not available, and therefore these sites were assigned the mean impact from all other stores.

Anti-sweat loads – Anti-sweat heaters are cycled off 50 percent of the time, where anti-sweat heater connected loads are based upon application records for each site. Energy savings were calculated using 12 hours of full load operation per day reduction (i.e., demand savings were determined based on continuous operation at 50 percent of the total connected load). Applications for 3 sites were not available, and therefore these sites were assigned the mean impact from all other stores.

Exhibit B-10 illustrates savings calculated for the EMS control of case lighting and anti-sweat heaters.

Exhibit B-10
Refrigerator EMS Energy and Demand Savings

Site ID	Check Number	Case Lighting Demand Impacts (kW)	Case Lighting Energy Impacts (kWh)	Door Heaters Demand Impacts (kW)	Door Heaters Energy Impacts (kWh)
60590	3389	0	45,990	5.5	48,180
60593	3381	0	48,545	2.5	21,900
60724	3413	0	48,545	6.0	52,560
60960	3411	0	91,980	11.0	96,360
61058	3405	0	127,750	7.5	65,700
61060	3402	0	66,430	4.5	39,420
61061	3372	0	33,215	7.0	61,320
61063	3366	0	28,105	5.5	48,180
61064	3379	0	99,645	2.0	17,520
61066	3415	0	104,755	11.0	96,360
61067	3361	0	38,325	9.0	78,840
61068	3409	0	102,200	10.5	91,980
61069	3391	0	91,214	5.0	43,800
61070	3373	0	66,430	4.5	39,420
61756	3407	0	94,535	13.0	113,880
62098	3416	0	79,205	10.0	87,600
62390	3403	0	38,325	7.0	61,320
62391	3400	0	28,105	7.5	65,700
62526	3378	0	63,875	4.0	35,040
62759	3404	0	22,995	7.5	65,700
62761	3395	0	43,435	1.5	13,140
62985	3364	0	51,100	8.5	74,460
62986	3412	0	84,315	9.5	83,220
63216	3399	0	48,545	14.5	127,020
63217	3359	0	15,151	3.0	26,280
63218	3384	0	63,875	5.5	48,180
63619	3363	0	132,860	6.0	52,560
63621	3401	0	71,540	8.0	70,080
63624	3368	0	22,995	4.6	40,296
63625	3374	0	22,995	3.9	34,164
63626	5687	0	38,325	9.5	83,220
63627	3388	0	33,215	8.0	70,080
63775	3394	0	56,210	4.0	35,040
63776	3414	0	86,870	11.0	96,360
63778	3357	0	28,105	9.5	83,220
63889	3367	0	22,995	4.0	35,040
62987	3408	0	59,519	7.0	61,198
61065	3371	0	59,519	7.0	61,198
61057	3386	0	59,519	7.0	61,198
	Totals	0	2,321,258	272	2,386,735

Indirect Cooling Savings -- The reduction of lighting and anti-sweat loads, within the refrigerated display cases, has an indirect effect of reducing compressor and condenser energy usage. The reduction in gains for both of these heat sources were calculated separately.

- To calculate refrigerated case impacts (due to refrigerated case lighting controls), the following assumptions were made:

  All energy serving the lights is assumed to dissipate in the form of heat -- thus the reduction of lighting energy relates directly to a reduction in refrigerated case load.

  Cycling of display lights at night has no impact on peak demand savings.

  Lighting energy savings in kW were converted to BTU when determining the reduction in refrigerated case loads.

- To calculate refrigerated case impacts (due to refrigerated case anti-sweat controls), the following assumptions were made:

  It was assumed that fifty percent of the anti-sweat gains are dissipated into the store and the other fifty percent to the refrigerated case. Thus reduced heat load resulting from anti-sweat cycling contributes only half of that heat for secondary load reduction in compressor and condenser energy usage.

  In contrast to application records (where anti-sweat heater cycling only contributes to energy savings), ex post demand savings were also calculated.

The savings due to the reduction in the refrigeration load were determined by computing the level of energy and demand associated with the refrigeration load (Btuh) at each of ten sites. As illustrated in Exhibit B-11 the ten sites previously analyzed in the Condenser Recircuit measure were used to determine a ratio of refrigerator load to kW demand, and to annual kWh use. This ratio was applied to the reduced load for each site in order to determine the reduction in energy and demand. Energy impacts were calculated using the combined load reduction for heaters and lighting. Demand impacts were calculated using the load reduction for heaters only.

Exhibit B-11
Refrigeration Load vs. Demand and Energy

Site	Maximum Refrigeration Plant Load *(Btuh)*	Maximum AC Load *(Btuh)*	Refrigeration Load *(Cooling Load - AC Load)*	Refrigeration Demand (kW)	Refrigeration Energy *(kWh/year)*	Demand Fraction *(kW per Btuh)*	Energy Fraction *(kWh per Btuh)*
3402	1,114,540	37	670,540	86	458,947	0.0001276	0.684443
3372	1,226,259	40	746,259	97	519,727	0.0001300	0.696444
3361	894,449	30	534,449	61	356,563	0.0001150	0.667160
3409	1,467,973	40	987,973	123	668,919	0.0001244	0.677062
3391	1,218,793	40	738,793	86	450,145	0.0001164	0.609297
3373	1,023,750	30	663,750	102	613,255	0.0001538	0.923925
3364	1,176,645	40	696,645	101	548,749	0.0001457	0.787703
3401	1,209,900	40	729,900	89	466,761	0.0001226	0.639486
3368	845,679	20	605,679	103	460,705	0.0001706	0.760643
3374	893,034	20	653,034	113	425,451	0.0001738	0.651499
		Total	7,027,022	963	4,969,223	0.0001370	0.707159

Heat Reclaim

One site claimed savings for a heat reclaim retrofit. Waste heat from the refrigerators are used to heat water, where the water heater element has been disconnected. Energy savings for this retrofit represented an annual operating factor of 50 percent. Given that no telephone or on-site audit data were gathered for this customer, this figure was determined to be acceptable. Demand savings claimed in the application were equivalent to the connected load of the equipment. This was not consistent with a 50 percent operating factor, and therefore savings were adjusted downward by this ratio.

Supermarket Refrigeration Summary of Findings

Total evaluation impacts for each retrofit measure installed at these supermarkets are illustrated in Exhibit B-12. Evaluation energy impacts were 6 percent higher than those claimed in the MDSS, while evaluation demand impacts were 17 percent lower than claimed in the MDSS. A portion of the demand impacts claimed in the application were dismissed due to errors in the calculation or summary. Evaluation demand savings included anti-sweat heater EMS impacts which were not claimed in the application.

Exhibit B-12
MDSS, Detailed Application, and Evaluation Savings

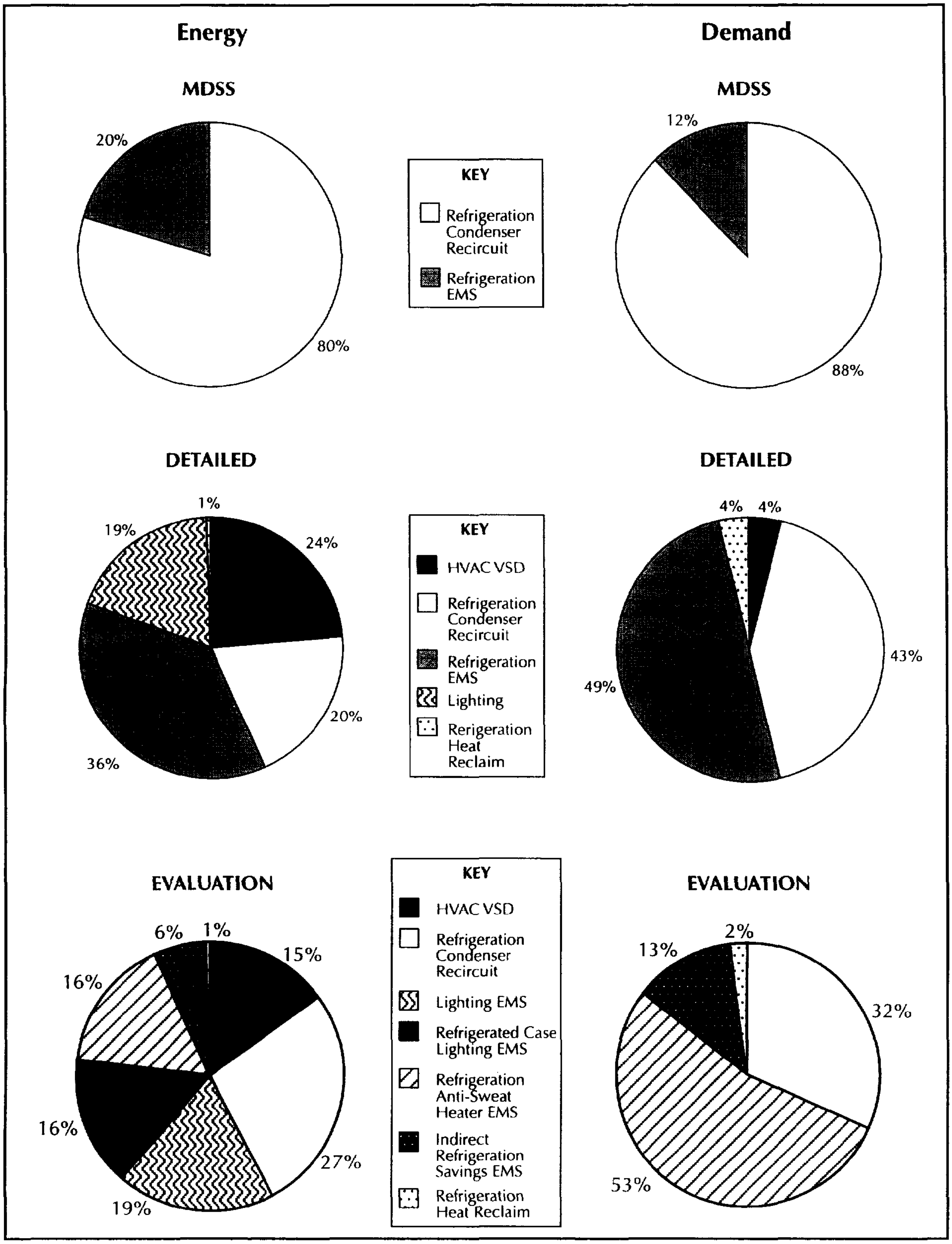


Exhibit B-13 details the overall MDSS record versus the gross unadjusted evaluation impacts by action code.

Exhibit B-13
MDSS vs. Evaluation

Action Code	MDSS Demand (kW)	Evaluation Demand (kW)	MDSS Energy (kWh)	Evaluation Energy (kWh)
453	74.3	109	2,808,306	2,859,899
489	531.5	397	11,021,897	11,823,334

B.4.2 Customized Incentives Program—Other Applications

Detailed calculations supporting the remaining 14 applications submitted under the Customized Incentives Program are presented in *Section B.6.3*. The application review and evaluation impact calculations submitted in that section are not intended to be stand-alone documents, but should be reviewed in conjunction with the application records themselves.

B.5 DETAILED METHODS USED TO DEVELOP RETROFIT EXPRESS ENGINEERING ESTIMATES

This section contains detailed information regarding the development of impacts for each RE measure, and is presented according to the following: 1) for each measure, a written summary provides an overview of the algorithm review, and 2) detailed calculations used in the analysis are provided.

B.6 DETAILED METHODS USED TO DEVELOP CUSTOMIZED INCENTIVES ENGINEERING ESTIMATES

This section contains detailed information regarding the development of impacts for each Customized Incentives application, and is presented according to the following: 1) for each application, a written summary provides a synopsis of the application review process, and 2) detailed supporting evaluation calculations are provided.

Appendix B.5
Detailed Standard Measure Engineering Calculations

Measure A: Night Covers for Display Cases

Measure Description:	This measure provides a film or blanket night cover for open vertical or open tub display cases. The target market for this measure is small grocery stores which restock during the day.
Summary of Advice Filing Calculations:	Energy estimates were derived using an Excel spreadsheet that was developed by the PG&E Mechanical and Nuclear Engineering Department. No demand impacts were calculated as the retrofit only affects off-peak hours.
Comments on Advice Filing Calculations:	The cited spreadsheet was not included with the other technical documents, and so the Advice Filing method could not be evaluated.
Comments on Advice Filing Inputs:	Inputs were taken from manufacture's data. There is no reason to doubt the validity of this data.
Evaluation Process:	An Evaluation estimate was not developed.
Additional Notes:	

A) Night Covers for Display Cases

1) Provide film or blanket night covers on open display cases.

The target market for this measure is smaller grocery stores who restock during the day.
Eligible units are open vertical stand-up display cases, of the single- or double-air curtain front design, and tub cases

2) Advice Filing Method:

Case Type	Percent of Participation	Cover Type	Energy Savings (kWh/yr-ft)	Weighted (kWh/yr-ft)
LT Multideck	4%	film	329	9.87
		blanket	370	3.70
MT Multideck	70%	film	143	75.08
		blanket	161	28.18
HT Multideck	8%	film	75	4.50
		blanket	84	1.68
LT Coffin	14%	film	85	8.93
		blanket	95	3.33
MT Coffin	4%	film	33	0.99
		blanket	37	0.37
			average = 136.61	

No demand impacts are estimated because covers are generally deployed at night, during non-business hours.

3) Evaluation Estimate:

All information used in the calculations are from manufacturer's data.
No reason to doubt validity, and unable to locate alternate sources.
Recommend using Advice Filing Estimates.

4) Summary of Results:

Impact Type (per linear foot)	Impact		Recommended Source
	Advice Filing	Evaluation	
NC Demand (kW)	0	NA	Advice Filing
Coinc. Demand (kW)	0	NA	Advice Filing
Annual Energy (kWh)	137	NA	Advice Filing

Measure B: Strip Curtains for Walk-in

Measure Description:	Installation of strip curtains on doorways to walk-in coolers. This reduces infiltration when the door is open.
Summary of Advice Filing Calculations:	Impacts were derived using PG&E Application Note 53-31-81 and some "conservative assumptions". Inputs included air changes per day and the change in enthalpy of the entering air.
Comments on Advice Filing Calculations:	The method used was inconsistent with the impacts developed for other measures that reduce infiltration, such as the Auto-Closer and Door Gasket measures for coolers and freezers. These programs use an ASHRAE method to calculate impacts.
Comments on Advice Filing Inputs:	According to the Advice Filing, the strip curtains were 65% effective in reducing infiltration. ASHRAE methods estimate that strip curtains in good condition are 80% to 95% effective in reducing infiltration.
Evaluation Process:	Energy and demand impacts were developed using the ASHRAE method and modified inputs.
Additional Notes:	The Advice Filing method grossly underestimates the energy and demand impacts of this measure. The Evaluation energy estimate is approximately ten times greater than the Advice Filing estimate.

B) Strip Curtains for Walk-in

1) Install strip curtains for walk-in coolers and refrigerated warehouses.

2) Ex-ante assumptions:

Average EER is 7.0
Door area is 3' x 7' or 21sqft
Ave air infiltration rate is 75 cuft/min
Volume of walk-in is 1,500 cuft
Ave walk-in temp is 30F
Ave indoor temp is 75 F
Relative humidity is 50%
11 air changes per day
Strip curtains assumed to be 65% effective at blocking infiltration.

3) Advice Filing Estimates:

Energy Savings:

Advice Filing uses PG&E Application Note 53-31-81 and makes "some conservative assumptions".

Q = I x H x 365 days/yr

where:
Q = loads due to infiltration (kBtu/yr)
I = volume of infiltrated air (volume x air changes per day)
= 16,500 cuft/day
H = enthalpy change per cuft of entering air
= 1.39 Btu/cuft

Q = (16,500 cuft/day) x (1.39 Btu/cuft) x 365 days/yr
= 8,371,275
= 8,371 kBtu/yr
adjust to kWh = 8,371 kBtu/yr x (1/7.0 Btu/Watt)
= 1,196
= 1,196 kWh/yr
Savings due to Curtains:
= 65% x 1,196 kWh/yr
= 777
= 777 kWh/yr
Adjust to sqft = (777 kWh/yr)/21 sqft
= 37
= 37 kWh/sqft-yr

Non-coincident Demand Savings:

= (37 kWh/yr-sqft)/(5,708 EFLH/yr)
= 0.00648
= 0.00648 kW/sqft

Coincident Demand Savings:

= (0.00648 kW/sqft) x 0.54 CDF
= 0.00350
= 0.0035 kW/sqft
Although the advice filing methods apply a diversity factor of 0.54, a more reasonable CDF would be 0.65.
= (5,708 EFLH/yr)/8,760 hrs/yr
= 0.65

4) **Evaluation Estimates:**

Non-coincident Demand Savings:

Infiltration by air exchange, according to ASHRAE* p.26.3.

qt = 3,790 x W x H^1.5 x (Q/A) x (1/R) x Dt x Df x (1-E)

where:

qt = average heat gain in a period (Btu/h)
W = door width
H = door height
Q/A = sensible heat load of infiltration per square foot of doorway
R = sensible heat ratio of the infiltration air heat gain
Dt = door open time factor
Df = door flow factor
E = effectiveness of doorway protective device (0 = unobstructed doorway)
ASHRAE* assumes that a strip curtain is 80% to 95% effective in reducing infiltration.

The cooler impact is initially calculated with the assumption that the door is left open for an entire hour.

Dt = 1.0
Df = 0.8 flow factor
E = 65% according to Advice Filing p. RF-17
Q/A = 0.16 tons/sqft according to ASHRAE* Fig. 3, p. 26.4
R = 0.59 according to ASHRAE* Table 7, p. 26.4

Baseline Loads (cooler) = 3,790 x 3ft x (7^1.5ft) x (0.16 tons/sqft) x (1/0.59) x 80% x 1.0 x (1-0)
= 45,684
Baseline Demand (cooler) = (45,648 Btuh)*(1ton/12,000 Btuh)*(1.6 kW/ton)
= 6.086
= 6.086 kW
This is a theoretical calculation, and assumes that a door would be left open for an entire hour.

Retrofit Loads (cooler) = 3,790 x 3ft x (7^1.5ft) x (0.16 tons/sqft) x (1/0.59) x (80% flow factor) x (1 - 65%)
= 15,989
Retrofit Demand (cooler) = (15,989 Btuh) x (1ton/12,000 Btuh) x (1.6 kW/ton)
= 2.132
= 2.132 kW
Again, this impact assumes that the cooler door is left open for an entire hour.

NC Demand Savings (cooler) = 6.086 kW - 2.132 kW
= 3.954
= 3.954 kW
Again, this impact assumes that the cooler door is left open for an entire hour.

The freezer impact is initially calculated with the assumption that the door is left open for an entire hour.
Q/A = 0.61 tons/sqft according to ASHRAE* Fig. 3, p. 26.4
R = 0.63 according to ASHRAE* Table 7, p. 26.4
Baseline Loads (freezer) = 3,790 x 3ft x (7^1.5ft) x (0.61 tons/sqft) x (1/0.63) x 80% x 1.0 x (1-0)
= 163,112
Baseline Demand (freezer) = (163,112 Btuh)*(1ton/12,000 Btuh)*(2.4 kW/ton)
= 32.622
= 32.622 kW
Again, this impact assumes that the freezer door is left open for an entire hour.

Retrofit Loads (freezer) = 3,790 x 3ft x (7^1.5ft) x (0.61 tons/sqft) x (1/0.63) x 80% x 1.0 x (1-65%)
= 57,089
Retrofit Demand (freezer) = (57,089 Btuh)*(1ton/12,000 Btuh)*(2.4 kW/ton)
= 11.418
= 11.418 kW

NC Demand Savings (freezer) = 32.622 kW - 11.418 kW
= 21.205
= 21.205 kW
Again, this impact assumes that the freezer door is left open for an entire hour.

Average NC Demand Savings:
= (3.954 kW x 80%) + (21.205 kW x 20%)
= 7.404
= 7.404 kW/21 sqft
= 0.353
= 0.353 kW/sqft

Energy Savings:
Assumptions:
50% of participants are grocery stores, and another 30% are split between warehouse and misc. commercial
Business hours are assumed to be 20 hours / day seven days a week
Walk-in doors are open 3 hours a day, according to Advice Filing estimates for Auto-Closer on Cooler or Freezer p. RF-76
Annual hours doors purposefully open = 1,095
80% of installations are coolers, 20% freezers, assumption used by Advice Filing estimates for Auto-Closer on Cooler or Freezer p.RF-76

Average Energy Savings = [(3.954 kW x 80%) + (21.205 kW x 20%)] x 1,095 hrs/yr
= 8,108
= (8,108 kWh/yr)/(21 sqft)
= 386
= 386 kWh/yr-sqft

Coincident Demand Savings:

Assume savings are spread across and entire year.

= (386 kWh/yr-sqft).8,760 hrs/yr

= 0.0441

= 0.0441 kWh/yr-sqft

5) Summary of Results:

Impact Type (per square foot)	Impact		Recommended Source
	Advice Filing	Evaluation	
NC Demand (kW)	0.0065	0.353	Evaluation
Coinc. Demand (kW)	0.0035	0.0441	Evaluation
Annual Energy (kWh)	37	386	Evaluation

6) Sources:

* ASHRAE Handbook, "Refrigeration Systems and Applications"; American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. Atlanta, GA, 1994

Measure C: Glass or Acrylic Doors (Low Temperature Case)

Measure Description:	Installation of glass or acrylic doors on existing open multideck low temperature refrigeration cases, in order to reduce infiltration.
Summary of Advice Filing Calculations:	Direct energy and demand impacts were calculated using connected load and case load values from Competitek.
Comments on Advice Filing Calculations:	Direct demand savings associated with case load reduction were used with no supporting calculations provided. No indirect impacts were developed.
Comments on Advice Filing Inputs:	While the baseline case load values were verified with alternate sources, the retrofit impacts underestimate potential savings. Additionally, indirect impacts were not estimated.
Evaluation Process:	Direct and indirect impacts were determined using case loads, evaporator fan connected loads, and anti-sweat heater loads.
Additional Notes:	Evaluation results suggest that the Advice Filing methods underestimate the energy and demand impacts for this measure by approximately 65% and 99%, respectively.

C) Glass or Acrylic Doors (Low Temperature Case)

1) **Installation of glass or acrylic doors on existing open multideck low temperature refrigeration cases.**

2) **Ex-ante calculation assumptions:**

50% of the replaced systems are multiplex and the other 50% are conventional systems.
Low temperature conventional systems will save 3.19 kWh/day-ft of display (35% of baseline).
Low temperature multiplex systems will save 1.71 kWh/day-ft of display (27% of baseline).
Annual operating hours for a refrigeration system is 5,708 hours/yr.
Baseline case load is 1,425 Btuh-ft
EER for low temp case is 4.43.

3) **Advice Filing Estimates:**

Baseline Case Load:

= [(1425 Btu/hr-ft)/(4.43 Btu/W-hr)] x (8,760 hrs/yr) x (1 kW/1,000Watts)
= 2818
= 2,818 kWh/yr-ft
Advice Filing p.RF-8 lists 2,820 kWh/yr-ft, assume rounding.

Energy Savings:

Average daily savings = (3.19 kWh/day-ft +1.71 kWh/day-ft)/2
= 2.45
Average annual savings = (2.45 kWh/day-ft) x (365 days/yr)
= 894.25
= 894 kWh/yr-ft

Case Load Savings:

The following calculation was not done in the Advice Filing, but was done in the Evaluation for purposes of comparison
= (894 kWh/yr-ft) x 4.43 Btu/Watt-hr
= 3960.42
= (3,960 kBtu/yr-ft) x (1 yr/365 days) x (1 day/24 hrs) x (1,000 Btu /1 kBtu)
= 452
= 452 Btu/hr-ft, a 31.7% savings over the baseline

Non-coincident Demand Savings:

= (894 kWh/yr-ft)/(5,708 full load hours/yr)
= 0.157
= 0.157 kW/ft

Coincident Demand Savings:

= 0.54 CDF x 0.157 kW/ft
= 0.0848

= 0.0848 kW/ft
The Advice Filing lists 0.0846 kW/ft, difference assumed to be rounding.
The Advice Filing uses a CDF of 0.54, which is not appropriate.
A more reasonable value is (5,708 EFLH/yr)/(8,760 hrs/yr) = 0.65

4) Evaluation Estimates:

Evaluation Assumptions:

Unless otherwise stated all values taken from EPRI report TR-100984, V1†.
Baseline design case load is 1,400 Btuh/ft
Retrofit design case load is 560 Btuh/ft
Average EER for a low temp case is 4.3 Btuh/Watt
Baseline anti-sweat energy use is 13 Watts/hr-ft
Retrofit anti-sweat energy use is 25 Watts/hr-ft
Baseline fan energy use is 70 Watts/hr-ft
Retrofit fan energy use is 19 Watts/hr-ft

Baseline Case Load:
= (1400 Btu/hr-ft)/(4.3 Btu/W-hr)
= 326
= (326 Watts/ft) x (24 hr/day) x (365 days/yr) x (1 kW/1,000Watts)
= 2856
= 2,856 kWh/yr-ft

Retrofit Case Load:
= (560 Btu/hr-ft)/(4.3 Btu/W-hr)
= 130
= (130 Watts/ft) x (8,760 hrs/yr) x (1 kW/1,000Watts)
= 1,139
= 1,139 kWh/yr-ft, case load only

Indirect Case Load:
Anti-sweat Energy Impacts = (13 Watts/hr-ft - 25 Watts/hr-ft)
= -12
= (-12 Watts/hr-ft) x (24 hrs/day) x (365 days/yr) x (1 kW/1,000 Watts) x 1.0 CDF
= -105
= -105 kWh/yr-ft
Evap. Fan Energy Impacts = (70 Watts/hr-ft - 19 Watts/hr-ft)
= 51
= (51 Watts/hr-ft) x (24 hrs/day) x (365 days/yr) x (1 kW/1,000 Watts) x 0.65 CDF
= 290
= 290 kWh/yr-ft

Energy Savings:

Average case load is stated to be 75% of the design load, according to EPRI report TR-100984, V1†.

Total Annual Savings = 0.75 x [(2,856 kWh/yr-ft) - 1,139 kWh/yr-ft] + [(290 kWh/yr-ft) -(105 kWh/yr-ft)]
= 1473
= 1,473 kWh/yr-ft
This is not comparable to the 894 kWh savings supported by Advice Filing Methods.
Recommend using Evaluation estimate, as indirect impacts are taken into account.

Non-coincident Demand Savings:
= (1,473 kWh/yr-ft)/(5,708 full load hours/yr)
= 0.258
= 0.258 kW/ft
Recommend using Evaluation estimate, as indirect impacts are taken into account.

Coincident Demand Savings:
Energy savings are assumed to be spread evenly across the entire year.
= (1,473 kWh/yr-ft)/(8,760 hours/yr)
= 0.168
= 0.168 kW/ft
The actual coincident demand can reasonably be assumed to be within the range of 0.258 kW/ft to 0.168 kW/ft, and may be closer to 0.258 kW/ft.
Recommend using Evaluation estimate, as indirect impacts are taken into account.

5) Summary of Results:

Impact Type (per linear foot)	Impact		Recommended Source
	Advice Filing	Evaluation	
NC Demand (kW)	0.157	0.258	Evaluation
Coinc. Demand (kW)	0.0846	0.168	Evaluation
Annual Energy (kWh)	894	1,473	Evaluation

6) Sources:

† EPRI report TR-100984, V1, "Engineering Methods for Estimating the Impacts of Demand-Side Management Programs";
Volume 1: Fundamentals of Engineering Simulations for Residential and Commercial End Uses; Electric Power Research Institute, Palo Alto, CA, 1992.

Measure D: New Refrigeration Case with Doors (Low Temperature Case)

Measure Description:	Replacement of existing open multideck low temperature refrigeration display cases, with multideck display cases with doors.
Summary of Advice Filing Calculations:	Direct energy and demand impacts were calculated using connected load and case load values from Competitek.
Comments on Advice Filing Calculations:	Direct demand savings associated with case load reduction were used with no supporting calculations provided. No indirect impacts were developed.
Comments on Advice Filing Inputs:	While the baseline case load values were verified with alternate sources, the retrofit impacts underestimate potential savings. Additionally, indirect impacts were not estimated.
Evaluation Process:	Direct and indirect impacts were determined using case loads, evaporator fan connected loads, and anti-sweat heater loads.
Additional Notes:	Evaluation results suggest that the Advice Filing methods underestimate the energy and demand impacts for this measure by approximately 65% and 99%, respectively.

D. New Refrigeration Case with Doors (Low Temperature Case):

1) **Replacement of existing open multideck low temperature refrigeration cases.**
Retrofits are low temperature case refrigeration with doors.

2) **Ex-ante calculation assumptions:**
50% of the replaced systems are multiplex and the other 50% are conventional systems.
Low temperature conventional systems will save 3.19 kWh/day-ft of display (35% of baseline).
Low temperature multiplex systems will save 1.71 kWh/day-ft of display (27% of baseline).
Annual operating hours for a refrigeration system is 5,708 hours/yr.
Baseline case load is 1,425 Btuh-ft
EER for low temp case is 4.43.

3) **Advice Filing Estimates:**

Baseline Case Load:

	= [(1425 Btu/hr-ft)/(4.43 Btu/W-hr)] x (8,760 hrs/yr) x (1 kW/1,000Watts)
	= 2818
	= 2,818 kWh/yr-ft
	Advice Filing p.RF-8 lists 2,820 kWh/yr-ft, assume rounding.

Energy Savings:

Average daily savings	= (3.19 kWh/day-ft +1.71 kWh/day-ft)/2
	= 2.45
Average annual savings	= (2.45 kWh/day-ft) x (365 days/yr)
	= 894.25
	= 894 kWh/yr-ft

Case Load Savings:

	The following calculation was not done in the Advice Filing, but was done in the Evaluation for purposes of comparison
	= (894 kWh/yr-ft) x 4.43 Btu/Watt-hr
	= 3960.42
	= (3,960 kBtu/yr-ft) x (1 yr/365 days) x (1 day/24 hrs) x (1,000 Btu /1 kBtu)
	= 452
	= 452 Btu/hr-ft, a 31.7% savings over the baseline

Non-coincident Demand Savings:

	= (894 kWh/yr-ft)/(5,708 full load hours/yr)
	= 0.157
	= 0.157 kW/ft

Coincident Demand Savings:

	= 0.54 CDF x 0.157 kW

= 0.0848
= 0.0848 kW/ft
The Advice Filing lists 0.0846 kW/ft, difference assumed to be rounding.
The Advice Filing uses a CDF of 0.54, which is not appropriate.
A more reasonable value is (5,708 EFLH/yr)/(8,760 hrs/yr) = 0.65

4) Evaluation Estimates:

Evaluation Assumptions:

Unless otherwise stated all values taken from EPRI report TR-100984, V1†.
Baseline design case load is 1,400 Btuh/ft
Retrofit design case load is 560 Btuh/ft
Average EER for a low temp case is 4.3 Btuh/Watt
Baseline anti-sweat energy use is 13 Watts/hr-ft
Retrofit anti-sweat energy use is 25 Watts/hr-ft
Baseline fan energy use is 70 Watts/hr-ft
Retrofit fan energy use is 19 Watts/hr-ft

Baseline Case Load:
= (1400 Btu/hr-ft)/(4.3 Btu/W-hr)
= 326
= (326 Watts/ft) x (24 hr/day) x (365 days/yr) x (1 kW/1,000Watts)
= 2856
= 2,856 kWh/yr-ft

Retrofit Case Load:
= (560 Btu/hr-ft)/(4.3 Btu/W-hr)
= 130
= (130 Watts/ft) x (8,760 hrs/yr) x (1 kW/1,000Watts)
= 1,139
= 1,139 kWh/yr-ft, case load only

Indirect Case Load:
Anti-sweat Energy Impacts = (13 Watts/hr-ft - 25 Watts/hr-ft)
= -12
= (-12 Watts/hr-ft) x (24 hrs/day) x (365 days/yr) x (1 kW/1,000 Watts) x 1.0 CDF
= -105
= -105 kWh/yr-ft
Evap. Fan Energy Impacts = (70 Watts/hr-ft - 19 Watts/hr-ft)
= 51
= (51 Watts/hr-ft) x (24 hrs/day) x (365 days/yr) x (1 kW/1,000 Watts) x 0.65 CDF
= 290
= 290 kWh/yr-ft

Energy Savings:

Average case load is stated to be 75% of the design load, according to EPRI report TR-100984, V1†.

Total Annual Savings = 0.75 x [(2,856 kWh/yr-ft) - 1,139 kWh/yr-ft] + [(290 kWh/yr-ft) -(105 kWh/yr-ft)]
= 1473
= 1,473 kWh/yr-ft
This is not comparable to the 894 kWh savings supported by Advice Filing Methods.
Recommend using Evaluation estimate, as indirect impacts are taken into account.

Non-coincident Demand Savings:
= (1,473 kWh/yr-ft)/(5,708 full load hours/yr)
= 0.258
= 0.258 kW/ft
Recommend using Evaluation estimate, as indirect impacts are taken into account.

Coincident Demand Savings:
Energy savings are assumed to be spread evenly across the entire year.
= (1,473 kWh/yr-ft)/(8,760 hours/yr)
= 0.168
= 0.168 kW/ft
The actual coincident demand can reasonably be assumed to be within the range of 0.258 kW/ft to 0.168 kW/ft, and may be closer to 0.258 kW/ft.
Recommend using Evaluation estimate, as indirect impacts are taken into account.

5) Summary of Results:

Impact Type (per linear foot)	Impact		Recommended Source
	Advice Filing	Evaluation	
NC Demand (kW)	0.157	0.258	Evaluation
Coinc. Demand (kW)	0.0846	0.168	Evaluation
Annual Energy (kWh)	894	1,473	Evaluation

6) Sources:

† EPRI report TR-100984, V1, "Engineering Methods for Estimating the Impacts of Demand-Side Management Programs";
Volume 1: Fundamentals of Engineering Simulations for Residential and Commercial End Uses; Electric Power Research Institute, Palo Alto, CA, 1992.

Measure E: New Refrigeration Case with Doors (Medium Temperature Case)

Measure Description:	Replacement of existing open multideck medium temperature refrigeration display cases, with multideck display cases with doors.
Summary of Advice Filing Calculations:	Direct energy and demand impacts were calculated using connected load and case load values from Competitek.
Comments on Advice Filing Calculations:	Direct demand savings associated with case load reduction were used with no supporting calculations provided. No indirect impacts were developed.
Comments on Advice Filing Inputs:	While the baseline case load values were verified with alternate sources, the retrofit impacts underestimate potential savings. Additionally, indirect impacts were not estimated.
Evaluation Process:	Direct and indirect impacts were determined using case loads, evaporator fan connected loads, and anti-sweat heater loads.
Additional Notes:	Evaluation results suggest that the Advice Filing methods underestimate the energy and demand impacts for this measure by approximately 17% and 41%, respectively.

E. New Refrigeration Case with Doors (Medium Temperature Case):

1) **Replacement of existing open multideck low temperature refrigeration cases.**
Retrofits are medium temperature case refrigeration with doors.

2) **Ex-ante calculation assumptions:**
50% of the replaced systems are multiplex and the other 50% are conventional systems.
Medium temperature conventional systems will save 1.29 kWh/day-ft of display (35% of baseline).
Actual calculation = (1.29 kWh/ft-day)/(4.54 kWh/ft-day) = 28%
Medium temperature multiplex systems will save 0.61 kWh/day-ft of display (27% of baseline).
Actual calculation = (0.61 kWh/ft-day)/(3.2 kWh/ft-day) = 19%
Annual operating hours for a refrigeration system is 5,708 hours/yr.
Baseline case load is 1,380 Btuh-ft
EER for medium temp case is 8.66

3) **Advice Filing Estimates:**

Baseline Case Load:

= [(1,380 Btu/hr-ft)/(8.66 Btu/W-hr)] x (8,760 hrs/yr) x (1 kW/1,000Watts)
= 1,396
= 1,396 kWh/yr-ft

Energy Savings:

Average daily savings = (1.29 kWh/day-ft + 0.61 kWh/day-ft)/2
= 0.95
Advice Filing lists 0.945 kWh/day-ft which is mathematically incorrect.
Average annual savings = (0.95 kWh/day-ft) x (365 days/yr)
= 346.75
= 347 kWh/yr-ft
345 kWh/yr-ft was calculated in the Advice Filing, (p.RF-26) due to using 0.945 kWh/ft-day as an input

Case Load Savings:

The following calculation was not done in the Advice Filing, but was done in the Evaluation for purposes of comparison
= (347 kWh/yr-ft) x 8.66 Btu/Watt-hr
= 3,005
= (3,005 kBtu/yr-ft) x (1 yr/365 days) x (1 day/24 hrs) x (1,000 Btu /1 kBtu)
= 343
= 343 Btu/hr-ft, a 24.6% savings over the baseline

Non-coincident Demand Savings:

= (347 kWh/yr-ft)/(5,708 full load hours/yr)
= 0.061
= 0.061 kW/ft

Advice Filing estimate is 0.0604 (p.RF-26) due to using 347 kWh/yr-ft as an input.

Coincident Demand Savings:

= 0.54 CDF x [(347 kWh/yr-ft)/(5,708 full load hours/year)]
= 0.0328
= 0.0328 kW/ft
Advice Filing estimate is 0.0326 (p.RF-26) due to using 347 kWh/yr-ft as an input.
The Advice Filing uses a CDF of 0.54, which is not appropriate.
A more reasonable value is (5,708 EFLH/yr)/(8,760 hrs/yr) = 0.65

4) Evaluation Estimates:

Evaluation Assumptions:

Unless otherwise stated all values taken from EPRI report TR-100984, V1†.
Baseline design case load is 1,400 Btuh/ft
Retrofit design case load is 550 Btuh/ft
Average EER for a med temp case is 8.6 Btuh/Watt
Baseline anti-sweat energy use is 0 Watts/hr-ft
Retrofit anti-sweat energy use is 23 Watts/hr-ft
Baseline fan energy use is 12 Watts/hr-ft
Retrofit fan energy use is 20 Watts/hr-ft

Baseline Case Load:

= (1400 Btu/hr-ft)/(8.6 Btu/W-hr)
= 163
= (163 Watts/ft) x (24 hr/day) x (365 days/yr) x (1 kW/1,000Watts)
= 1428
= 1,428 kWh/yr-ft

Retrofit Case Load:

= (550 Btu/hr-ft)/(8.6 Btu/W-hr)
= 64
= (64 Watts/ft) x (8,760 hrs/yr) x (1 kW/1,000Watts)
= 561
= 561 kWh/yr-ft, case load only

Indirect Case Load:

Anti-sweat Energy Impacts = (0 Watts/hr-ft - 23 Watts/hr-ft)
= -23
= (-23 Watts/hr-ft) x (24 hrs/day) x (365 days/yr) x (1 kW/1,000 Watts) x 1.0 CDF
= -201
= -201 kWh/yr-ft

Evap. Fan Energy Impacts = (12 Watts/hr-ft - 20 Watts/hr-ft)
= -8
= (-8 Watts/hr-ft) x (24 hrs/day) x (365 days/yr) x (1 kW/1,000 Watts) x 0.65 CDF
= -46

= -46 kWh/yr-ft

Energy Savings:

Average case load is stated to be 75% of the design load, according to EPRI report TR-100984, V1†.

Total Annual Savings = 0.75 x [(1,428 kWh/yr-ft) - 561 kWh/yr-ft] + [(-201 kWh/yr-ft) -(46 kWh/yr-ft)]
= 403
= 403 kWh/yr-ft
This is not comparable to the 345 kWh/yr-ft savings supported by Advice Filing Methods.
Recommend using Evaluation estimate, as indirect impacts are taken into account.

Non-coincident Demand Savings:
= (403 kWh/yr-ft)/(5,708 full load hours/yr)
= 0.0706
= 0.0706 kW/ft
Recommend using Evaluation estimate, as indirect impacts are taken into account.

Coincident Demand Savings:
Energy savings are assumed to be spread evenly across the entire year.
= (403 kWh/yr-ft)/(8,760 hours/yr)
= 0.0460
= 0.0460 kW/ft
The actual coincident demand can reasonably be assumed to be within the range of 0.0706 kW/ft to 0.0460 kW/ft, and may be closer to 0.0706 kW/ft.
Recommend using Evaluation estimate, as indirect impacts are taken into account.

5) Summary of Results:

Impact Type (per linear foot)	Impact		Recommended Source
	Advice Filing	Evaluation	
NC Demand (kW)	0.0604	0.0706	Evaluation
Coinc. Demand (kW)	0.0326	0.0460	Evaluation
Annual Energy (kWh)	345	403	Evaluation

6) Sources:

† EPRI report TR-100984, V1, "Engineering Methods for Estimating the Impacts of Demand-Side Management Programs";
Volume 1: Fundamentals of Engineering Simulations for Residential and Commercial End Uses; Electric Power Research Institute, Palo Alto, CA, 1992.

Measure F: Low Heat/No Heat Refrigeration Case Doors

Measure Description:	Provides an incentive to customers to request energy efficient low heat/no heat case doors when they purchase a new display case.
Summary of Advice Filing Calculations:	Direct and indirect energy impacts were developed using the compressor efficiency and the connected load associated with door heaters.
Comments on Advice Filing Calculations:	The method used to develop indirect impacts is inconsistent with those used for similar measures in the Advice Filing. The Humidistat Control measure, for example, uses an alternate approach (as recommended by LBL following a review of the measure). This recommendation should be adopted across all measures to ensure consistency in the methods applied.
Comments on Advice Filing Inputs:	Inputs are based upon manufactures' data and appear valid.
Evaluation Process:	Direct and indirect impacts were determined. Indirect impacts were estimated using the methods recommended by LBL.
Additional Notes:	The indirect impacts calculated in the Advice Filing were greater than the direct impacts. This result is incorrect.

F) Low Heat/No Heat Refrigeration Case Door

1) Provide incentive to customers to request low heat/no heat doors at time of new display case purchase.

Glass heaters are included on display case doors to eliminate condensation.
Advanced designs incorporate heat-reflective coatings, gas inserted between panes, non-metallic spacers of the panes, and non-metallic frames.

2) Ex-ante assumptions:

Two manufacturers were cited, Anthony (60% of the market) and Ardco (40% of the market).
50% of participation will be with low temperature cases, and the other 50% medium temperature cases.
80% of cases will be equipped with humidistat controls.
Humidistat control will turn off glass heaters 50% of the time.
Compressor efficiency med temp. = 7.5 EER
Compressor efficiency low temp. = 5.0 EER

3) Advice Filing Estimates:

Medium Temperature Cases

Manufacturer = Anthony						
	Model 400	Model 1000R	Average (400, 100R)	EE-Model 1200	Base - EE amps/ft	Market Share
Amps	8.235	5.895	7.065	2.948	4.117	60%
Length (ft)	25.2	25.2	25.2	25.2		
amps/ft	0.327	0.234	0.280	0.117	0.163	
Manufacturer = Ardco						
	Model Vanguard	Model Swingline	Average (Vang, Swing)	EE-Model Enertech	Base - EE amps/ft	Market Share
Amps	7.730	5.670	6.7	3.067	3.633	40%
Length (ft)	25	25	25	25		
amps/ft	0.309	0.227	0.268	0.123	0.145	

Advice Filing, p. RF-31

total = 0.156
= 0.156 amps/ft

Low Temperature Cases

Manufacturer = Anthony						
	Model 600	Model	Average 600	EE-Model 100	Base - EE amps/ft	Market Share

Amps Length (ft) amps/ft	30.893 25.2 1.226		30.893 25.2 1.226	22.76 25 0.910	8.133 0.316	60%
Manufacturer = Ardco						
	Model Vanguard	Model Swingline	Average (Vang, Swing)	EE-Model Enertech	Base - EE	Market Share
Amps Length (ft) amps/ft	25.600 25 1.024	21.700 25 0.868	23.65 25 0.946	17.100 25 0.684	6.55 0.262	40%

Advice Filing, p. RF-31

total = 0.294
= 0.294 amps/ft
Average for low and medium temperature cases = 0.225
= 0.225 amps/ft

Heat Load in Btuh for Glass, Door Rail, and Frame Heaters, and Lights

Manufacturer = Anthony					
Medium Temp.	Model 400	Model 1000R	Average (400, 100R)	EE-Model 1200	Savings
Btuh Length (ft) Btuh/ft	3,103 10.1 307.3	2,781 10.1 275.3	2,942 10.1 291.3	2,030 10.1 201.0	912 90.3
Low Temp.	Model 600			EE Model 100	Savings
Btuh Length (ft) Btuh/ft	7,653 10.1 757.8			3,690 10.0 369.0	3,963 388.8

Advice Filing, p. RF-32

Advice Filing lists 90.4 Btuh/ft as savings for med. temp. cases.
Advice Filing lists 390.1 Btuh/ft as savings for low temp. cases.
Difference is assumed to be due to rounding.

Direct Energy Savings:

Direct Door Heat Savings = 0.225 amps/ft x 120 volts x (1kw/1000 Watts)
= 0.027
= 0.027 kW/ft

Full Load Hours = (20% x 8,760 hrs/yr) + (80% x 8,760 hrs/yr x 50%)
= 5,256
= 5,256 full load hours/yr

Direct Energy Impacts = 0.027 kW/ft x 5,256 hrs/yr
= 142
= 142 kWh/ft-yr

Indirect Energy Savings:

Hours Heat Conducted into Case = 5,256 hrs/yr - (4 hrs/day x 365 days/yr)
= 3,796

Indirect Energy Impacts = (Δ in heat to case Btuh/ft) x 1/EER x (hours heat conducted into case) x (1 kW/1,000 Watts)
Indirect Energy Impacts (med. temp.) = 90.41 Btuh/ft x (1/7.5 Btuh/Watt) x 3,796 hrs/yr x (1 kW/1,000 Watts)
= 45.76
= 45.76 kWh/ft-yr

Indirect Energy Impacts (low temp.) = 390 Btuh/ft x (1/5 Btuh/Watt) x 3,796 hrs/yr x (1 kW/1,000 Watts)
= 296.09
= 296.1 kWh/ft-yr

Indirect Energy Impacts (mean) = (45.76 kWh/ft-yr + 296.1 kWh/ft-yr)/2
= 170.93
= 170.93 kWh/ft-yr

It seems inconceivable that the indirect impact could be larger than the direct impact.
This method does not agree with the recommendations of the LBL review of Humidistat Controls, p.RF-34, which recommends assuming 60% of the heater load will be conducted into the case.

Total Energy Savings:

= 142 kWh/ft-yr + 170.93 kWh/yr
= 312.93
= 312.93 kWh/ft-yr
This method does not agree with the recommendations of the LBL review of Humidistat Controls.

Non-coincident Demand Savings:

= 0.225 amps/ft x 120 volts x (1kw/1000 Watts)
= 0.027
= 0.027 kW/ft

Coincident Demand Savings:

= 0.027 kW/ft x 0.54 CDF
= 0.01458
= 0.0146 kW/ft
Although the advice filing methods apply a CDF = 0.54, this is not an appropriate value.
Impacts are continuous over an entire year, therefore (313 kWh/ft-yr)/(8,760 hrs/yr) = 0.0357 kW is a more appropriate demand savings estimate.

4) Evaluation Estimates:

Direct Energy Savings:

See Advice Filing estimate.

Indirect Energy Savings:

Assume 60% of heat reduction is transferred into case. See Advice Filing p. RF-34, Humidistat Controls.
First, an adjustment is made for the hours that doors are open due to customer use and stoking.

Hours Case Open = 4 hrs x 365 days/yr
= 1,460

Hours Heat Conducted into Case = [20% x (8,760 hrs/yr - 1,460 hrs/yr)] + [80% x (8,760 hrs/yr - 1,460 hrs/yr) x 50%]
= 4,380
= 4,380 hrs/yr

Decrease in refrigeration load = (0.027 kW/ft) x (3,413 Btu/kWh) x (60% heat transfer to case)
= 55.29
= 55.29 Btuh/ft

Mean EER = (7.5 EER + 5.0 EER)/2 according to Advice Filing, p.RF-34
= 6.25 EER

Compressor load savings = [(55.29 Btuh/ft)/(6.25 Btuh/Watt)] x 1 kW/1,000 Watts
= 0.00885

= 0.00885 kW/ft
Indirect energy savings = 0.00885 kW/ft x 4,380 hrs/yr
= 38.75
= 38.75 kWh/ft-yr

Total Energy Savings:
= 142 kWh/yr + 38.75 kWh/ft-yr
= 180.75
= 181 kWh/ft-yr
Evaluation estimate should supersede Advice Filing estimate, as it acknowledges the LBL review recommendations.

Coincident Demand Savings:

Assume savings is distributed evenly across an entire year.
= (38.75 kWh/ft-yr + 142 kWh/ft-yr)/(8,760 hrs/yr)
= 0.0206
= 0.0206 kW/ft
Evaluation estimate should supersede Advice Filing estimate, as it acknowledges the LBL review recommendations.

5) Summary of Results:

Impact Type (per linear foot)	Impact		Recommended Source
	Advice Filing	Evaluation	
NC Demand (kW)	0.0270	-	†††
Coinc. Demand (kW)	0.0146	0.0206	Evaluation
Annual Energy (kWh)	313	181	Evaluation

††† Using the Evaluation methods, this value is unnecessary.

Measure G: Humidistat Control

Measure Description:	Installation of humidistat control devices which regulate display case anti-sweat heaters. Humidistat controls turn off anti-sweat heaters when ambient relative humidity is low enough that sweating will not occur.
Summary of Advice Filing Calculations:	An algorithm, which was reviewed by LBL, is used to develop direct and indirect impacts. Algorithm inputs include the connected load of the anti-sweat heater as well as the efficiency of the compressor.
Comments on Advice Filing Calculations:	The operating factor for humidistat controls is applied twice for no discernible reason in the development of indirect energy savings. Demand impacts are also affected, as they are derived using the final energy savings estimate. Additionally, an inappropriate CDF of 0.54 is applied to determine the coincident demand impacts.
Comments on Advice Filing Inputs:	The connected load for the anti-sweat heaters is developed using manufactures' data. The Advice Filing only uses values from energy efficient systems, and thereby underestimates the humidistat control impacts for conventional display cases.
Evaluation Process:	Direct and indirect impacts were determined using modified inputs that account for both conventional and energy efficient display cases. The operating factor for the humidistat controls is only applied once in the indirect impact calculations. Coincident demand impacts are developed with the assumption that the energy savings is distributed evenly across the entire year.
Additional Notes:	Due to the redundant application of an operating factor, the Evaluation estimates are significantly greater than the Advice Filing estimates. Evaluation demand and energy estimates are 144% and 38% greater, respectively.

G) Humidistat Control

1) Installation of humidistat control devices to regulate display case anti-sweat heaters.

Controls turn off anti-sweat heaters when ambient relative humidity is low enough that sweating will not occur.

2) Ex-ante assumptions:

Door heat load med temp = 201.36 Btu/hr-ft
Door heat load low temp = 369.0 Btu/hr-ft
Reduction of heater use = 50%
Compressor efficiency med temp = 7.5 EER
Compressor efficiency low temp = 5.0 EER
Business day = 18 hrs
Time doors open = 4 hours
Refrigeration load due to heaters = 60% of heater energy
Door heater usage = 0.4695 amps/ft
This value is from the Low Heat/No Heat Refrigeration Case Door spreadsheet, p. RF-31,32.
0.4695 amps/ft is derived using values associated with energy efficient systems.
0.4695 = {[(0.117 + 0.91)/2] x 60%} + {[(0.123 + 0.682)/2] x 40%}

3) Advice Filing Estimates:

Direct Energy Savings:

Door Heater Usage = 0.4695 amps/ft x 120 volts x 1kW/1,000 Watts
= 0.05634
= 0.05634 kW/ft

Direct Energy Savings = 0.05634 x 8,760 hrs/yr x 50%
= 246.8
= 246.8 kWh/yr

Indirect Energy Savings:

Decrease in refrigeration load = (0.05634 kW/ft) x (3,413 Btu/kWh) x 50% x (60% heat transfer to case)
= 57.69
Mean EER = (7.5 EER + 5.0 EER)/2
= 6.25 EER
Compressor load savings = [(57.69 Btuh/ft)/(6.25 Btuh/Watt)] x 1 kW/1,000 Watts
= 0.00923

Impact hours = [8,760 hrs/yr - (4 hrs case open x 365 days/yr)} x 50%
= 3,650
= 3,650 hrs/yr

Indirect energy savings = 0.00923 kW/ft x 3,650 hrs/yr
= 33.69
= 33.69 kWh/ft-yr
The operating factor of 50% associated with controls is applied both in the refrigeration load and the impact hours estimates.
The indirect energy savings should instead be double the reported value, or 67.38 kWh/ft-yr.

Total Energy Savings:

= 246.8 kWh/yr + 33.69 kWh/yr
= 280.49
= 280.5 kWh/yr
The total energy savings should be (246.8 kWh/yr) + (67.38 kWh/yr) = 314.2 kWh/yr.

Non-coincident Demand Savings:

Indirect duty cycle savings = 33.69 kWh/ft-yr/5,708 EFLH/yr of operation
= 0.0059
See note in indirect energy savings regarding evaluation of this value.
Direct Demand Savings = 0.05634 kW/ft x 50%
= 0.02817
Total Demand Savings = 0.0059 kW/ft + 0.02817 kW/ft
= 0.03407
= 0.03407 kW/ft

Coincident Demand Savings:

= 0.03407 kW/ft x 0.54 CDF
= 0.0184
= 0.0184 kW/ft
See note in indirect energy savings regarding evaluation of this value.
The use of a CDF is redundant as the evaluation already takes this into account.
Both the EFLH used to determine duty cycle savings and the operating factor of 50% used in the direct demand savings, take a CDF into account.

4) Evaluation Estimates:

Direct Energy Savings:

Using Advice Filing data from p.RF31-32, door heater usage for standard doors was calculated.

Door Heater Usage (Standard Doors) = {[(0.280 + 1.225)/2] x 60%} + {[(0.268 + 0.946)/2] x 40%}
= 0.6943
= 0.6943 amps/ft

Assume 50% low heat doors, 50% standard doors to calculate door heater usage.
This assumption is a conservative estimate, but is not based upon any "hard" data.
Door Heater Usage (mean) = (0.6943 amps/ft + 0.4695 amps/ft)/2
= 0.5819
= 0.5819 amps/ft
Adjust to kW = 0.5819 amps/ft x 120 volts x 1kW/1,000 Watts
= 0.0698
= 0.0698 kW/ft

Direct Energy Savings = 0.0698 kW/ft x 8,760 hrs/yr x 50%
= 305.7
= 305.7 kWh/yr

Indirect Energy Savings:

Decrease in refrigeration load = (0.0698 kW/ft) x (3,413 Btu/kWh) x (60% heat transfer to case)
= 142.94
= 142.94 Btuh/ft
Mean EER = (7.5 EER + 5.0 EER)/2
= 6.25 EER
Compressor load savings = [(142.94 Btuh/ft)/(6.25 Btuh/Watt)] x 1 kW/1,000 Watts

= 0.02287

Impact hours = 3,650 hrs/yr, from Advice Filing

Indirect energy savings = 0.02287 kW/ft x 3,650 hrs/yr
= 83.47
= 83.47 kWh/ft-yr

Total Energy Savings:
= 305.7 kWh/yr + 83.47 kWh/yr
= 389.2
= 389 kWh/yr
This value takes into account the fact that not all of the participants in the program will have low heat/no heat refrigeration doors.
This value should supersede the Advice Filing estimate.

Coincident Demand Savings:
Assume savings is distributed evenly across an entire year.
= (83.47 kWh/ft-yr + 305.7 kWh/ft-yr)/(8,760 hrs/yr)
= 0.0449
= 0.0449 kW/ft
Recommend using Evaluation estimate as values reflect that not all installations will be on low heat/no heat doors.

5) Summary of results:

Impact Type (per linear foot)	Impact		Recommended Source
	Advice Filing	Evaluation	
NC Demand (kW)	0.0341	-	†††
Coinc. Demand (kW)	0.0184	0.0449	Evaluation
Annual Energy (kWh)	281	389	Evaluation

††† Using the Evaluation methods, this value is unnecessary.

Measure H: Case Lighting, Electronic Ballast

Measure Description:	Replacement of standard lighting ballasts in refrigeration display cases with electronic ballasts.
Summary of Advice Filing Calculations:	Demand and energy impacts were determined using the power draw of various lamps with both standard and electronic ballasts.
Comments on Advice Filing Calculations:	The method used to develop energy impacts appears valid. However, a coincident diversity factor (CDF) is applied to the non-coincident impact to develop peak period impacts. This is unnecessary, as the lights in a display cases normally operate during peak hours.
Comments on Advice Filing Inputs:	Although a spreadsheet (based on manufacture's data) was used to derive key engineering inputs, attempts to reproduce these results were unsuccessful.
Evaluation Process:	Energy impacts were calculated using the Advice Filing method, and revised inputs. Demand impacts were developed without the application of a CDF.
Additional Notes:	The Evaluation demand and energy impacts are 74% and 16% greater, respectively.

H. Case Lighting, Electronic Ballast

1) Replacing standard ballasts in refrigeration display cases with electronic ballasts

2) Ex-ante calculation assumptions:

Majority of cases have single lamp ballasts.
Same ballast will run (1)F96HO, (1)F72HO, (1)F60HO, and (2)F48HO lamps.
Lamps and ballasts rated at 95% of maximum wattage at 78F.
Average low temperature case is -10 F, medium temperature case is +20 F.
Note: Baseline at beginning of Advice Filing lists low temp as -23 F and the medium temp range as 9 F-26 F.
EPRI† Table 6-21, p.6-138 lists med temp as 15 F, and low temp as -25 F.
Protective sleeve covers will increase bulb wall temp. 10 F above case temperature.
Lamps and ballasts draw 65% of maximum wattage at 0 F, and 70% of maximum wattage at +30 F.
20% of display cases are EMS controlled and run 16 hrs/day, 365 days/yr, 80% run continuously for 8760 hrs/yr.
Majority of participants will be for new cases.

3) Advice Filing Estimates:

Non-coincident Demand with a Temperature Correction:

Medium temperature cases, 800ma	= (16 Watts/lamp) x (70%/95%)
	= 11.79
	= 11.8 Watts /lamp
Low temperature cases, 1,500ma	= (14 Watts/lamp) x (65%/95%)
	= 9.58
	= 9.6 Watts /lamp
Mean NC demand impact	= [(11.8 W/lamp + 9.6 W/lamp)/2] x 1 kW/1000 Watts
	= 0.0107
	= 0.0`07 kW/lamp
	Though 16 W and 14 W are listed on the Advice Filing spreadsheet (p.RF-40), the values cannot be recreated.

Coincident Demand:

	= (0.0107 kW/lamp) x 0.67 CDF
	= 0.0072
	= 0.0072 kW/lamp

Energy Impacts:

Average operating hours	= (80% x 8,760 hours/year) + (20% x 16 hours/day x 365 days/year)
	= 8,176
	= 8,176 full load hours/year
Energy Savings	= (8,176 hrs/yr x 0.0107 kW/lamp)
	= 87.48
	= 87.5 kWh/year-lamp

4) Evaluation Estimates:

# lamps	type	lamp watts	min temp	m. amps	stnd. bllst tot watts	EE bllst tot watts	stnd. vs EE % change	elec bllst tot watts	EE vs. elec % change	EE vs. elec W/lamp
1	F48	60		800	75	72	4.0%			
2	F48	60		800	140	136	2.9%			
1	F72	85		800	106	102	3.8%	75	26.5%	27
1	F96	110		800	130	123	5.4%	95	22.8%	28
2	F96	110		800	250	241	3.6%	190	21.2%	26
1	F96	95		800	112	106	5.4%	80	24.5%	26
2	F96	95		800	216	210	2.8%	160	23.8%	25
						average =	**4.0%**	**average =**	**23.7%**	**26**
						Listed as 4.2% in Advice Filing, possibly due to rounding.				
1	F96	215		1500	230	227	1.3%	200	11.9%	27
2	F96	215		1500	470	446	5.1%	400	10.3%	23
1	F96	195		1500	209	206	1.4%	180	12.6%	26
2	F96	195		1500	408	404	1.0%	350	13.4%	27
						average =	**2.2%**	**average =**	**12.0%**	**26**

# lamps	type	lamp watts	min temp	m. amps	stnd. bllst tot watts	EE bllst tot watts	stnd. vs EE W saved	elec bllst tot watts	EE vs. elec W saved	EE vs. elec W/lamp
2	F48	60	-20	800	140	134	6	107	27	13.5
1	F60	74	-20	800	100	96	4	76	20	20
1	F72	85	-20	800	106	102	4	75	27	27
					average =	**111**	**5**	**86**	**25**	**20**
2	F48	116	-20	1500	241	235	6	211	24	12
1	F60	138	-20	1500	157	153	4	138	15	15
1	F72	168	-20	1500	181	176	5	159	17	17
					average =	**188**	**5**	**169**	**19**	**15**

Recreated from Advice Filing, p. RF-42

Non-coincident Demand with a Temperature Correction:

Medium temperature cases, 800ma = (20 Watts/lamp) x (70%/95%)
= 14.74
= 14.7 Watts /lamp

Low temperature cases, 1,500ma = (15 Watts/lamp) x (65%/95%)
= 10.26
= 10.3 Watts /lamp

Mean NC demand impact = [(14.7 W/lamp + 10.3 W/lamp)/2] x 1 kW/1000 Watts
= 0.0125
= 0.0125 kW/lamp

Recommend using Evaluation estimate as the results are reproducible.

Coincident Demand:

There is no need to apply a CDF.
Lights that do turn off in the evening will still be on 100% during business hours.
Recommend using Evaluation estimate to supersede Advice Filing estimate.

Annual Energy Impacts:
= (8,176 hrs/yr x 0.0125 kW/lamp)
= 102.20
= 102 kWh/year-lamp
Recommend using Evaluation estimate to supersede Advice Filing estimate.

6) Summary of results:

Impact Type (per lamp)	Impact		Recommended Source
	Advice Filing	Evaluation	
NC Demand (kW)	0.0107	0.0125	Evaluation
Coinc. Demand (kW)	0.0072	0.0125	Evaluation
Annual Energy (kWh)	88	102	Evaluation

7) Sources:

† EPRI report TR-100984, V1, "Engineering Methods for Estimating the Impacts of Demand-Side Management Programs";
Volume 1: Fundamentals of Engineering Simulations for Residential and Commercial End Uses; Electric Power Research Institute, Palo Alto, CA, 1992.

Measure I: Insulate Bare Suction Line

Measure Description:	Provides an incentive for customers with small stores to insulate bare suction lines.
Summary of Advice Filing Calculations:	Energy impacts were determined using ASHRAE algorithms which incorporate radiant and convective heat transfer. No demand impacts were calculated.
Comments on Advice Filing Calculations:	The method used to develop energy impacts appears valid. Review of the measure indicates that there are demand savings associated with insulating bare suction line.
Comments on Advice Filing Inputs:	Inputs used are consistent with values from the ASHRAE Fundamentals Handbook.
Evaluation Process:	Energy impacts were calculated using the ASHRAE method. Demand impacts were assumed to be spread evenly across an entire year.
Additional Notes:	The Evaluation and Advice Filing energy impacts differ by just a small rounding error.

I. Insulate Bare Suction Line

1) Provides an incentive for smaller customers to insulate bare refrigeration suction lines.

Rebate is only available for pipes with 1.5" diameter or less, and must be installed on old equipment.
Insulation decreases heat load to compressor, lowering compressor operating hours.

2) Ex-ante calculation assumptions:

Temp of superheat at exit of evaporator is 15 F.
Average coil to compressor rise is 5 F.
Low temp suction temperature is -20 F, so vapor temperature is 0 F.
Med temp suction temperature is 15 F, so vapor temperature is 35 F.

The language used above is not consistent with a refrigeration cycle.
Assume that there is a 20 F rise in temp from expansion valve to the compressor.
For ease of calculation this temp increase is assumed to be instantaneous at the point where the suction line leaves the display case.

Compressor operates 4,960 EFLH.
Average indoor temp. is 75 F.
Average wind speed is 0.5 mph (44 fpm, ASHRAE 1989 Fundamentals, p.13.9)

ASHRAE† p.13.9 simply lists a range of 0-100 fpm. 44 fpm is in this range.

Med temp. compressor efficiency, 7.5 EER
Low temp. compressor efficiency, 5.0 EER
80% of participation is for med temp. cases, 20% for low temp. cases.
Low temp. insulation is 1" thick.
Med temp. insulation is 3/4" thick.
Conductivity (k value) of insulation is 0.27 Btu-in/hr-sqft-F

Pipe Diameter		Insulation Radius (1")		Insulation Radius (3/4")	
Nominal	Actual	Surface	Inside	Surface	Inside
0.38	0.500	1.19	0.26	0.96	0.26
0.50	0.625	1.44	0.32	1.16	0.32
0.75	0.875	1.44	0.45	1.19	0.45
0.10	1.125	1.44	0.57	1.22	0.57
1.25	1.375	1.75	0.70	1.49	0.70
1.50	1.625	1.75	0.82	1.52	0.82

Recreated using data from Advice Filing, p.RF-50.

3) **Advice Filing Estimates:**

All sample calculations are for a 1.5" nominal diameter copper pipe with 3/4" of insulation.

Calculate bare pipe convective heat transfer:

From ASHRAE† p.22.15

hcv = C x [(1/d)^0.2] x [(1/tave)^0.181] x (Δt^0.266) x [1 + 1.277(wind)]^0.5

where:

hcv = heat transfer coefficient, Btu/hr-sqft-F
C = constant, 1.016 for horizontal cylinders (ASHRAE† p.22.15)
d = diameter of pipe, inches
tave = average temp of air film, F assumed to be 55 F from Advice Filing p.RF-48
Δt = surface to air temp difference, F (assume surface temp to be same as vapor temp)
wind = air speed, mph

= 1.016 x [(1/1.625in)^0.2] x [(1/55)^0.181] x [(75F - 35F)^0.266] x [1 + 1.277(0.5mph)]^0.5
= 1.524
= 1.524 Btu/hr-sqft-F

Calculate bare pipe radiant heat transfer:

From ASHRAE† p.22.15

hrad = {(e x 0.173 x 10^(-8) x [(ta + 459.6)^4 - (ts + 459.6)^4]}/(ta-ts)

where:

hrad = radiant heat transfer coefficient, Btu/hr-sqft-F
e = surface emittance, (0.44 for dull pipe, ASHRAE† p.22.18)
ta = air temperature, F
ts = surface temperature, F (assume to be same temp as vapor temp)

= {(0.44 x 0.173 x 10^(-8) x [(75 F + 459.6)^4 - (35 F + 459.6)^4]}/(75 F - 35 F)
= 0.415550322
= 0.4156 Btu/hr-sqft-F

Total bare pipe heat transfer:

= hrad + hcv
= 1.524 Btu/hr-sqft-F + 0.4156 Btu/hr-sqft-F
= 1.9396
= 1.94 Btu/hr-sqft-F

Calculate insulated pipe heat transfer:

From ASHRAE† p.208

qs = (ti - ts)/{[rs x ln(rs/ri)/k] + Rs}

where:

qs = rate of heat transfer per unit area of insulation's outer surface, Btu/hr-sqft
ti = temperature of inner surface, F (assume to be same temp as vapor temp)
ts = temperature of outer surface, F
k = thermal conductivity of insulation, Btu-in/hr-sqft-F
= 0.27 Btu-in/hr

Rs = surface resistance, F-sqft-hr/Btu

To correct for ambient temp incorporate surface resistance, Rs = 0.65 F-sqft-hr/Btu

qs = 1/{[1.52 in x ln(1.52 in/82 in)/0.27 Btu/hr-sqft-F] + (0.65 F-sqft-hr/Btu)}
= 0.242460133
= 0.242 Btu/hr-sqft-F

Calculate Heat Gain for Bare Pipe:

= (htot, Btu/hr-sqft-F) x Δt x (area, sqft)
= 1.94 Btu/hr-sqft-F x 40 F x 0.425 sqft/ft
= 32.98
= 32.98 Btu/hr-ft
Advice Filing, p.RF-48 lists 32.93 Btu/hr
Difference due to rounding.

Calculate Heat Gain for Insulated Pipe:

= (htot, Btu/hr-sqft-F) x Δt x (area, sqft)
= 0.24 Btu/hr-sqft-F x 40 F x 0.796 sqft/ft
= 7.76896
= 7.77 Btu/hr-ft
Advice Filing, p.RF-48 lists7.71 Btu/hr
Difference due to rounding.

Energy Savings:

Assume all heat gains are directly proportional to increased demand for the compressor.
EER = 7.5 Btu/Watt-hr

= [(32.93 Btu/hr-ft) - (7.77 Btu/hr-ft)] x (1/7.5 Btu/Watt-hr) x 4,960 EFLH
= 16,672
= 16,672 Watt-hr/ft-yr x 1 kW/1,000 Watts
Adjust to kWh = 16.672
= 16.672 kWh/ft-yr

Neither coincident nor non-coincident demand savings were calculated.

4) Evaluation Estimates:

Pipe Diameter (in)		Circum. (in)	sqft per linear foot	Insulation Radius (1")			
Nominal	Actual			Surface	Inside	Circum (in)	area per ft
0.38	0.500	1.571	0.131	1.19	0.26	7.477	0.623
0.50	0.625	1.963	0.164	1.44	0.32	9.048	0.754
0.75	0.875	2.749	0.229	1.44	0.45	9.048	0.754
0.10	1.125	3.534	0.295	1.44	0.57	9.048	0.754
1.25	1.375	4.320	0.360	1.75	0.70	10.996	0.916
1.50	1.625	5.105	0.425	1.75	0.82	10.996	0.916

Recreated using data from Advice Filing, p.RF-50.

Pipe Diameter (in)		Circum.	sqft per	Insulation Radius (3/4")			
Nominal	Actual	(in)	linear foot	Surface	Inside	Circum (in)	area per ft
0.38	0.500	1.571	0.131	0.96	0.26	6.032	0.503
0.50	0.625	1.963	0.164	1.16	0.32	7.288	0.607
0.75	0.875	2.749	0.229	1.19	0.45	7.477	0.623
0.10	1.125	3.534	0.295	1.22	0.57	7.665	0.639
1.25	1.375	4.320	0.360	1.49	0.70	9.362	0.780
1.50	1.625	5.105	0.425	1.52	0.82	9.550	0.796

Recreated using data from Advice Filing, p.RF-50.

Calculate convective and radiant heat transfer from bare pipe:

Pipe Diameter (in)		Medium Temperature (Btu/hr-sqft-F)			Low Temperature (Btu/hr-sqft-F)		
Nominal	Actual	hcv	hrad	htot	hcv	hrad	htot
0.38	0.500	1.930	0.416	2.345	2.281	0.376	2.657
0.50	0.625	1.845	0.416	2.261	2.181	0.376	2.557
0.75	0.875	1.725	0.416	2.141	2.039	0.376	2.415
0.10	1.125	1.641	0.416	2.056	1.939	0.376	2.315
1.25	1.375	1.576	0.416	1.992	1.863	0.376	2.239
1.50	1.625	1.524	0.416	1.940	1.802	0.376	2.178

All sample calculations are for a 1.5" nominal diameter copper pipe with 3/4" of insulation.

Calculate Heat Gain for Bare Pipe:

= (htot, Btu/hr-sqft-F) x Δt x (area, sqft)
= 1.94 Btu/hr-sqft-F x 40 F x 0.425 sqft/ft
= 32.98
= 32.98 Btu/hr-ft
Advice Filing, p.RF-48 lists 32.93 Btu/hr
Difference due to rounding.

Calculate insulated pipe heat transfer:

From ASHRAE† p.208
qs = (ti - ts)/[rs x ln(rs/ri)/k]
where:
qs = rate of heat transfer per unit area of insulation's outer surface, Btu/hr-sqft
ti = temperature of inner surface, F (assume to be same temp as vapor temp)
ts = temperature of outer surface, F
k = thermal conductivity of insulation, Btu-in/hr-sqft-F
= 0.27 Btu-in/hr

qs = (35 F - 75 F)/[1.52 in x ln(1.52 in/0.82 in)/0.27 Btu/hr-sqft-F]
= -11.51281434
= 11.513 Btu/hr-sqft

To correct for surface resistance (Rs) use values from ASHRAE† Fig.6, p.22.15
If qs = 11.513, Rs = 0.72
qs = (35 F - 75 F)/{[1.52 in x ln(1.52 in/0.82 in)/0.27 Btu/hr-sqft-F] + 0.72F-sqft-hr/Btu
= -9.536549009
= 9.537 Btu/hr-sqft

Calculate Heat Gain for Insulated Pipe:
= (qs, Btu/hr-sqft) x sqft/ft
= 9.537 Btu/hr-sqft x 0.796 sqft/ft
= 7.591452
= 7.591 Btu/hr-ft
Advice Filing, p.RF-48 lists 7.71 Btu/hr

Energy Savings:

Assume all heat gains are directly proportional to increased demand for the compressor.

EER = 7.5 Btu/Watt-hr

= [(32.98 Btu/hr-ft) - (7.591 Btu/hr-ft)] x (1/7.5 Btu/Watt-hr) x 4,960 EFLH
= 16,791
= 16,791 Watt-hr/ft-yr x 1 kW/1,000 Watts

Adjust to kWh = 16.791
= 16.791 kWh/ft-yr

Advice Filing lists 16.67 kWh/ft-yr

Coincident Demand Savings:

Assume that savings are spread evenly across an entire year.
= (16.791 kWh/ft-yr)/8,760 hrs/yr
= 0.00192
= 0.00192 kW

Low Temperature Estimates					
Nominal Pipe Diameter (in)	Unadjusted qs (Btu/hr-sqft)	Heat Gain (bare) (Btu/hr-ft)	Heat Gain (ins) (Btu/hr-ft)	Energy Savings (kWh)	Demand Savings (kW)
0.38	5.967	26.084	6.269	19.656	0.002244
0.50	4.986	31.384	6.447	24.738	0.002824
0.75	6.448	41.498	8.132	33.099	0.003778
0.10	8.093	51.147	9.933	40.884	0.004667
1.25	6.735	60.453	10.274	49.778	0.005682
1.50	8.141	69.491	12.134	56.898	0.006495
Average =	6.73			Average = 37.51	0.00428
Rs =	0.75				

Medium Temperature Estimates					
Nominal Pipe Diameter (in)	Unadjusted qs (Btu/hr-sqft)	Heat Gain (bare) (Btu/hr-ft)	Heat Gain (ins) (Btu/hr-ft)	Energy Savings (kWh)	Demand Savings (kW)
0.38	8.612	12.279	3.748	5.642	0.000644
0.50	7.229	14.798	3.885	7.217	0.000824
0.75	9.333	19.616	4.979	9.680	0.001105
0.10	11.633	24.225	6.144	11.957	0.001365
1.25	9.595	28.678	6.383	14.745	0.001683
1.50	11.513	33.011	7.590	16.812	0.001919
Average =	9.65			Average = 11.01	0.00126
Rs =	0.72				

Average Energy Savings:

= (80% x 11.01 kWh/yr) + (20% x 37.51 kWh/yr)
= 16.31
= 16.31 kWh/yr

Average Coincident Demand Savings:

= (80% x 0.00126 kW) + (20% x 0.00428 kW/yr)
= 0.001864
= 0.00186 kW/yr

5) Summary of results:

Impact Type (per linear foot)	Impact		Recommended Source
	Advice Filing	Evaluation	
NC Demand (kW)	-	-	
Coinc. Demand (kW)	-	0.00186	Evaluation
Annual Energy (kWh)	16.02	16.31	Evaluation

6) Sources:

† ASHRAE Handbook, "Fundamentals"; American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. Atlanta, GA, 1989.

Measure J: Multiplex Compressor System

Measure Description:	Replacement of equally sized conventional compressor systems with multiplex systems for a supermarket application.
Summary of Advice Filing Calculations:	Energy and demand impacts are based upon average system-wide savings as reported by EPRI.
Comments on Advice Filing Calculations:	Review of the Advice Filing estimates indicate that the effects of ambient and mechanical subcooling were included in the impact estimate. Program documentation, however, does no t specify subcooling as a necessary component of the multiplex system.
Comments on Advice Filing Inputs:	While the inputs are substantiated by the cited documentation, the inclusion of ambient and mechanical subcooling impacts is not consistent with the policy and procedures for the measure.
Evaluation Process:	Using the same sources cited in the Advice Filing, energy and demand impacts were developed, without ambient and mechanical subcooling.
Additional Notes:	The Evaluation estimates were smaller than the Advice Filing. Energy and demand impacts were reduced by 7% and 57%, respectively, due to the exclusion of subcooling impacts.

J. **Multiplex Compressor System**

1) **Replacement of equally sized conventional compressor systems with multiplex systems for a supermarket application.**

2) **Ex-ante calculation assumptions:**

Lower limit savings 10%
Upper limit savings 27% using additional controls
15.1% savings cited from EPRI* p. ES-15.
This includes savings due to ambient and mechanical subcooling, (something that is not a requirement for participation in this program).
Best judgment savings is 13%, with floating head pressure control.
Competitek† p.190, cites energy savings of13.7% for a monitored Safeway store.

3) **Advice Filing Estimates:**

Energy Savings:

Baseline energy use, conventional system = 2,141 kWh/day EPRI* Table 3-4, p. 3-7
Daily Energy Savings = 15.1% x 2,141 kWh/day
= 323
Advice filing cites 325 kWh/day, which is prorated from the total savings of 497 kWh/day (23.2%).
Value taken from EPRI* Table ES-4, p. ES15
Annual Energy Savings = (325 kWh/day) x 365 day/yr
= 118,625
= 118,625 kWh/yr

Rated Capacity = (808,220 BTU/hr)/12,000 BTU/ton
= 67.35
= 67.35 tons for new Multiplex Compressors

Annual Savings per Ton = (118,625 kWh/yr)/67.35 tons
= 1,761
= 1,761 kWh/ton-yr

Savings Prorated = (1,761 kWh/ton-yr) x (13% best judgement/15.1% EPRI CU-6268)
= 1,516
= 1,516 kWh/ton-yr

Coincident Demand Savings:

= 29.3 kW, a 25.6% savings
Value taken from EPRI* Table ES-5, p. ES17
= 29.3 kW/67.35 tons
= 0.435
= 0.435 kW/ton rating of new compressors
Savings Prorated = (0.435 kW/ton) x (13%/15.1%)
= 0.375
= 0.375 kW/ton

Non-coincident Demand Savings:

The Advice Filing back calculates the non-coincident demand savings value by applying a 0.54 CDF
= (0.375 kW/ton) x (1/0.54 CDF)
= 0.694
= 0.694 kW/ton

4) Evaluation Estimates:

Energy Savings:

Baseline energy use, conventional system = 2,141 kWh/day EPRI* Table 3-4, p. 3-7

Daily Energy Savings = 12.1% x 2,141 kWh/day
= 259

EPRI* Table ES-5, p. ES-17 indicates that a multiplex system, with floating head pressure control should save 12.1% of the energy use of a conventional system.

Annual Energy Savings = (259 kWh/day) x 365 day/yr
= 94,535
= 94,535 kWh/yr

Annual Savings per Ton = (94,535 kWh/yr)/67.35 tons
= 1,404
= 1,404 kWh/ton-yr

The Evaluation Estimate uses the same source of information as the Advice Filing, but without including energy savings for ambient and mechanical subcooling.

Recommend that Evaluation Estimate supersede Advice Filing Estimate, as the program only requires floating head pressure installation, and does not specify subcooling.

Non-coincident Demand Savings:

Use full load operating hours cited in the Advice Filing baseline, p. RF-6.
= (1,404 kWh/ton-yr)/(4,960 mean full load operating hours/year)
= 0.283
= 0.283 kW/ton

Coincident Demand Savings:

Using EPRI* = 24.5 kW, a 21.4% savings.

Value taken from EPRI* Table ES-5, p. ES17
= 24.5 kW/67.35 tons
= 0.364

While 0.364 kW/ton is a more conservative estimate, it is suspect.

EPRI* cites a 1.4 kW impact due to the use of floating head pressure. This might be true for the winter months when much of the testing of the floating head pressure system was done, however this would not be true for PG&E's peak load hour which would occur in the summer.

Assume energy savings is distributed evenly over an entire year.
= (1,404 kWh/ton-yr)/8,760 hrs/yr
= 0.160
= 0.160 kW /ton

This represents the most conservative demand estimate method.

The non-coincident demand savings estimate represents the demand estimate method with the highest impact.

The demand estimate derived from EPRI* Table ES-5, p. ES-17 is outside the range of these two estimates.

Greatest Impact = 0.283 kW/ton
Least Impact = 0.160 kW/ton
Reported Impact = 0.364 kW/ton

This discrepancy in the EPRI* reported values for demand and energy should be investigated further.

5) **Summary of Results:**

Impact Type (per ton)	Impact		Recommended Source
	Advice Filing	Evaluation	
NC Demand (kW)	0.694	0.283	Evaluation
Coinc. Demand (kW)	0.375	0.160	Evaluation
Annual Energy (kWh)	1,516	1,404	Evaluation

6) **Sources:**

* Foster Miller. 1989. "Supermarket Refrigeration Modeling and Field Demonstration," (prepared for the Electric Power Research Institute, (Palo Alto, CA) EPRI report CU-6268), Waltham, MA, March.

† Shepherd, Michael, Amory Lovins, et al. 1990. "The State of the Art: Appliances," Competitek, Rocky Mountain Institute, Snowmass, CO, August.

†† LBL 1985. Usibelli, A., et al. :Commercial Sector Conservation Technologies," Lawrence Berkeley Laboratory, LBL 18543, Berkeley, CA February.

Measure K: Electronic Adjustable Speed Compressor

Measure Description:	Provides an incentive to install a controller to convert an existing fixed speed compressor to an adjustable speed compressor, or to replace an existing compressor with a compressor that has an adjustable speed drive (ASD).
Summary of Advice Filing Calculations:	Energy impacts were developed using a best judgment savings value derived from a number of sources. No demand impacts were developed.
Comments on Advice Filing Calculations:	Impacts do not take into account the baseline motor efficiency.
Comments on Advice Filing Inputs:	The sources cited in the Advice Filing were unavailable, and so could not be verified. No alternate sources were located.
Evaluation Process:	Energy impacts were developed using a 90% baseline motor efficiency. Demand impacts were assumed to be spread evenly across an entire year.
Additional Notes:	The Evaluation energy estimate was 11% greater than the Advice Filing estimate.

K. Electronic Adjustable Speed Compressor

1) Provides an incentive to install a controller to convert an existing fixed speed compressor to an adjustable speed compressor, or replace an existing compressor with a compressor that has an adjustable speed drive (ASD).

Existing compressor must be on a non-multiplexed refrigeration unit.
Existing compressor must be 5 hp or more with a halocarbon refrigerant.

2) Ex-ante calculation assumptions:

Savings range from 7% to 30%, depending on the type of refrigeration system.
Best judgment estimate for compressor energy savings is 12.5%.
Average annual compressor operating hours is 4,960.
Baseline power draw is 0.746 kW/hp.

3) Advice Filing Estimates:

Energy Savings:

= 4,960 hrs x 12.5% x 0.746 kW/hp
= 462.52
= 462.5 kWh/yr-hp

Neither coincident nor non-coincident demand impacts were developed.

4) Evaluation Estimates:

Energy Savings:

The Advice Filing estimate does not take into account the baseline motor efficiency in determining impacts.
5 hp and greater motor efficiencies range from 85% to 95%.
Using a mean value of 90% the following equation can be applied.
= 12.5% x [(4,960 hrs x 0.746 kW/hp)/90%]
= 513.9
= 513.9 kWh/yr-hp

Coincident Demand Savings:

Assume energy savings is spread evenly across an entire year.
= (513.9 kWh/yr-hp)/(8,760 hrs/yr)
= 0.0587
= 0.0587 kW/hp

5) Summary of results:

Impact Type	Impact	Recommended

(per horsepower)	Advice Filing	Evaluation	Source
NC Demand (kW)	-	-	-
Coinc. Demand (kW)	-	0.0587	Evaluation
Annual Energy (kWh)	462.5	513.9	Evaluation

Measure M: Mechanical Subcooler

Measure Description:	Installation of a mechanical subcooler for a low temperature refrigeration system.
Summary of Advice Filing Calculations:	A bin analysis method was used to develop demand and energy impacts.
Comments on Advice Filing Calculations:	The Advice Filing method could not be reproduced due to inadequate documentation contained in that report.
Comments on Advice Filing Inputs:	Inputs used in the estimates were not included in the Advice Filing, and therefore could not be verified.
Evaluation Process:	An Evaluation estimate was not developed.
Additional Notes:	Demand impacts were developed using a CDF of 0.54, which may be inappropriate given the methods used. Without additional documentation, however, a more thorough analysis could not be performed.

M. Mechanical Subcooler

1) Installation of a mechanical subcooler in a low temperature refrigeration system.

Savings result from providing a greater capacity to the low temperature system at a higher total system efficiency.
Lower discharge gas temperature in subcooled units leads to lower power use.

2) Ex-ante calculation assumptions:

Air-cooled condensers design for a 15 degree temperature difference.
Suction temperature is -25 F.
Subcooling temperature is 40 F.
Travis AFB weather is used as a PG&E system average.
Peak demand savings are averaged over the three highest temperature bins.
The condensing temperature for an air-cooled unit is the dry bulb temperature plus 20 F.
The condensing temperature for an evaporative-cooled unit is the wet bulb temperature plus 15 F.

3) Advice Filing Estimate:

A bin analysis method was used to determine demand and energy impacts.
Inputs in the bin analysis method included:

- Bin weather data
- Type of condenser, either air-cooled or evaporative-cooled.
- Average system operating capacity
- Evaporator efficiency
- Suction line superheat
- Compressor efficiency
- Subcooling temperature
- Subcooler capacity.

Analysis Method:
The following steps were implemented sequentially:

- Mid-point dry bulb temperature and coincident wet bulb temperature determined for each bin.
- Standard and subcooled enthalpies found from refrigerant tables.
- Standard and subcooled mass flow rates found from tons (of heat) rejected and enthalpy difference between suction and evaporation conditions.
- Enthalpy was determined for discharge gas conditions.
- Associated power calculated from mass flow and enthalpy difference between discharge and suction conditions for standard and subcooled cases.
- Additional power consumption is subcooler cycle calculated from subcooler mass flow rate and the enthalpy difference.
- Demand savings calculated as standard cycle power draw minus subcooled cycle power draw.
- Energy estimates calculated as difference in total power draw times the number of hours for a given bin.
- Calculations completed for various refrigeration system sizes, and an average value was used to determine impacts per year-ton.

Analysis Results:

Capacity	Savings	
	kWh/yr-ton	kW/ton
15 tons	589.73	0.6089
30 tons	589.73	0.6089
50 tons	589.72	0.6087
Average	589.7	0.6088

4) Evaluation Estimate:

Advice Filing estimates could not be reproduced due to inadequate documentation contained in the report.

Further analysis is required to determine the accuracy of the Advice Filing coincident demand impacts. A CDF of 0.54 was applied to the NC demand impacts, which may not be appropriate given the methods used. Without additional documentation, however, a more thorough analysis of the coincident impacts could not be performed.

5) Summary of results:

Impact Type (per ton)	Impact		Recommended Source
	Advice Filing	Evaluation	
NC Demand (kW)	0.6088	-	Advice Filing
Coinc. Demand (kW)	0.3288	-	Advice Filing
Annual Energy (kWh)	589.7	-	Advice Filing

Measure N: Floating Head Pressure Control

Measure Description:	Installation of a floating head pressure control which allows the condensing temperature to "float" below a conventional set minimum condensing temperature setpoint when the ambient temperature is lower than design conditions.
Summary of Advice Filing Calculations:	Energy impacts were developed using a best judgment savings value derived from a number of sources. No demand impacts were developed.
Comments on Advice Filing Calculations:	Review of the sources cited in the Advice Filing indicates that the savings value used is conservative and is substantiated by the references.
Comments on Advice Filing Inputs:	
Evaluation Process:	An Evaluation estimate was not developed.
Additional Notes:	Demand impacts were not developed as floating head pressure controls are effective only during periods of low ambient temperature.

N. Floating Head Pressure Control

1) **Retrofit allows the condensing temperature (CT) to "float" below a conventional set minimum condensing temperature setpoint when the ambient temperature is lower than design conditions**

Lowering of condensing temperature saves energy
Retrofit minimum CT set points should be 70 F for halocarbon, 60 F for ammonia

2) **Ex-ante calculation assumptions:**

Typical setting for CT is 82 degrees for halocarbon systems
Typical setting for CT is 78 degrees for ammonia systems
Ambient temperatures will only be cold enough in the winter months, half of the year
Baseline compressor energy consumption is 9,137 kWh/yr-ton
A review of this calculation of compressor energy usage from EPRI CU-6268* actually yields 9,141 kWh/yr-ton.)
Energy savings is assumed to be 6% of compressor use
Energy savings is assumed to be the same for ammonia and halocarbon systems

3) **Advice Filing Estimates:**

Energy Savings:

= (0.06*9,137 kWh/yr-ton)
= 548.220
= 548 kWh/yr-ton
Using 9,141 kWh/yr-ton does not change this value.

Demand Savings:

No demand savings as there is no "floating" unless ambient temperatures are low.

4) **Evaluation Estimates:**

Estimates for energy savings associated with floating head pressure range from 2% (EPRI CU-6268* p.ES-15) to 15% (LBL† p.3-8).
Review of all sources indicates that the value used in the Advice Filing is a conservative one, and is substantiated by the references cited.

5) **Summary of results:**

Impact Type (per ton)	Impact: Advice Filing	Impact: Evaluation	Recommended Source
NC Demand (kW)	-	-	Advice Filing
Coinc. Demand (kW)	-	-	Advice Filing
Annual Energy (kWh)	548	-	Advice Filing

6) **Sources:**

* Walker D., EPRI Report CU-6268, "Supermarket Refrigeration Modeling and Field Demonstration". Prepared for the Electric Power Research Institute, Palo Alto, CA. Foster-Miller, Inc. Witham MA. March 1989

† Usibelli, et al. LBL-18543, "Commercial-Sector Conservation Technologies". Prepared for Pacific Gas and Electric Co. San Francisco, CA. Lawrence Berkeley Labs, Berkeley, CA. February 1985.

Measure O: Cooler or Freezer Door Gaskets

Measure Description:	Replacement of worn-out gaskets with new gaskets on walk-in doors for coolers or freezers.
Summary of Advice Filing Calculations:	Used an equation from ASHRAE Refrigeration Handbook to determine infiltration loads associated with a faulty gasket for both a cooler and a freezer. Energy and demand impacts were determined using infiltration loads, the efficiency of the refrigeration system, and the hours that infiltration occurs.
Comments on Advice Filing Calculations:	Program review has shown that the ASHRAE method was incorrectly applied.
Comments on Advice Filing Inputs:	The value used for the average door area was inconsistent with other measures, and was determined to be too small. Review of the hours that infiltration would occur revealed that they are underestimated.
Evaluation Process:	Energy and demand impacts were developed using the correctly applied ASHRAE equation and the modified inputs.
Additional Notes:	The Evaluation estimates for energy and demand are 102% and 146% greater than the Advice Filing estimates, respectively.

O. Cooler or Freezer Door Gaskets

1) Replace worn-out gaskets with new gaskets on walk-in door for coolers or freezers.

2) Ex-ante calculation assumptions:

Cooler/freezer door intentionally open 3 hr/day or 1,095 hours/yr
Door is assumed to be ajar for 25% of the rest of time, or 1,915 hours/yr
Impact is over the remaining 5,750 hours/year
Typical door perimeter, 16 ft
Door dimensions, W = 2ft x H = 6ft
Cooler temp. = 40 F, Freezer temp. = 0 F
Kitchen temp. = 70 F, relative humidity 60%
A faulty gasket allows 3% of the load gained from a fully open door.
Cooler performance factor is 1.6 kW/ton; freezer performance factor 2.4 kW/ton
80% of installations are coolers, 20% freezers

3) Analysis of ex-ante assumptions:

Door dimensions are unreasonable. A six foot cook (not uncommon) could not fit through this door comfortably
Additionally, this is inconsistent with the methods used in the evaluation of other programs.
A 3 foot x 7 foot door was used to calculate for strip curtain impacts for walk-in coolers, Advice Filing, p. RF-16
Proposed dimensions: Width = 3ft x Height = 7ft, a very conservative estimate.

Convert performance factor into EER:

Cooler performance factor = 1.6 kW/ton
= 1/[1.6 kW/ton x (1 ton/12,000 Btuh) x 1000 Watts/kW]
= 7.5
= 7.5 EER (Btuh/Watt)

Freezer performance factor = 2.4 kW/ton
= 1/[2.4 kW/ton x (1 ton/12,000 Btuh) x 1000 Watts/kW]
= 5.0
= 5.0 EER (Btuh/Watt)

Both performance factors are reasonable.
EPRI TR 100894, V1† lists a range of 3.9 EER to 4.7 EER for low temp. freezers and 7.6 EER to 9.6 EER for medium temp. coolers.

4) Advice Filing Estimates:

Infiltration by air exchange, according to 1990 ASHRAE Handbook-Refrigeration, p. 27.3-4

qt = 3,790 x W x H^1.5 x (Q/A) x (1/R) x Dt x Df

where:

qt = average heat gain in a period (Btu/h)
W = door width
H = door height

Q/A = sensible heat load of infiltration per square foot of doorway
R = sensible heat ratio of the infiltration air heat gain
Dt = door open time factor
Df = door flow factor

This version of the equation excludes an important parameter that should be retained for calculations.

qt = 3,790 x W x H^1.5 x (Q/A) x (1/R) x Dt x Df x (1-E)

where:

E = effectiveness of doorway protective device (0 = unobstructed doorway)
Advice Filing assumes that a door with a faulty gasket is 97% effective in reducing infiltration.

Demand savings for coolers:

Dt = 5,750 hrs/8,760 hrs
Df = (0.80 flow factor x 3% savings assumption)
Q/A = 0.155 tons/sqft
R = 0.59
qt = 3,790 x 2ft x (6^1.5ft) x (0.155 tons/sqft) x (1/0.59) x (5,750 hr/8,760 hr) x (0.80 x 0.03)
= 461
Demand Savings = (461 Btu/h) x (1ton-hr/12,000 Btu) x (1.6 kW/ton)
= 0.061
= 0.061 kW

Demand savings for freezers:

Q/A = 0.62 tons/sqft
R = 0.63
qt = 3,790 x 2ft x (6^1.5ft) x (0.62 tons/sqft) x (1/0.63) x (5,750 hr/8,760 hr) x (0.80*0.03)
= 1,727
Demand Savings = (1,727 Btu/h) x (1ton-hr/12,000 Btu) x (2.4 kW/ton)
= 0.345
= 0.345 kW
Advice Filing, p.RF-74 lists 0.346 kW.

Annual Energy Savings:

Energy Savings = [(0.061 kW x 0.80)+(0.345 kW x 0.20)] x 8,760 hr/yr
= 1,032
= 1,032 kWh/yr
Advice Filing, p.RF-74 lists 1,035 kWh.
Difference is due to using 0.345 kW instead of 0.346 kW

Non-coincident Demand Savings:

= (1,032 kWh/yr)/5,750 hrs door closed/year
= 0.179
= 0.179 kW

Advice Filing, p.RF-74 lists 0.179 kW
Difference is due to using 0.345 kW instead of 0.346 kW

Coincident Demand Savings:

= 0.179 kW x 0.54 CDF
= 0.097
= 0.097 kW

5) Evaluation Estimates:

The equation used in the Advice Filing excludes an important parameter that should be retained for calculations.

qt = 3,790 x W x H^1.5 x (Q/A) x (1/R) x Dt x Df x (1-E)

where:

E = effectiveness of doorway protective device (0 = unobstructed doorway)
Advice Filing assumes that an faulty gasket is 97% effective in reducing infiltration.

Demand savings for coolers:

Dt = 1.0

The impact is initially calculated with the assumption that the impact is for an entire hour.

Df = 0.80 flow factor

E = 97% according to Advice Filing, p. RF-76

Q/A = 0.16 tons/sqft according to ASHRAE* Fig. 3, p. 26.4

R = 0.59 according to ASHRAE* Table 7, p. 26.4

Note that the Df value is separated from the effectiveness term.

The net result is the same, but the Evaluation Estimate is in compliance with the ASHRAE* method.

qt = 3,790 x 3ft x (7^1.5ft) x (0.16 tons/sqft) x (1/0.59) x 1.0 x (0.80 flow factor) x (1 - 97%)

= 1,371

NC Demand Savings = (1,371 Btu/h) x (1ton-hr/12,000 Btu) x (1.6 kW/ton)

= 0.183

= 0.183 kW

Again, this impact is for an entire hour.

Demand savings for freezers:

Dt = 1.0

The impact is initially calculated with the assumption that the impact is for an entire hour.

Q/A = 0.61 tons/sqft according to ASHRAE* Fig. 3, p. 26.4

R = 0.63 according to ASHRAE* Table 7, p. 26.4

qt = 3,790 x 3ft x (7^1.5ft) x (0.61 tons/sqft) x 1.0 (1/0.63) x (0.80 flow factor) x (1 - 97%)

= 4,893

NC Demand Savings = (4,893 Btu/h) x (1ton-hr/12,000 Btu) x (2.4 kW/ton)

= 0.979

= 0.979 kW

Again, this impact is for an entire hour.

Total Non-coincident Demand Savings:

= (0.183 kW x 0.80)+(0.979 kW x 0.20)

= 0.342

= 0.342 kW

Evaluation estimate should supersede Advice Filing value.

Annual Energy Savings:

Hours Door Left Ajar = (365 day/yr x 20 hr/day) - (1,095 hr/yr door open)

= 6,205

= 6,205 hrs x 25% chance ajar

= 1,551

Hours for potential savings = 8,760 hrs - 1,551 hrs - 1,095 hrs

= 6,114

= 6,114 hrs/yr

Annual Energy Savings = 0.342 kW x 6,114 hrs/yr
= 2,091
= 2,091 kWh/yr
Evaluation Estimate should supersede Advice Filing value.

Coincident Demand Savings:

For a given hour in the year, the chance that a door will be closed is the CDF.

= 0.342 kW x (6,114 hrs/yr door closed)/(8,760 hrs/yr)

= 0.239

= 0.239 kW

Evaluation Estimate should supersede Advice Filing value.

6) Summary of results:

Impact Type (per walk-in)	Impact		Recommended Source
	Advice Filing	Evaluation	
NC Demand (kW)	0.180	0.342	Evaluation
Coinc. Demand (kW)	0.097	0.239	Evaluation
Annual Energy (kWh)	1,035	2,091	Evaluation

7) Sources:

† EPRI report TR-100984, V1, "Engineering Methods for Estimating the Impacts of Demand-Side Management Programs"; Volume 1: Fundamentals of Engineering Simulations for Residential and Commercial End Uses; Electric Power Research Institute, Palo Alto, CA, 1992.

* ASHRAE Handbook, "Refrigeration Systems and Applications"; American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. Atlanta, GA, 1994

Measure P: Auto-Closer for Cooler or Freezer

Measure Description:	Installation of an automatic, hydraulic-type door closer on doors to walk-in coolers or freezers. The purpose of this measure is to reduce the loads caused by infiltration when a walk-in door is inadvertently left ajar.
Summary of Advice Filing Calculations:	Used an equation from ASHRAE Refrigeration Handbook to determine infiltration loads associated with an open door for both a cooler and a freezer. Energy and demand impacts were determined using infiltration loads, the efficiency of the refrigeration system, and the time that the door was assumed to be ajar.
Comments on Advice Filing Calculations:	Program review has shown that the ASHRAE method was incorrectly applied.
Comments on Advice Filing Inputs:	The value used for the average door area was inconsistent with other measures, and was determined to be too small. The hours that a door is left ajar are overestimated.
Evaluation Process:	Energy and demand impacts were developed using the correctly applied ASHRAE equation and the modified inputs.
Additional Notes:	While the Evaluation energy impact is 53% greater than the Advice Filing impact, the demand impact is 12% smaller than the Advice Filing impact.

P. Auto-Closer for Cooler or Freezer

1) **Install an automatic, hydraulic-type door closer on doors to walk-in coolers and freezers**

2) **Ex-ante calculation assumptions:**

Cooler/freezer door intentionally open 3 hr/day or 1,095 hours/yr
Door is assumed to be ajar for 25% of the rest of time, or 1,915 hours/yr
Typical door perimeter, 16 ft
Door dimensions, W = 2ft x H = 6ft
Cooler temp. = 40 F, Freezer temp. = 0 F
Kitchen temp. = 70 F, relative humidity 60%
An ajar door allows 20% of the load gained from a fully open door.
Cooler performance factor is 1.6 kW/ton; freezer performance factor 2.4 kW/ton
80% of installations are coolers, 20% freezers

3) **Analysis of ex-ante assumptions:**

Door dimensions are unreasonable. A six foot cook (not uncommon) could not fit through this door comfortably
Additionally, this is inconsistent with the methods used in the evaluation of other programs.
A 3 foot x 7 foot door was used to calculate for strip curtain impacts for walk-in coolers, Advice Filing, p. RF-16
Proposed dimensions: Width = 3ft x Height = 7ft, a very conservative estimate.

Convert performance factor into EER:

Cooler performance factor = 1.6 kW/ton
= 1/[1.6 kW/ton x (1 ton/12,000 Btuh) x 1000 Watts/kW]
= 7.5
= 7.5 EER (Btuh/Watt)

Freezer performance factor = 2.4 kW/ton
= 1/[2.4 kW/ton x (1 ton/12,000 Btuh) x 1000 Watts/kW]
= 5.0
= 5.0 EER (Btuh/Watt)

Both performance factors are reasonable.
EPRI TR 100894, V1† lists a range of 3.9 EER to 4.7 EER for low temp. freezers and 7.6 EER to 9.6 EER for medium temp. coolers.

4) **Advice Filing Estimates:**

Infiltration by air exchange, according to 1990 ASHRAE Handbook-Refrigeration, p. 27.3-4

qt = 3,790 x W x H^1.5 x (Q/A) x (1/R) x Dt x Df

where:

qt = average heat gain in a period (Btu/h)
W = door width
H = door height
Q/A = sensible heat load of infiltration per square foot of doorway

R = sensible heat ratio of the infiltration air heat gain
Dt = door open time factor
Df = door flow factor

This version of the equation excludes an important parameter that should be retained for calculations.

qt = 3,790 x W x H^1.5 x (Q/A) x (1/R) x Dt x Df x (1-E)

where:

E = effectiveness of doorway protective device (0 = unobstructed doorway)
Advice Filing assumes that an ajar door is 80% effective in reducing infiltration.

Demand savings for coolers, when door is left ajar:

Dt = 1,915 hrs/8,760 hrs
Df = (0.80 flow factor x 20% savings assumption)
Q/A = 0.155 tons/sqft
R = 0.59
qt = 3,790 x 2ft x (6^1.5ft) x (0.155 tons/sqft) x (1/0.59) x (1,915 hr/8,760 hr) x (0.80 x 0.20)
= 1,024
Demand Savings = (1,024 Btu/h) x (1ton-hr/12,000 Btu) x (1.6 kW/ton)
= 0.137
= 0.137 kW

Demand savings for freezers, when door is left ajar:

Q/A = 0.62 tons/sqft
R = 0.63
qt = 3,790 x 2ft x (6^1.5ft) x (0.62 tons/sqft) x (1/0.63)* x (1,915 hr/8,760 hr) x (0.80*0.20)
= 3,835
Demand Savings = (3,835 Btu/h) x (1ton-hr/12,000 Btu) x (2.4 kW/ton)
= 0.767
= 0.767 kW

Annual Energy Savings:

Energy Savings = [(0.137 kW x 0.80)+(0.767 kW x 0.20)] x 8,760 hr/yr
= 2,304
= 2,304 kWh/yr

Non-coincident Demand Savings:

= (2,304 kWh/yr)/1,915 hours door ajar/year
= 1.203
= 1.203 kW

Coincident Demand Savings:

= 1.203 kW x 0.54 CDF
= 0.650
= 0.650 kW

5) Evaluation Estimates:

The equation used in the Advice Filing excludes an important parameter that should be retained for calculations.

qt = 3,790 x W x H^1.5 x (Q/A) x (1/R) x Dt x Df x (1-E)

where:

E = effectiveness of doorway protective device (0 = unobstructed doorway)
Advice Filing assumes that an ajar door is 80% effective in reducing infiltration.

Demand savings for coolers, when door is left ajar:

Dt = 1.0
The impact is initially calculated with the assumption that the door is left ajar for an entire hour.
Df = 0.80 flow factor
E = 80% according to Advice Filing, p. RF-76
Q/A = 0.16 tons/sqft according to ASHRAE* Fig. 3, p. 26.4
R = 0.59 according to ASHRAE* Table 7, p. 26.4
Note that the Df value is separated from the effectiveness term.
The net result is the same, but the Evaluation Estimate is in compliance with the ASHRAE* method.

qt = 3,790 x 3ft x (7^1.5ft) x (0.16 tons/sqft) x 1.0 x (1/0.59) x (0.80 flow factor) x (1 - 80%)
= 9,137
NC Demand Savings = (9,137 Btu/h) x (1ton-hr/12,000 Btu) x (1.6 kW/ton)
= 1.218
= 1.218 kW
Again, this impact assumes that the cooler door is left ajar for an entire hour.

Demand savings for freezers, when door is left ajar:
Dt = 1.0
The impact is initially calculated with the assumption that the door is left ajar for an entire hour.
Q/A = 0.61 tons/sqft according to ASHRAE* Fig. 3, p. 26.4
R = 0.63 according to ASHRAE* Table 7, p. 26.4
qt = 3,790 x 3ft x (7^1.5ft) x (0.61 tons/sqft) x (1/0.63) x 1.0 x (0.80 flow factor) x (1 - 80%)
= 32,622
NC Demand Savings = (32,622 Btu/h) x (1ton-hr/12,000 Btu) x (2.4 kW/ton)
= 6.524
= 6.524 kW
Again, this impact assumes that the freezer door is left ajar for an entire hour.

Average NC Demand Savings:
= (1.218 kW x 0.80)+(6.524 kW x 0.20)
= 2.279
= 2.279 kW
Evaluation estimate should supersede Advice Filing value.

Annual Energy Savings:
Assume a busy, full-day restaurant, open 20 hours/day, 365 days/year.

Hours Door Left Ajar = (365 day/yr x 20 hr/day) - (1,095 hr/yr door open)
= 6,205
= 6,205 hrs x 25% chance ajar
= 1,551
Annual Energy Savings = [(1.218 kW x 0.80)+(6.524 kW x 0.20)] x 1,551 hr/yr
= 3,535
= 3,535 kWh/yr
The Advice Filing estimate understates the potential energy savings by 53%.
Evaluation Estimate should supersede Advice Filing value.

Coincident Demand Savings:
Although the advice filing methods apply a diversity factor (CDF), this does not appear to be necessary.
If the energy savings are assumed to be spread evenly across the time that the door potentially could be ajar, then a CDF need not be applied.

= 2.279 x (1,551 hrs door ajar)/6,205 hrs door potentially ajar

= 0.570
= 0.570 kW
Evaluation Estimate should supersede Advice Filing value.

6) **Summary of results:**

Impact Type (per walk-in)	Impact		Recommended Source
	Advice Filing	Evaluation	
NC Demand (kW)	1.203	2.279	Evaluation
Coinc. Demand (kW)	0.650	0.570	Evaluation
Annual Energy (kWh)	2,304	3,535	Evaluation

7) **Sources:**

† EPRI report TR-100984, V1, "Engineering Methods for Estimating the Impacts of Demand-Side Management Programs"; Volume 1: Fundamentals of Engineering Simulations for Residential and Commercial End Uses; Electric Power Research Institute, Palo Alto, CA, 1992.

* ASHRAE Handbook, "Refrigeration Systems and Applications"; American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. Atlanta, GA, 1994

Measure Q: Cooler or Freezer with Non-Electric Condensate Evaporator

Measure Description:	Replacement of an electric condensate evaporator with a non-electric one. A non-electric condensate evaporator routes the hot gas following compression to the condensate pan to evaporate water.
Summary of Advice Filing Calculations:	Demand and energy estimates were developed using the connected load of an electric condensate evaporator and its controls.
Comments on Advice Filing Calculations:	The method used to develop energy impacts appears valid. The use of a CDF in the development of demand impacts is unnecessary. The CDF is based upon the cycling of the compressor, which is unrelated to the operation of the condensate evaporator.
Comments on Advice Filing Inputs:	Inputs are based upon manufactures' data and appear to be valid.
Evaluation Process:	Demand estimates were generated with the assumption that the CDF for the measure is 1.0.
Additional Notes:	The Evaluation demand estimate is 84% greater than the Advice Filing estimate.

Q. Cooler or Freezer with Non-Electric Condensate Evaporator:

1) **Hot gas following compression can be routed to the condensate pan to evaporate water.**
In the absence of a hot gas evaporative system, electric resistance heaters are typically used.

2) **Ex-ante calculation assumptions:**
Condensate evaporators draw 215 Watts.
Controlled condensate evaporators operate just 4,380 hr/yr.
Uncontrolled units run constantly for 8,760 hours per year.
25% of the replaced units have controlled condensate evaporators.
Maximum power draw when pan is empty for controlled condensate evaporators is 30 W.

3) **Advice Filing Estimates:**
Non-coincident Demand Savings:

= [(215 Watts x 0.75) + (215 Watts x 0.25 x 0.5)]/1,000 Watts/kW
= 0.188
= 0.188 kW/unit

Coincident Demand Savings:

= 0.54 CDF x {[(215 Watts x 0.75) + (215 Watts x 0.25 x 0.5)]/1,000 Watts/kW)
= 0.102
0.102 kW/unit Advice Filing Estimate
Note also that the 30 W value is not used in calculating the coincident demand.
The 30 W power draw cancels itself out for demand estimates .

Energy Savings:

= {(215 Watts x 8760 Hours x 0.75)+[0.25*(((215 Watts -30 Watts) x 8760 Hours x 0.5)+(30 Watts x 8760 Hours))]}/1000 Watts/kW
= 1681
1,681 kWh/unit
There is no explanation in the advice filing for the use of the 30 Watt value in this algorithm.
According to the 1994 CIA Policy and Procedures (p.4.1-54) 30 Watts is the maximum power draw when the pan is empty.

4) **Evaluation Estimates:**
Non-coincident Demand Savings:
See Advice Filing.

Coincident Demand Savings:
Although the advice filing methods apply a diversity factor (CDF), this does not appear to be necessary.
It is not anticipated that the electric resistance heater would be associated in any manner with the cycling of the refrigeration compressors.
Since the Advice Filing bases the CDF on the cycling of the refrigeration compressors, it should not be applied.
Therefore:
Baseline Coinc. kW = 0.188 kW/unit
Since the end-use is completely avoided, this is the impact.

Energy Savings:

See Advice Filing.

5) Summary of results:

Impact Type (per unit)	Impact		Recommended Source
	Advice Filing	Evaluation	
NC Demand (kW)	0.188	-	Advice Filing
Coinc. Demand (kW)	0.102	0.188	Evaluation
Annual Energy (kWh)	1,681	-	Advice Filing

1994 Measure: High Capacity Oversized Condenser, Evaporative-Cooled (Ammonia)

Measure Description:	Provides an incentive to increase the size of the evaporative condenser to meet or exceed ARI standard 490-89, and thus increase the total heat of rejection (THR).
Summary of Advice Filing Calculations:	Energy and demand impacts were developed using values generated for the High Capacity Oversized Condenser Evaporative-Cooled (Halocarbon) measure.
Comments on Advice Filing Calculations:	Demand impacts were developed using an inappropriate CDF. Energy impacts were based upon the impacts for the halocarbon measure. The methods used could not be verified because the references cited were not available.
Comments on Advice Filing Inputs:	Halocarbon measure non-coincident demand values were incorrectly entered into the Advice Filing method.
Evaluation Process:	Demand estimates were generated with the assumption that the energy savings are spread evenly across an entire year. Energy impacts were re-calculated using values from the halocarbon measure.
Additional Notes:	The Evaluation demand estimate is 37% smaller than the Advice Filing estimate. The difference in energy impacts is assumed to be the result of rounding.

1994. High Capacity Oversized Condenser, Air-Cooled

1) Incentive to increase size of air-cooled condenser and thus increase the total heat of rejection (THR).

Oversizing must meet/exceed ARI standard 460-87.

ARI standard 460-87 has been updated. New standard is 460-94.

Oversizing lowers condensing temperature (CT) and the discharge pressure of the compressors.

2) Ex-ante calculation assumptions:

Discharge temperatures range from 130 to 100 C.

Average compressor demand savings for R-12/R-22 medium temperature systems is 0.5736 kW/ton.

No mention is made of impacts for low temperature systems.

Using a 1.6 kW/ton performance factor (Advice Filing p.RF-76) for a medium temperature system the savings attributable to the reduced compressor demand would account for 35.8% of the entire system power draw.

(0.5736 kW/ton)/1.6 kW/ton = 35.8%

There is a power increase of 0.06 hp/ton for auxiliary fans.

= 0.06 hp/ton x 0.746 kW/hp

= 0.04476

= 0.04476 kW/ton

3) Advice Filing Estimates:

Impacts stated in the Advice Filing could not be verified because the method used was not described.

Inputs used in the Advice Filing could not be verified, as not all of the inputs were listed

The cited sources for the demand savings were unobtainable.

4) Evaluation Estimates:

Advice Filing coincident impacts were developed using 0.54 CDF.

Using the energy impact and NC demand impact, full load hours were back-calculated, yielding 4,957 hours.

This is very close to the 4,960 average EFLH's cited in the Advice Filing (p.RF-6), and indicates that the application of a CDF is inappropriate.

Coincident Demand Savings:

Assume savings is spread evenly across the entire year, a conservative estimate of demand savings.

= (71.38 kWh/ton-F)/8,760 hrs/yr

= 0.0081

= 0.0081 kW/ton-F

Actual impacts at the time of system peak are most likely greater than this value.

5) Summary of Results:

Impact Type (per ton-F)	Impact		Recommended Source
	Advice Filing	Evaluation	
NC Demand (kW)	0.0144	-	Advice Filing
Coinc. Demand (kW)	0.0078	0.0081	Evaluation

Annual Energy (kWh)	71.38	-	Advice Filing

1994. High Capacity Oversized Condenser, Evaporative-Cooled (Halocarbon)

1) Incentive to increase size of evaporative condenser and thus increase the total heat of rejection (THR).

Oversizing must meet/exceed ARI standard 490-89.
Oversizing lowers condensing temperature (CT) and discharge pressure of compressors.
A penalty must be applied if the sum of condenser fan and pump horsepower exceeds 0.09 hp/condenser ton.

2) Ex-ante calculation assumptions:

Oversizing the condenser reduces medium temperature compressors power draw by 0.01471 kW/ton-F.
There is a power increase of 0.06 hp/ton for auxiliary fans.

= 0.06 hp/ton x 0.746 kW/hp
= 0.04476
= 0.04476 kW/ton
Advice Filing lists 0.0055 kW/ton (p.NRR-64) which is inconsistent with other hp to kW conversions (see p.NRR-59,61).

Compressors operate a total of 4.960 EFLH per year.

3) Advice Filing Estimates:

Impacts stated in the Advice Filing could not be verified because the references cited were not available.

4) Evaluation Estimates:

Advice Filing coincident impact were developed using 0.54 CDF.

Coincident Demand Savings:

Assume savings is spread evenly across the entire year.
= (37.25 kWh/ton-F)/8,760 hrs/yr
= 0.0043
= 0.0043 kW/ton-F
Actual impacts at the time of system peak are most likely greater than this value.

5) Summary of Results:

Impact Type (per ton-F)	Impact		Recommended Source
	Advice Filing	Evaluation	
NC Demand (kW)	0.0075	-	Advice Filing
Coinc. Demand (kW)	0.0041	0.0043	Evaluation
Annual Energy (kWh)	37.25	-	Advice Filing

1994. High Capacity Oversized Condenser, Evaporative-Cooled (Ammonia)

1) Incentive to increase size of evaporative condenser and thus increase the total heat of rejection (THR).

Oversizing must meet/exceed ARI standard 490-89.
Oversizing lowers condensing temperature (CT) and discharge pressure of compressors.
A penalty must be applied if the sum of condenser fan and pump horsepower exceeds 0.09 hp/condenser ton.

2) Ex-ante calculation assumptions:

Average operating hours are based upon assumptions as no current data exists.
EPRI estimates that demand savings for ammonia systems are 25% greater than demand savings for halocarbon systems.
All calculations are based upon a similar analysis completed for halocarbon systems (Advice Filing p.NRR-64,65)

3) Calculation of operating hours:

Advice Filing Estimate:

	% Participation	Full Load Hours/yr	Weighted
Industrial	0.35	2,340	819
Dist. Warehouse	0.15	4,960	744
Fruit Cold Storage	0.30	3,720	1,116
Fruit Hydrocoolers	0.20	1,620	324
		Weighted ave = 3,003	

4) Advice Filing Estimates:

Non-coincident Demand Savings:

= (0.0092 kW/ton-F x 1.25)
= 0.0115
= 0.0115 kW/ton-F
This value is unsubstantiated by Advice Filing documentation.
0.0094 kW/ton-F is the value used in the Advice Filing for the Measure Summary, p.NRR-68
Demand savings for the halocarbon condenser is 0.0075 kW, not 0.0092 kW/ton-F (Advice Filing, p. NRR-65).

Coincident Demand Savings:

= (0.0094 kW/ton-F x 0.54)
= 0.0051
= 0.0051 kW/ton-F

Advice Filing Estimate:

Energy Savings = (0.0092 kW/yr-ton-F x 3003)
= 27.6276
= 27.63 kWh/yr-ton-F

	The reported value in the Measure Summary is 28.19 kWh/yr-ton-F. Using 0.0092 kW/ton-F ignores the prior calculation, which estimates non-coincident savings to be 0.0115 kW/ton-F.

5) Evaluation Estimates:

Non-coincident Demand Savings:

Halocarbon demand savings for oversizng the evaporative condenser = 0.0075 kW/ton-F (Advice Filing, p.NRR-65).
Demand savings for ammonia systems will be 25% greater than halocarbon savings (Advice Filing, p.NRR-67).
= (0.0075 kW/ton-F x 1.25)
= 0.0094
= 0.0094 kW/ton-F
0.0094 kW/ton-F is the value used in the Advice Filing for the Measure Summary, p. NRR-68

Coincident Demand Savings:

Although the Advice Filing methods apply a diversity factor (CDF), this does not appear to be necessary.
Energy savings are assumed to be spread evenly across the entire year.
= [(28.23 kWh/yr -ton-F) /8,760 hrs/yr]
= 0.0032
= 0.0032 kW/ton-F
This value should supersede the Advice Filing estimate,.
Actual coincident impacts can be assumed to be within the range of 0.0032 kW/ton-F to 0.0094 kW/ton-F, and may be closer to 0.0094 kW/ton-F.

Energy Savings:

= (0.0094 kW/ton-F x 3,003 full load hours/yr)
= 28.23
= 28.23 kWh/yr-ton-F
The reported value of 28.19 in the Measure Summary, p. NRR-68 is close to 28.23.
Recommend using 28.23 kWh/yr-ton-F as the results are reproducible.

6) Summary of Results:

Impact Type (per ton-F)	Impact		Recommended Source
	Advice Filing	Evaluation	
NC Demand (kW)	0.0094	0.0094	Advice Filing
Coinc. Demand (kW)	0.0051	0.0032	Evaluation
Annual Energy (kWh)	28.19	28.23	Evaluation

1994 Measure: Energy-Efficient Evaporator Motors: Display Case

Measure Description:	Replacement of an existing burned-out shaded pole evaporator motor with a permanent split capacitor motor for a refrigeration display case.
Summary of Advice Filing Calculations:	Energy and demand savings were developed using fan power draw, annual fan energy use, compressor efficiency, and case loads associated with evaporator fans.
Comments on Advice Filing Calculations:	Demand impacts were developed using an inappropriate CDF, and did not take indirect impacts into account. The method used to develop energy is valid.
Comments on Advice Filing Inputs:	Inputs were taken from the PG&E Commercial New Construction model, but could not be verified (because the document was unavailable).
Evaluation Process:	Demand estimates were developed which include the case load savings. An energy impact was not developed.
Additional Notes:	The Evaluation demand estimate is 191% greater than the Advice Filing estimate.

1993. Energy-Efficient Evaporator Motors: Display Case

1) **Replace existing shaded-pole (SP) evaporator fan motors with permanent-split capacitor (PSC) motors.**
The program targets customers replacing a burned-out evaporator fan motors in display cases.
The long term goal is to encourage refrigeration servicemen to stock PSC fan motors instead of SP motors.

2) **Ex-ante calculation assumptions:**
Baseline evaporator fan energy usage for a display case is 234 kWh/yr-ft, according to Commercial New Construction model.
Baseline evaporator fan power draw for a display case is 0.0267 kW/ft, according to Commercial New Construction model.
PSC fan motors are 33% more efficient than similarly sized SP motors.
50% of installations will be in low temperature cases, with the remainder being medium temperature cases.
Low temperature compressors have EER of 5.0.
Medium temperature compressors have EER of 7.5.
100% of fan motor heat is transferred into the refrigerated space of the display case.

3) **Advice Filing† Estimates:**

Direct Demand Savings:

= 0.0267 kW/ft x 33%
= 0.0088
= 0.0088 kW/ft

Energy Savings:

Direct Energy Savings:
= 234 kWh/yr-ft x 33%
= 77.22
= 77.22 kW/yr-ft

Indirect Energy Savings:
Case Load Reduction = kW saved x 3,414 Btuh/kW x 100%
= 0.0088 kW/ft x 3,414 Btuh/kW x 100%
= 30.0432
= 30.0432 Btuh/ft
Advice Filing† lists 30.081 kW/ft. Difference assumed to be rounding.
Adjust to kWh = 30.0432 Btuh/ft x 8,760 hrs/yr x {[(1/5.0 Btuh/Watt) x 50%]} + [(1/7.5 Btuh/Watt) x 50%]} x 1 kW/1,000 Watts
= 43.86
= 43.86 kWh/yr-ft
Advice Filing† lists 44.02 kWh/yr-ft as the value. Difference assumed to be rounding.

Total Energy Savings:
= 77.2 kWh/yr-ft + 44.02 kWh/yr-ft
= 121.22
= 121.22 kWh/yr-ft

Coincident Demand Savings:

= 0.0088 kW/ft x 0.54 CDF
= 0.00475
= 0.00475 kW/ft
Though the Advice Filing† uses a CDF of 0.54, this is not an appropriate value as the fans are assumed operate continuously.
Additionally, this does not take into account the indirect impacts.
A more appropriate coincident impact would be (121.22 kWh/ft-yr)/(8,760 hrs/yr) = 0.0138 kW/ft

4) Evaluation Estimates:

Direct Demand Savings:

See Advice Filing estimate.

Indirect Demand Savings:

Case Load Reduction = kW saved x 3,414 Btuh/kW x 100%
= 0.0088 kW/ft x 3,414 Btuh/kW x 100%
= 30.0432
= 30.0432 Btuh/ft

Adjust to kW = 30.0432 Btuh/ft x {[(1/5.0 Btuh/Watt) x 50%]} + [(1/7.5 Btuh/Watt) x 50%]} x 1 kW/1,000 Watts
= 0.00501
= 0.00501 kW/ft

Total Demand Savings:

= 0.0088 kW/ft + 0.00501 kW/ft
= 0.0138
= 0.0138 kW/ft

Energy Savings:

See Advice Filing estimate.

5) Summary of Results:

Impact Type (per linear foot)	Impact		Recommended Source
	Advice Filing†	Evaluation	
NC Demand (kW)	0.0088	-	†††
Coinc. Demand (kW)	0.00475	0.0138	Evaluation
Annual Energy (kWh)	121.22	-	Advice Filing

††† Using the Evaluation methods, this value is unnecessary.

6) Sources:

† Advice Filing for the 1994 Retrofit Express Program; PG&E, October, 1993.

1994 Measure: Energy-Efficient Evaporator Motors: Walk-in Box

Measure Description:	Replacement of an existing burned-out shaded pole evaporator motor with a permanent split capacitor motor for a walk-in.
Summary of Advice Filing Calculations:	Energy and demand savings were developed using fan kVA, motor power factor, compressor efficiency, and heat gains associated with evaporator fans.
Comments on Advice Filing Calculations:	Demand impacts were developed using an inappropriate CDF, and did not take indirect impacts into account. The method used to develop energy impacts is valid.
Comments on Advice Filing Inputs:	Inputs are from the ASHRAE HVAC Systems and Applications Handbook, and manufactures' data, which appear valid.
Evaluation Process:	Demand estimates were developed which include the case load savings. An energy impact was not developed.
Additional Notes:	The Evaluation demand estimate is 147% greater than the Advice Filing estimate.

1993. Energy-Efficient Evaporator Motors: Walk-in Box

1) Replace existing shaded-pole (SP) evaporator fan motors with permanent-split capacitor (PSC) motors.

The program targets customers replacing a burned-out evaporator fan motors in walk-ins.
The long term goal is to encourage refrigeration servicemen to stock PSC fan motors instead of SP motors.

2) Ex-ante calculation assumptions:

Baseline evaporator fan kVA for SP motors is 4.46 kVA/hp, according to Advice Filing† data, (p.RF-47 to p.RF-49).
Baseline power factor for SP motors is 60%, according to ASHRAE*, Table 4, p.40.5
Retrofit evaporator fan kVA for PSC motors is 2.10 kVA/hp, according to Advice Filing† data, (p.RF-47 to p.RF-49).
Retrofit power factor for PSC motors is 95%, according to ASHRAE* Table 4, p.40.5.
20% of installations will be in low temperature cases.
80% of installations will be in medium temperature cases.
Low temperature compressors have EER of 5.0.
Medium temperature compressors have EER of 7.5.
80% of the fans are located inside of the refrigerated space.
If a fan is located within the refrigerated space 100% of fan motor heat is transferred into the cooling load.

3) Advice Filing† Estimates:

Direct Demand Savings:

kW = kVA x power factor
= (4.46 kVA/hp x 60%) - (2.10 kVA/hp x 95%)
= 0.681
= 0.681 kW/hp

Energy Savings:

Direct Energy Savings:
= 0.681 kW/hp x 8,760 hrs/yr
= 5,965.56
= 5,966 kW/hp-yr

Indirect Energy Savings:
Case Load Reduction = kW saved x 3,414 Btuh/kW x 80%
= 0.681 kW/hp x 3,414 Btuh/kW x 80%
= 1,859.95
= 1,860 Btuh/hp
Adjust to kWh = 1,859.95 Btuh/hp x 8,760 hrs/yr x {[(1/5.0 Btuh/Watt) x 20%]} + [(1/7.5 Btuh/Watt) x 80%]} x 1 kW/1,000 Watts
= 2,389.66
= 2,390 kWh/yr-ft

Total Energy Savings:
= 5,965.56 kWh/yr-hp + 2389.66 kWh/yr-hp
= 8,355.22

= 8,355 kWh/yr-hp

Coincident Demand Savings:

= 0.681 kW/hp x 0.54 CDF
= 0.3677
= 0.368 kW/ft

Though the Advice Filing uses a CDF of 0.54, this is not an appropriate value as the fans are assumed operate continuously.
Additionally, this does not take into account the indirect impacts.
A more appropriate coincident impact would be (8,355 kWh/hp-yr)/(8,760 hrs/yr) = 0.954 kW/hp

4) Evaluation Estimates:

Direct Demand Savings:

See Advice Filing estimate.

Indirect Demand Savings:

Case Load Reduction = kW saved x 3,414 Btuh/kW x 80%
= 0.681kW/hp x 3,414 Btuh/kW x 80%
= 1,860
= 1,860 Btuh/hp

Adjust to kW = 1,860 Btuh/ft x {[(1/5.0 Btuh/Watt) x 20%]} + [(1/7.5 Btuh/Watt) x 80%]} x 1 kW/1,000 Watts
= 0.2728
= 0.273 kW/hp

Total Demand Savings:

= 0.681 kW/hp + 0.273 kW/hp
= 0.954
= 0.954 kW/hp

Energy Savings:

See Advice Filing estimate.

5) Summary of Results:

Impact Type (per horsepower)	Impact		Recommended Source
	Advice Filing	Evaluation	
NC Demand (kW)	0.681	-	†††
Coinc. Demand (kW)	0.386	0.954	Evaluation
Annual Energy (kWh)	8,355.22	-	Advice Filing

††† Using the Evaluation methods, this value is unnecessary.

6) Sources:

† Advice Filing for the 1994 Retrofit Express Program; PG&E, October, 1993.

* ASHRAE Handbook, "HVAC Systems and Applications"; American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.

Atlanta, GA, 1992

Appendix B.6.1
Error Documentation

Brief analysis of Grocery #37 ASD measure (#1) savings:

Summary	Supply Fan		Calculated Savings		Attachment 7 Savings	
Usage by Measure	Demand	Energy	Demand	Energy	Demand	Energy
Baseline	18.00	150,754	-	-	-	-
Measure #1	15.00	25,732	3.00	125,022	0.00	125,022
Measure #2	15.00	25,732	-	-	-	-
Measure #3	15.00	25,732	-	-	-	-

Brief analysis of Grocery #37 condenser measure (#2) savings:

Summary	Refrigeration Compressors		A/C Compressors		Condenser Fans		Total		Calculated Savings		Attachment 7 Savings	
Usage by Measure	Demand	Energy	Demand	Energy	Demand	Energy	Demand	Energy	Demand	Energy	Demand	Energy
Baseline	73.00	448,248	20.00	9,624	9.00	26,541	102.00	484,413	-	-	-	-
Measure #1	73.00	448,248	20.00	9,624	8.00	26,541	101.00	484,413	-	-	-	-
Measure #2	73.00	412,969	20.00	3,165	9.00	67,082	102.00	483,216	-1.00	1,197	2.00	1,196
Measure #3	67.00	368,868	20.00	4,774	9.00	64,254	96.00	437,896	-	-	-	-

Brief analysis of Grocery #37 EMS measure (#3) savings:

Summary	Refrigeration Compressors		A/C Compressors		Condenser Fans		Ice Cream	LT#1	LT#2	MT#1	MT#2	Lighting	Total		Calculated Savings		Attachment 7 Savings	
Usage by Measure	Demand	Energy	Demand	Energy	Demand	Energy	Energy	Energy	Energy	Energy	Energy	Energy	Demand	Energy	Demand	Energy	Demand	Energy
Baseline													-	-	-	-	-	-
Measure #1													-	-	-	-	-	-
Measure #2	73.00	412,969	20.00	3,165	9.00	67,082	10,750	120,867	34,775	30,366	30,660	194,909	102.00	905,543	-	-	-	-
Measure #3	67.00	368,868	20.00	4,774	9.00	64,254	5,667	65,689	29,352	16,789	29,486	109,636	96.00	694,515	6.00	211,028	6.00	211,027

Brief analysis of Grocery #37, summary of measure savings:

Summary	Calculated Summary Savings	
Usage by Measure	Demand	Energy
Baseline	-	-
Measure #1	3.00	125,022
Measure #2	-1.00	1,197
Measure #3	6.00	211,028

Brief analysis of Grocery #37 summary of total savings:

Summary	Total Level		Calculated Savings		Attachment 7 Level		Calculated Attach 7 Savings	
Usage by Measure	Demand	Energy	Demand	Energy	Demand	Energy	Demand	Energy
Baseline	240.00	1,487,219	-	-	240.00	1,487,219	-	-
Measure #1	236.00	1,344,106	4.00	143,113	240.00	1,344,106	0.00	143,113
Measure #2	237.00	1,342,910	-1.00	1,196	237.00	1,342,910	3.00	1,196
Measure #3	231.00	1,131,883	6.00	211,027	231.00	1,131,883	6.00	211,027

Brief analysis of Grocery #51 ASD measure (#1) savings:

Summary	Supply Fan		Calculated Savings		Attachment 7 Savings	
Usage by Measure	Demand	Energy	Demand	Energy	Demand	Energy
Baseline	14.00	120,672	-	-	-	-
Measure #1	14.00	23,205	0.00	97,467	0.00	97,467
Measure #2	14.00	23,205	-	-	-	-
Measure #3	14.00	23,205	-	-	-	-

Brief analysis of Grocery #51 condenser measure (#2) savings:

Summary	Refrigeration Compressors		A/C Compressors		Condenser Fans		Total		Calculated Savings		Attachment 7 Savings	
Usage by Measure	Demand	Energy	Demand	Energy	Demand	Energy	Demand	Energy	Demand	Energy	Demand	Energy
Baseline	56.00	339,933	17.00	15,149	16.00	63,758	89.00	418,840	-	-	-	-
Measure #1	56.00	339,933	17.00	15,149	15.00	63,758	88.00	418,840	-	-	-	-
Measure #2	56.00	307,456	16.00	12,765	11.00	86,582	83.00	406,803	5.00	12,037	6.00	12,037
Measure #3	53.00	283,836	16.00	12,765	11.00	83,978	80.00	380,579	-	-	-	-

Brief analysis of Grocery #51 EMS measure (#3) savings:

Summary	Refrigeration Compressors		A/C Compressors		Condenser Fans		Ice Cream	LT#1	LT#2	MT#2	Lighting	Total		Calculated Savings		Attachment 7 Savings	
Usage by Measure	Demand	Energy	Demand	Energy	Demand	Energy	Energy	Energy	Energy	Energy	Energy	Demand	Energy	Demand	Energy	Demand	Energy
Baseline												-	-	-	-	-	-
Measure #1												-	-	-	-	-	-
Measure #2	56.00	307,456	16.00	12,765	11.00	86,582	17,608	23,196	68,964	66,839	172,412	83.00	755,822	-	-	-	-
Measure #3	53.00	283,836	16.00	12,765	11.00	83,978	9,767	12,836	41,873	44,559	133,297	80.00	622,911	3.00	132,911	3.00	132,911

Brief analysis of Grocery #51, summary of measure savings:

Summary	Calculated Summary Savings	
Usage by Measure	Demand	Energy
Baseline	-	-
Measure #1	0.00	97,467
Measure #2	5.00	12,037
Measure #3	3.00	132,911

Brief analysis of Grocery #51 summary of total savings:

Summary	Total Level		Calculated Savings		Attachment 7 Level		Calculated Attach 7 Savings	
Usage by Measure	Demand	Energy	Demand	Energy	Demand	Energy	Demand	Energy
Baseline	221.00	1,356,554	-	-	221.00	1,356,554	-	-
Measure #1	220.00	1,259,087	1.00	97,467	221.00	1,259,087	0.00	97,467
Measure #2	214.00	1,247,049	6.00	12,038	214.00	1,247,049	7.00	12,038
Measure #3	211.00	1,114,138	3.00	132,911	211.00	1,114,138	3.00	132,911

Revisions based upon an updated (3/15/95) spreadsheet included within this application

Brief analysis of Grocery #63 ASD measure (#1) savings:

Summary	Supply Fan		Calculated Savings		Attachment 7 Savings	
Usage by Measure	Demand	Energy	Demand	Energy	Demand	Energy
Baseline	18.00	150,840	-	-	-	-
Measure #1	17.00	31,598	1.00	119,242	0.00	119,242
Measure #2	17.00	31,598	-	-	-	-
Measure #3	17.00	31,598	-	-	-	-

Brief analysis of Grocery #63 condenser measure (#2) savings:

Summary	Refrigeration Compressors		A/C Compressors		Condenser Fans		Total		Calculated Savings		Attachment 7 Savings	
Usage by Measure	Demand	Energy	Demand	Energy	Demand	Energy	Demand	Energy	Demand	Energy	Demand	Energy
Baseline	75.00	460,446	20.00	16,171	16.00	30,435	111.00	507,052	-	-	-	-
Measure #1	75.00	460,446	20.00	16,171	8.00	30,435	103.00	507,052	-	-	-	-
Measure #2	78.00	402,479	16.00	7,782	7.00	57,732	101.00	467,993	2.00	39,059	10.00	39,059
Measure #3	72.00	375,809	16.00	7,782	7.00	56,343	95.00	439,934	-	-	-	-

Brief analysis of Grocery #63 EMS measure (#3) savings:

Summary	Refrigeration Compressors		A/C Compressors		Condenser Fans		Ice Cream	LT#1	MT#1	MT#2	Lighting	Total		Calculated Savings		Attachment 7 Savings	
Usage by Measure	Demand	Energy	Demand	Energy	Demand	Energy	Energy	Energy	Energy	Energy	Energy	Demand	Energy	Demand	Energy	Demand	Energy
Baseline												0.00	0	-	-	-	-
Measure #1												0.00	0	-	-	-	-
Measure #2	78.00	402,479	16.00	7,782	7.00	57,732	11,257	14,191	156,103	78,525	153,418	101.00	881,487	-	-	-	-
Measure #3	72.00	375,809	16.00	7,782	7.00	56,343	9,475	9,811	115,422	52,350	115,847	95.00	742,839	6.00	138,648	6.00	138,648

Brief analysis of Grocery #63, summary of measure savings:

Summary	Calculated Summary Savings	
Usage by Measure	Demand	Energy
Baseline	-	-
Measure #1	1.00	119,242
Measure #2	2.00	39,059
Measure #3	6.00	138,648

Brief analysis of Grocery #63 summary of total savings:

Summary	Total Level		Calculated Savings		Attachment 7 Level		Calculated Attach 7 Savings	
Usage by Measure	Demand	Energy	Demand	Energy	Demand	Energy	Demand	Energy
Baseline	242.00	1,563,010	-	-	242.00	1,563,010	-	-
Measure #1	234.00	1,443,768	8.00	119,242	242.00	1,443,768	0.00	119,242
Measure #2	232.00	1,404,709	2.00	39,059	232.00	1,404,709	10.00	39,059
Measure #3	226.00	1,266,061	6.00	138,648	226.00	1,266,061	6.00	138,648

Brief analysis of Grocery #73 ASD measure (#1) savings:

Summary	Supply Fan		Calculated Savings		Attachment 7 Savings	
Usage by Measure	Demand	Energy	Demand	Energy	Demand	Energy
Baseline	18.00	150,516	-	-	-	-
Measure #1	17.00	45,312	1.00	105,204	0.00	105,204
Measure #2	17.00	45,312	-	-	-	-
Measure #3	17.00	45,312	-	-	-	-

Brief analysis of Grocery #73 condenser measure (#2) savings:

Summary	Refrigeration Compressors		A/C Compressors		Condenser Fans		Total		Calculated Savings		Attachment 7 Savings	
Usage by Measure	Demand	Energy	Demand	Energy	Demand	Energy	Demand	Energy	Demand	Energy	Demand	Energy
Baseline	136.00	698,552	17.00	15,585	16.00	69,138	169.00	783,275	-	-	-	-
Measure #1	136.00	698,552	17.00	15,585	16.00	69,138	169.00	783,275	-	-	-	-
Measure #2	133.00	632,041	14.00	7,252	16.00	98,489	163.00	737,782	6.00	45,493	6.00	45,493
Measure #3	129.00	603,447	17.00	8,322	16.00	95,555	162.00	707,324	-	-	-	-

Brief analysis of Grocery #73 EMS measure (#3) savings:

Summary	Refrigeration Compressors		A/C Compressors		Condenser Fans		Ice Cream	LT#1	LT#2	MT#1	MT#2	Lighting	Total		Calculated Savings		Attachment 7 Savings	
Usage by Measure	Demand	Energy	Demand	Energy	Demand	Energy	Energy	Energy	Energy	Energy	Energy	Energy	Demand	Energy	Demand	Energy	Demand	Energy
Baseline													-	-	-	-	-	-
Measure #1													-	-	-	-	-	-
Measure #2	133.00	632,041	14.00	7,252	16.00	98,489		83,395		36,792	169,331	353,831	163.00	1,381,131	-	-	-	-
Measure #3	129.00	603,447	17.00	8,322	16.00	95,555		55,597		24,528	112,887	270,156	162.00	1,170,492	1.00	210,639	1.00	210,639

Brief analysis of Grocery #73, summary of measure savings:

Summary	Calculated Summary Savings	
Usage by Measure	Demand	Energy
Baseline	-	-
Measure #1	1.00	105,204
Measure #2	6.00	45,493
Measure #3	1.00	210,639

Brief analysis of Grocery #73 summary of total savings:

Summary	Total Level		Calculated Savings		Attachment 7 Level		Calculated Attach 7 Savings	
Usage by Measure	Demand	Energy	Demand	Energy	Demand	Energy	Demand	Energy
Baseline	332.00	2,153,212	-	-	332.00	2,153,212	-	-
Measure #1	331.00	2,048,008	1.00	105,204	332.00	2,048,008	0.00	105,204
Measure #2	326.00	2,002,515	5.00	45,493	326.00	2,002,515	6.00	45,493
Measure #3	325.00	1,791,876	1.00	210,639	325.00	1,791,876	1.00	210,639

Brief analysis of Grocery #75 ASD measure (#1) savings:

Summary	Supply Fan		Calculated Savings		Attachment 7 Savings	
Usage by Measure	Demand	Energy	Demand	Energy	Demand	Energy
Baseline	18.00	150,840	-	-	-	-
Measure #1	17.00	31,058	1.00	119,782	0.00	119,782
Measure #2	17.00	31,058	-	-	-	-
Measure #3	17.00	31,058	-	-	-	-

Brief analysis of Grocery #75 condenser measure (#2) savings:

Summary	Refrigeration Compressors		A/C Compressors		Condenser Fans		Total		Calculated Savings		Attachment 7 Savings	
Usage by Measure	Demand	Energy	Demand	Energy	Demand	Energy	Demand	Energy	Demand	Energy	Demand	Energy
Baseline	80.00	514,279	18.00	16,058	16.00	31,099	114.00	561,436	-	-	-	-
Measure #1	80.00	514,279	18.00	16,058	12.00	31,099	110.00	561,436	-	-	-	-
Measure #2	83.00	437,470	15.00	8,439	11.00	69,484	109.00	515,393	1.00	46,043	5.00	46,044
Measure #3	83.00	410,836	15.00	8,439	11.00	67,447	109.00	486,722	-	-	-	-

Brief analysis of Grocery #75 EMS measure (#3) savings:

Summary	Refrigeration Compressors		A/C Compressors		Condenser Fans		Ice Cream	LT#1	MT#1	MT#2	Lighting	Total		Calculated Savings		Attachment 7 Savings	
Usage by Measure	Demand	Energy	Demand	Energy	Demand	Energy	Energy	Energy	Energy	Energy	Energy	Demand	Energy	Demand	Energy	Demand	Energy
Baseline												-	-	-	-	-	-
Measure #1												-	-	-	-	-	-
Measure #2	83.00	437,470	15.00	8,439	11.00	69,484	28,926	312,382	88,441	97,324	301,938	109.00	1,344,404	-	-	-	-
Measure #3	83.00	410,836	15.00	8,439	11.00	67,447	15,236	184,953	62,921	64,882	231,009	109.00	1,045,723	0.00	298,681	5.00	317,117

Brief analysis of Grocery #75, summary of measure savings:

Summary	Calculated Summary Savings	
Usage by Measure	Demand	Energy
Baseline	-	-
Measure #1	1.00	119,782
Measure #2	1.00	46,043
Measure #3	0.00	298,681

Brief analysis of Grocery #75 summary of total savings:

Summary	Total Level		Calculated Savings		Attachment 7 Level		Calculated Attach 7 Savings	
Usage by Measure	Demand	Energy	Demand	Energy	Demand	Energy	Demand	Energy
Baseline	298.00	2,221,381	-	-	298.00	2,221,381	-	-
Measure #1	293.00	2,101,599	5.00	119,782	298.00	2,101,599	0.00	119,782
Measure #2	293.00	2,055,555	0.00	46,044	293.00	2,055,555	5.00	46,044
Measure #3	293.00	1,756,875	0.00	298,680	288.00	1,738,438	5.00	317,117

Brief analysis of Grocery #76 ASD measure (#1) savings:

Summary	Supply Fan		Calculated Savings		Attachment 7 Savings	
Usage by Measure	Demand	Energy	Demand	Energy	Demand	Energy
Baseline	18.00	150,840	-	-	-	-
Measure #1	17.00	35,762	1.00	115,078	0.00	115,078
Measure #2	17.00	35,762	-	-	-	-
Measure #3	17.00	35,762	-	-	-	-

Brief analysis of Grocery #76 condenser measure (#2) savings:

Summary	Refrigeration Compressors		A/C Compressors		Condenser Fans		Total		Calculated Savings		Attachment 7 Savings	
Usage by Measure	Demand	Energy	Demand	Energy	Demand	Energy	Demand	Energy	Demand	Energy	Demand	Energy
Baseline	76.00	493,318	18.00	16,492	16.00	31,211	110.00	541,021	-	-	-	-
Measure #1	76.00	493,318	18.00	16,492	12.00	31,211	106.00	541,021	-	-	-	-
Measure #2	78.00	416,861	17.00	7,811	11.00	67,516	106.00	492,188	0.00	48,833	5.00	48,833
Measure #3	78.00	410,836	17.00	7,811	11.00	67,447	106.00	486,094	-	-	-	-

Brief analysis of Grocery #76 EMS measure (#3) savings:

Summary	Refrigeration Compressors		A/C Compressors		Condenser Fans		Ice Cream	LT#1	MT#1	MT#2	Lighting	Total		Calculated Savings		Attachment 7 Savings	
Usage by Measure	Demand	Energy	Demand	Energy	Demand	Energy	Energy	Energy	Energy	Energy	Energy	Demand	Energy	Demand	Energy	Demand	Energy
Baseline												-	-	-	-	-	-
Measure #1												-	-	-	-	-	-
Measure #2	78.00	416,861	17.00	7,811	11.00	67,516	3,482	57,159	19,053	137,970	298,716	106.00	1,008,568	-	-	-	-
Measure #3	78.00	410,836	17.00	7,811	11.00	67,447	3,095	50,808	16,936	122,640	225,347	106.00	904,920	0.00	103,648	0.00	103,429

Brief analysis of Grocery #76, summary of measure savings:

Summary	Calculated Summary Savings	
Usage by Measure	Demand	Energy
Baseline	-	-
Measure #1	1.00	115,078
Measure #2	0.00	48,833
Measure #3	0.00	103,648

Brief analysis of Grocery #76 summary of total savings:

Summary	Total Level		Calculated Savings		Attachment 7 Level		Calculated Attach 7 Savings	
Usage by Measure	Demand	Energy	Demand	Energy	Demand	Energy	Demand	Energy
Baseline	285.00	1,892,463	-	-	285.00	1,892,463	-	-
Measure #1	281.00	1,777,385	4.00	115,078	285.00	1,777,385	0.00	115,078
Measure #2	280.00	1,728,551	1.00	48,834	280.00	1,728,551	5.00	48,834
Measure #3	280.00	1,625,123	0.00	103,428	280.00	1,625,123	0.00	103,428

Brief analysis of grocery #77 ASD measure (#1) savings:

Summary	Supply Fan		Calculated Savings		Attachment 7 Savings	
Usage by Measure	Demand	Energy	Demand	Energy	Demand	Energy
Baseline	14.00	120,672	-	-	-	-
Measure #1	14.00	26,933	0.00	93,739	0.00	93,793
Measure #2	14.00	26,933	-	-	-	-
Measure #3	14.00	26,933	-	-	-	-

Brief analysis of grocery #77 condenser measure (#2) savings:

Summary	Refrigeration Compressors		A/C Compressors		Condenser Fans		Total		Calculated Savings		Attachment 7 Savings	
Usage by Measure	Demand	Energy	Demand	Energy	Demand	Energy	Demand	Energy	Demand	Energy	Demand	Energy
Baseline	134.00	754,233	21.00	17,570	16.00	60,503	171.00	832,306	-	-	-	-
Measure #1	134.00	754,233	21.00	17,570	12.00	60,503	167.00	832,306	-	-	-	-
Measure #2	136.00	691,010	20.00	9,330	16.00	94,834	172.00	795,174	-5.00	37,132	0.00	37,132
Measure #3	127.00	633,140	20.00	9,330	12.00	92,794	159.00	735,264	-	-	-	-

Brief analysis of grocery #77 EMS measure (#3) savings:

Summary	Refrigeration Compressors		A/C Compressors		Condenser Fans		Ice Cream	LT#1	LT#2	MT#1	MT#2	Lighting	Total		Calculated Savings		Attachment 7 Savings	
Usage by Measure	Demand	Energy	Demand	Energy	Demand	Energy	Energy	Energy	Energy	Energy	Energy	Energy	Demand	Energy	Demand	Energy	Demand	Energy
Baseline													-	-	-	-	-	-
Measure #1													-	-	-	-	-	-
Measure #2	136.00	691,010	20.00	9,330	16.00	94,834	14,892	49,932	234	31,054	28,908	267,756	172.00	1,187,950	-	-	-	-
Measure #3	127.00	633,140	20.00	9,330	12.00	92,794	9,928	44,384	4,672	20,703	25,696	205,223	159.00	1,045,870	13.00	142,080	13.00	142,081

Brief analysis of grocery #77, summary of measure savings:

Summary	Calculated Summary Savings	
Usage by Measure	Demand	Energy
Baseline	-	-
Measure #1	0.00	93,739
Measure #2	-5.00	37,132
Measure #3	13.00	142,080

Brief analysis of grocery #77 summary of total savings:

Summary	Total Level		Calculated Savings		Attachment 7 Level		Calculated Attach 7 Savings	
Usage by Measure	Demand	Energy	Demand	Energy	Demand	Energy	Demand	Energy
Baseline	308.00	1,959,506	-	-	308.00	1,959,506	-	-
Measure #1	304.00	1,865,767	4.00	93,739	308.00	1,865,767	0.00	93,739
Measure #2	308.00	1,828,635	-4.00	37,132	308.00	1,828,635	0.00	37,132
Measure #3	295.00	1,686,554	13.00	142,081	295.00	1,686,554	13.00	142,081

Brief analysis of Grocery #103 ASD measure (#1) savings:

Summary	Supply Fan		Calculated Savings		Attachment 7 Savings	
Usage by Measure	Demand	Energy	Demand	Energy	Demand	Energy
Baseline	21.00	181,008	-	-	-	-
Measure #1	21.00	31,013	0.00	149,995	0.00	149,995
Measure #2	21.00	31,013	-	-	-	-
Measure #3	21.00	31,013	-	-	-	-

Brief analysis of Grocery #103 condenser measure (#2) savings:

Summary	Refrigeration Compressors		A/C Compressors		Condenser Fans		Total		Calculated Savings		Attachment 7 Savings	
Usage by Measure	Demand	Energy	Demand	Energy	Demand	Energy	Demand	Energy	Demand	Energy	Demand	Energy
Baseline	147.00	845,174	36.00	26,374	13.00	29,223	196.00	900,771	-	-	-	-
Measure #1	147.00	845,174	36.00	26,374	13.00	29,223	196.00	900,771	-	-	-	-
Measure #2	126.00	577,635	32.00	13,709	13.00	129,683	171.00	721,027	25.00	179,744	24.00	179,744
Measure #3	117.00	532,277	36.00	26,374	13.00	106,614	166.00	665,265	-	-	-	-

Brief analysis of Grocery #103 EMS measure (#3) savings:

Summary	Refrigeration Compressors		A/C Compressors		Condenser Fans		Ice Cream	LT#1	LT#2	MT#1	MT#2	Lighting	Total		Calculated Savings		Attachment 7 Savings	
Usage by Measure	Demand	Energy	Demand	Energy	Demand	Energy	Energy	Energy	Energy	Energy	Energy	Energy	Demand	Energy	Demand	Energy	Demand	Energy
Baseline													-	-	-	-	-	-
Measure #1													-	-	-	-	-	-
Measure #2	126.00	577,635	32.00	13,709	13.00	129,683	35,110	105,646		33,989	38,544	268,983	171.00	1,203,299	-	-	-	-
Measure #3	117.00	532,277	36.00	26,374	13.00	106,614	13,158	29,696		18,717	25,696	201,737	166.00	954,269	5.00	249,030	16.00	249,030

Brief analysis of Grocery #103, summary of measure savings:

Summary	Calculated Summary Savings	
Usage by Measure	Demand	Energy
Baseline	-	-
Measure #1	0.00	149,995
Measure #2	25.00	179,744
Measure #3	5.00	249,030

	Measure #1		Measure #2	
	Demand	Energy	Demand	Energy
Ice Cream	10.6	60932	6.3	28269
LT#1	39.7	228924	33.3	156605
LT#2				
MT#1	75.8	437407	69.2	317023
MT#2	20.4	117912	17.1	75739
	146.5	845175	125.9	577636

Brief analysis of Grocery #103 summary of total savings:

Summary	Total Level		Calculated Savings		Attachment 7 Level		Calculated Attach 7 Savings	
Usage by Measure	Demand	Energy	Demand	Energy	Demand	Energy	Demand	Energy
Baseline	340.00	2,236,306	-	-	340.00	2,236,306	-	-
Measure #1	340.00	2,086,311	0.00	149,995	340.00	2,086,311	0.00	149,995
Measure #2	315.00	1,906,567	25.00	179,744	315.00	1,906,567	25.00	179,744
Measure #3	299.00	1,657,537	16.00	249,030	299.00	1,657,537	16.00	249,030

Revisions based upon an updated (3/15/95) spreadsheet included within this application

Brief analysis of Grocery #202 ASD measure (#1) savings:

Summary	Supply Fan		Calculated Savings		Attachment 7 Savings	
Usage by Measure	Demand	Energy	Demand	Energy	Demand	Energy
Baseline	18.00	150,840	-	-	-	-
Measure #1	11.00	20,921	7.00	129,919	0.00	129,919
Measure #2	11.00	20,921	-	-	-	-
Measure #3	11.00	20,921	-	-	-	-

Brief analysis of Grocery #202 condenser measure (#2) savings:

Summary	Refrigeration Compressors		A/C Compressors		Condenser Fans		Total		Calculated Savings		Attachment 7 Savings	
Usage by Measure	Demand	Energy	Demand	Energy	Demand	Energy	Demand	Energy	Demand	Energy	Demand	Energy
Baseline	126.00	760,565	24.00	4,223	12.00	59,824	162.00	824,612	-	-	-	-
Measure #1	126.00	760,565	24.00	4,223	8.00	59,824	158.00	824,612	-	-	-	-
Measure #2	121.00	696,000	22.00	1,451	12.00	99,205	155.00	796,656	3.00	27,956	14.00	27,955
Measure #3	113.00	644,888	22.00	1,451	12.00	98,188	147.00	744,527	-	-	-	-

Brief analysis of Grocery #202 EMS measure (#3) savings:

Summary	Refrigeration Compressors		A/C Compressors		Condenser Fans		Ice Cream	LT#1	MT#1	MT#2	Lighting	Total		Calculated Savings		Attachment 7 Savings	
Usage by Measure	Demand	Energy	Demand	Energy	Demand	Energy	Energy	Energy	Energy	Energy	Energy	Demand	Energy	Demand	Energy	Demand	Energy
Baseline												0.00	0	-	-	-	-
Measure #1												0.00	0	-	-	-	-
Measure #2	121.00	696,000	22.00	1,451	12.00	99,205	21,480	76,457	82,379	29,083	258,017	155.00	1,264,072	-	-	-	-
Measure #3	113.00	644,888	22.00	1,451	12.00	98,188	12,638	48,011	53,308	24,225	145,134	147.00	1,027,843	8.00	236,229	8.00	236,230

Brief analysis of Grocery #202, summary of measure savings:

Summary	Calculated Summary Savings	
Usage by Measure	Demand	Energy
Baseline	-	-
Measure #1	7.00	129,919
Measure #2	3.00	27,956
Measure #3	8.00	236,229

Brief analysis of Grocery #202 summary of total savings:

Summary	Total Level		Calculated Savings		Attachment 7 Level		Calculated Attach 7 Savings	
Usage by Measure	Demand	Energy	Demand	Energy	Demand	Energy	Demand	Energy
Baseline	335.00	2,103,700	-	-	335.00	2,103,700	-	-
Measure #1	324.00	1,964,110	11.00	139,590	335.00	1,964,110	0.00	139,590
Measure #2	321.00	1,936,154	3.00	27,956	321.00	1,936,154	14.00	27,956
Measure #3	313.00	1,699,924	8.00	236,230	313.00	1,699,924	8.00	236,230

Brief analysis of Grocery #404 ASD measure (#1) savings:

Summary	Supply Fan		Calculated Savings		Attachment 7 Savings	
Usage by Measure	Demand	Energy	Demand	Energy	Demand	Energy
Baseline	21.00	181,008	-	-	-	-
Measure #1	21.00	33,137	0.00	147,871	0.00	147,871
Measure #2	21.00	33,137	-	-	-	-
Measure #3	21.00	33,137	-	-	-	-

Brief analysis of Grocery #404 condenser measure (#2) savings:

Summary	Refrigeration Compressors		A/C Compressors		Condenser Fans		Total		Calculated Savings		Attachment 7 Savings	
Usage by Measure	Demand	Energy	Demand	Energy	Demand	Energy	Demand	Energy	Demand	Energy	Demand	Energy
Baseline	132.00	754,011	42.00	25,575	13.00	34,769	187.00	814,355	-	-	-	-
Measure #1	132.00	754,011	42.00	25,575	13.00	34,769	187.00	814,355	-	-	-	-
Measure #2	126.00	578,989	39.00	18,212	13.00	24,392	178.00	621,593	9.00	192,762	9.00	188,580
Measure #3	106.00	557,892	42.00	3,718	13.00	69,394	161.00	631,004	-	-	-	-

Brief analysis of Grocery #404 EMS measure (#3) savings:

Summary	Refrigeration Compressors		A/C Compressors		Condenser Fans		Ice Cream	LT#1	LT#2	MT#1	MT#2	Lighting	Total		Calculated Savings		Attachment 7 Savings	
Usage by Measure	Demand	Energy	Demand	Energy	Demand	Energy	Energy	Energy	Energy	Energy	Energy	Energy	Demand	Energy	Demand	Energy	Demand	Energy
Baseline													-	-	-	-	-	-
Measure #1													-	-	-	-	-	-
Measure #2	126.00	578,989	39.00	18,212	13.00	24,392	47,374	169,594		283,649	72,708	289,674	178.00	1,484,592	-	-	-	-
Measure #3	106.00	557,892	42.00	3,718	13.00	69,394	27,483	96,769		187,522	48,472	217,256	161.00	1,208,506	17.00	276,086	17.00	280,268

Brief analysis of Grocery #404, summary of measure savings:

Summary	Calculated Summary Savings	
Usage by Measure	Demand	Energy
Baseline	-	-
Measure #1	0.00	147,871
Measure #2	9.00	192,762
Measure #3	17.00	276,086

Detail Level	Measure #2 (Recircuit)		Measure #3 (EMS)	
Results	Demand	Energy	Demand	Energy
A/C Compressors	39	18212		
Ice Cream			5.1	21864
LT#1			29.7	135120
LT#2				
MT#1	67.4	305987	63.6	287067
MT#2	19.4	88128	18.6	83537

Brief analysis of Grocery #404 summary of total savings:

Summary	Total Level		Calculated Savings		Attachment 7 Level		Calculated Attach 7 Savings	
Usage by Measure	Demand	Energy	Demand	Energy	Demand	Energy	Demand	Energy
Baseline	387.00	2,613,930	-	-	387.00	2,609,749	-	-
Measure #1	387.00	2,446,059	0.00	167,871	386.00	2,461,878	1.00	147,871
Measure #2	378.00	2,273,298	9.00	172,761	378.00	2,273,298	8.00	188,580
Measure #3	360.00	1,997,211	18.00	276,087	360.00	1,993,030	18.00	280,268

Appendix B.6.2
Detailed Condenser Recircuit Engineering Calculations

Condenser Capacity	1,984,500	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	6	circuits	119,070
LT#1 Condensing Circuits	12	circuits	238,140
LT#2 Condensing Circuits	0	circuits	0
MT#1 Condensing Circuits	34	circuits	674,730
MT#2 Condensing Circuits	13	circuits	257,985
AC Condensing Circuits	35	circuits	694,575
Total Circuits	100		1,984,500

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	Refrigeration Case Load (Btuh)	Application Factor (unitless)	Calculated Application Factor, Check (unitless)	Equivalent Btuh rejected for case Load (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	1.0	49,440	-	1.4	49,440	5.13	3.413	32,893		82,333	1.00	10
108	72	8.0	49,440	-	1.5	49,440	5.36	3.413	31,481		80,921	1.00	74
103	70	53.0	49,440	-	1.5	49,440	5.36	3.413	31,481		80,921	1.00	489
98	68	159.0	49,440	-	1.5	49,440	5.47	3.413	30,848		80,288	1.00	1,437
93	66	287.0	49,440	-	1.7	49,440	5.68	3.413	29,708		71,126	0.73	1,824
88	66	364.0	49,440	-	1.7	49,440	5.78	3.413	29,194		70,751	0.73	2,273
83	63	457.0	49,440	-	1.7	49,440	6.00	3.413	28,123		69,970	0.73	2,749
78	61	581.0	49,440	-	1.7	49,440	6.21	3.413	27,172		69,276	0.73	3,377
73	59	707.0	49,440	-	1.7	49,440	6.28	3.413	26,869		69,055	0.73	4,063
68	56	804.0	49,440	-	1.7	49,440	6.50	3.413	25,960		68,391	0.73	4,464
63	53	965.0	49,440	-	1.7	49,440	6.57	3.413	25,683		68,189	0.73	5,301
58	50	1100.0	49,440	-	1.8	49,440	6.79	3.413	24,851		67,581	0.73	5,847
53	47	1098.0	49,440	-	1.8	49,440	6.94	3.413	24,314		67,189	0.73	5,710
48	43	902.0	49,440	-	1.8	49,440	6.94	3.413	24,314		67,189	0.73	4,691
43	40	681.0	49,440	-	1.8	49,440	6.94	3.413	24,314		67,189	0.73	3,542
38	36	397.0	49,440	-	1.8	49,440	6.94	3.413	24,314		67,189	0.73	2,065
33	32	159.0	49,440	-	1.8	49,440	6.94	3.413	24,314		67,189	0.73	827
28	27	32.0	49,440	-	1.8	49,440	6.94	3.413	24,314		67,189	0.73	166

			Application
kWh=	48,907	=	48,902
kWh=	9.64	=	9.6

Condenser Capacity	1,984,500	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	6	circuits	119,070
LT#1 Condensing Circuits	12	circuits	238,140
LT#2 Condensing Circuits	0	circuits	0
MT#1 Condensing Circuits	34	circuits	674,730
MT#2 Condensing Circuits	13	circuits	257,985
AC Condensing Circuits	35	circuits	694,575
Total Circuits	100		1,984,500

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	Refrigeration Case Load (Btuh)	Application Factor (unitless)	Calculated Application Factor, Check (unitless)	Equivalent Btuh rejected for case Load (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	1.0	108,900	-	1.4	108,900	6.30	3.413	58,996		167,896	1.00	17
108	72	8.0	108,900	-	1.4	108,900	6.50	3.413	57,181		166,081	1.00	134
103	70	53.0	108,900	-	1.4	108,900	6.60	3.413	56,315		165,215	1.00	875
98	68	159.0	108,900	-	1.4	108,900	6.60	3.413	56,315		165,215	1.00	2,624
93	66	287.0	108,900	-	1.6	108,900	6.70	3.413	55,474		149,396	0.73	3,405
88	66	364.0	108,900	-	1.6	108,900	6.90	3.413	53,866		148,222	0.73	4,194
83	63	457.0	108,900	-	1.6	108,900	7.00	3.413	53,097		147,660	0.73	5,190
78	61	581.0	108,900	-	1.6	108,900	7.10	3.413	52,349		147,115	0.73	6,505
73	59	707.0	108,900	-	1.6	108,900	7.30	3.413	50,914		146,068	0.73	7,699
68	56	804.0	108,900	-	1.6	108,900	7.50	3.413	49,557		145,076	0.73	8,522
63	53	965.0	108,900	-	1.6	108,900	7.60	3.413	48,905		144,600	0.73	10,094
58	50	1100.0	108,900	-	1.7	108,900	7.80	3.413	47,651		143,685	0.73	11,211
53	47	1098.0	108,900	-	1.7	108,900	8.00	3.413	46,459		142,815	0.73	10,911
48	43	902.0	108,900	-	1.7	108,900	8.00	3.413	46,459		142,815	0.73	8,963
43	40	681.0	108,900	-	1.7	108,900	8.00	3.413	46,459		142,815	0.73	6,767
38	36	397.0	108,900	-	1.7	108,900	8.00	3.413	46,459		142,815	0.73	3,945
33	32	159.0	108,900	-	1.7	108,900	8.00	3.413	46,459		142,815	0.73	1,580
28	27	32.0	108,900	-	1.7	108,900	8.00	3.413	46,459		142,815	0.73	318

			Application
kWh=	92,955	=	93,159
kWh=	17.29	=	17.2

MT#1, Measure #2

Condenser Capacity	1,984,500	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	6	circuits	119,070
LT#1 Condensing Circuits	12	circuits	238,140
LT#2 Condensing Circuits	0	circuits	0
MT#1 Condensing Circuits	34	circuits	674,730
MT#2 Condensing Circuits	13	circuits	257,985
AC Condensing Circuits	35	circuits	694,575
Total Circuits	100		1,984,500

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	Refrigeration Case Load (Btuh)	Application Factor (unitless)	Calculated Application Factor, Check (unitless)	Equivalent Btuh rejected for case Load (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	1.0	367,000	-	1.4	367,000	9.54	3.413	131,297		498,297	1.00	38
108	72	8.0	367,000	-	1.4	367,000	9.92	3.413	126,267		493,267	1.00	296
103	70	53.0	367,000	-	1.4	367,000	9.92	3.413	126,267		493,267	1.00	1,961
98	68	159.0	367,000	-	1.4	367,000	10.11	3.413	123,894		490,894	1.00	5,772
93	66	287.0	367,000	-	1.5	367,000	10.50	3.413	119,292		454,084	0.73	7,323
88	66	364.0	367,000	-	1.5	367,000	10.69	3.413	117,172		452,536	0.73	9,122
83	63	457.0	367,000	-	1.5	367,000	11.07	3.413	113,150		449,600	0.73	11,060
78	61	581.0	367,000	-	1.5	367,000	11.45	3.413	109,395		446,858	0.73	13,594
73	59	707.0	367,000	-	1.5	367,000	11.61	3.413	107,887		445,758	0.73	16,315
68	56	804.0	367,000	-	1.5	367,000	11.92	3.413	105,081		443,709	0.73	18,070
63	53	965.0	367,000	-	1.5	367,000	12.23	3.413	102,418		441,765	0.73	21,139
58	50	1100.0	367,000	-	1.5	367,000	12.53	3.413	99,966		439,975	0.73	23,520
53	47	1098.0	367,000	-	1.5	367,000	12.84	3.413	97,552		438,213	0.73	22,910
48	43	902.0	367,000	-	1.5	367,000	13.00	3.413	96,352		437,337	0.73	18,589
43	40	681.0	367,000	-	1.5	367,000	13.00	3.413	96,352		437,337	0.73	14,034
38	36	397.0	367,000	-	1.5	367,000	13.00	3.413	96,352		437,337	0.73	8,182
33	32	159.0	367,000	-	1.5	367,000	13.00	3.413	96,352		437,337	0.73	3,277
28	27	32.0	367,000	-	1.5	367,000	13.00	3.413	96,352		437,337	0.73	659

				Application
kWh=	195,862	=		195,872
kWh=	36.47	=		38.5

Condenser Capacity	1,984,500	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	6	circuits	119,070
LT#1 Condensing Circuits	12	circuits	238,140
LT#2 Condensing Circuits	0	circuits	0
MT#1 Condensing Circuits	34	circuits	674,730
MT#2 Condensing Circuits	13	circuits	257,985
AC Condensing Circuits	35	circuits	694,575
Total Circuits	100		1,984,500

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	Refrigeration Case Load (Btuh)	Application Factor (unitless)	Calculated Application Factor, Check (unitless)	Equivalent Btuh rejected for case Load (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	1.0	145,200	-	1.4	145,200	11.81	3.413	41,962		187,162	1.00	12
108	72	8.0	145,200	-	1.4	145,200	12.14	3.413	40,821		186,021	1.00	96
103	70	53.0	145,200	-	1.4	145,200	12.30	3.413	40,290		185,490	1.00	626
98	68	159.0	145,200	-	1.4	145,200	12.47	3.413	39,741		184,941	1.00	1,851
93	66	287.0	145,200	-	1.5	145,200	12.80	3.413	38,716		173,463	0.73	2,377
88	66	364.0	145,200	-	1.5	145,200	12.96	3.413	38,238		173,114	0.73	2,977
83	63	457.0	145,200	-	1.5	145,200	13.29	3.413	37,289		172,421	0.73	3,645
78	61	581.0	145,200	-	1.5	145,200	13.46	3.413	36,818		172,077	0.73	4,575
73	59	707.0	145,200	-	1.5	145,200	13.87	3.413	35,729		171,283	0.73	5,403
68	56	804.0	145,200	-	1.5	145,200	14.28	3.413	34,704		170,534	0.73	5,968
63	53	965.0	145,200	-	1.5	145,200	14.69	3.413	33,735		169,827	0.73	6,963
58	50	1100.0	145,200	-	1.5	145,200	15.10	3.413	32,819		169,158	0.73	7,722
53	47	1098.0	145,200	-	1.5	145,200	15.51	3.413	31,951		168,525	0.73	7,504
48	43	902.0	145,200	-	1.5	145,200	15.51	3.413	31,951		168,525	0.73	6,164
43	40	681.0	145,200	-	1.5	145,200	15.51	3.413	31,951		168,525	0.73	4,654
38	36	397.0	145,200	-	1.5	145,200	15.51	3.413	31,951		168,525	0.73	2,713
33	32	159.0	145,200	-	1.5	145,200	15.51	3.413	31,951		168,525	0.73	1,087
28	27	32.0	145,200	-	1.5	145,200	15.51	3.413	31,951		168,525	0.73	219

			Application
kWh=	64,555	=	64,547
kWh=	12.29	=	12.3

Condenser Capacity	1,984,500	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	6	circuits	119,070
LT#1 Condensing Circuits	12	circuits	238,140
LT#2 Condensing Circuits	0	circuits	0
MT#1 Condensing Circuits	34	circuits	674,730
MT#2 Condensing Circuits	13	circuits	257,985
AC Condensing Circuits	35	circuits	694,575
Total Circuits	100		1,984,500

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	AC Load (tons)	AC Load (Btuh)	Equivalent Btuh rejected for AC (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	1.0	37.00	444,000	444,000	23.22	3.413	65,261		509,261	1.00	19
108	72	8.0	37.00	444,000	444,000	25.03	3.413	60,542		504,542	1.00	142
103	70	53.0	37.58	450,960	450,960	25.03	3.413	61,491		512,451	1.00	955
98	68	159.0	31.80	381,600	381,600	25.93	3.413	50,228		431,828	1.00	2,340
93	66	287.0	26.02	312,240	312,240	26.83	3.413	39,720		351,960	1.00	3,340
88	66	364.0	20.23	242,760	242,760	28.10	3.413	29,485		272,245	1.00	3,145
83	63	457.0	14.45	173,400	173,400	28.73	3.413	20,599		193,999	1.00	2,758
78	61	581.0	8.67	104,040	104,040	29.87	3.413	11,888		115,928	1.00	2,024
73	59	707.0	2.89	34,680	34,680	31.01	3.413	3,817		38,497	1.00	791
68	56	804.0										
63	53	965.0										
58	50	1100.0										
53	47	1098.0										
48	43	902.0										
43	40	681.0										
38	36	397.0										
33	32	159.0										
28	27	32.0										

			Application
kWh=	15,513	>	7,782
kWh=	19.12	>	16

Condenser, Measure #2

Condenser Capacity	1,984,500	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	6	circuits	119,070
LT#1 Condensing Circuits	12	circuits	238,140
LT#2 Condensing Circuits	0	circuits	0
MT#1 Condensing Circuits	34	circuits	674,730
MT#2 Condensing Circuits	13	circuits	257,985
AC Condensing Circuits	35	circuits	694,575
Total Circuits	100		1,984,500

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	AC Heat Rejection (Btuh)	Refrigeration Heat Rejection (Btuh)	Condenser Load Factor (unitless)	Calculated Condenser Load Factor, Check (unitless)	Total Heat Rejection (Btuh)	Total Heat Rejection from the Application (MBtuh)	Total Heat Rejection from the Application (Btuh)
113	74	1.0	509,261	935,687	-	1.4	1,444,949	1,312	1,312,000
108	72	8.0	504,542	926,290	-	1.4	1,430,833	1,306	1,306,000
103	70	53.0	512,451	924,893	-	1.4	1,437,344	1,313	1,313,000
98	68	159.0	431,828	921,338	-	1.5	1,353,165	1,243	1,243,000
93	66	287.0	351,960	848,069	-	1.7	1,200,028	1,171	1,171,000
88	66	364.0	272,245	844,623	-	1.8	1,116,869	1,102	1,102,000
83	63	457.0	193,999	839,651	-	1.9	1,033,650	1,035	1,035,000
78	61	581.0	115,928	835,325	-	2.1	951,253	925	925,000
73	59	707.0	38,497	832,162	-	2.3	870,659	922	922,000
68	56	804.0	0	827,710	-	2.4	827,710	919	919,000
63	53	965.0	0	824,381	-	2.4	824,381	917	917,000
58	50	1100.0	0	820,399	-	2.4	820,399	914	914,000
53	47	1098.0	0	816,742	-	2.4	816,742	911	911,000
48	43	902.0	0	815,866	-	2.4	815,866	911	911,000
43	40	681.0	0	815,866	-	2.4	815,866	912	912,000
38	36	397.0	0	815,866	-	2.4	815,866	912	912,000
33	32	159.0	0	815,866	-	2.4	815,866	912	912,000
28	27	32.0	0	815,866	-	2.4	815,866	912	912,000
						Total Rejected	18,207,311	18,549	18,549,000

Condenser Capacity	1,984,500	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	6	circuits	119,070
LT#1 Condensing Circuits	12	circuits	238,140
LT#2 Condensing Circuits	0	circuits	0
MT#1 Condensing Circuits	34	circuits	674,730
MT#2 Condensing Circuits	13	circuits	257,985
AC Condensing Circuits	35	circuits	694,575
Total Circuits	100		1,984,500

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	Refrigeration Case Load (Btuh)	Application Factor (unitless)	Calculated Application Factor, Check (unitless)	Equivalent Btuh rejected for case Load (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	1.0	49,440	-	1.5	49,440	5.57	3.413	30,294	[redacted]	79,734	1.00	9
108	72	8.0	49,440	-	1.5	49,440	5.68	3.413	29,708	[redacted]	79,148	1.00	70
103	70	53.0	49,440	-	1.5	49,440	5.68	3.413	29,708	[redacted]	79,148	1.00	461
98	68	159.0	49,440	-	1.5	49,440	5.68	3.413	29,708	[redacted]	79,148	1.00	1,384
93	66	287.0	49,440	-	1.7	49,440	5.68	3.413	29,708	[redacted]	71,126	0.73	1,824
88	66	364.0	49,440	-	1.7	49,440	5.68	3.413	29,708	[redacted]	71,126	0.73	2,313
83	63	457.0	49,440	-	1.7	49,440	5.68	3.413	29,708	[redacted]	71,126	0.73	2,904
78	61	581.0	49,440	-	1.7	49,440	5.68	3.413	29,708	[redacted]	71,126	0.73	3,692
73	59	707.0	49,440	-	1.7	49,440	5.68	3.413	29,708	[redacted]	71,126	0.73	4,492
68	56	804.0	49,440	-	1.7	49,440	5.68	3.413	29,708	[redacted]	71,126	0.73	5,109
63	53	965.0	49,440	-	1.7	49,440	5.68	3.413	29,708	[redacted]	71,126	0.73	6,132
58	50	1100.0	49,440	-	1.7	49,440	5.68	3.413	29,708	[redacted]	71,126	0.73	6,989
53	47	1098.0	49,440	-	1.7	49,440	5.68	3.413	29,708	[redacted]	71,126	0.73	6,977
48	43	902.0	49,440	-	1.7	49,440	5.68	3.413	29,708	[redacted]	71,126	0.73	5,731
43	40	681.0	49,440	-	1.7	49,440	5.68	3.413	29,708	[redacted]	71,126	0.73	4,327
38	36	397.0	49,440	-	1.7	49,440	5.68	3.413	29,708	[redacted]	71,126	0.73	2,523
33	32	159.0	49,440	-	1.7	49,440	5.68	3.413	29,708	[redacted]	71,126	0.73	1,010
28	27	32.0	49,440	-	1.7	49,440	5.68	3.413	29,708	[redacted]	71,126	0.73	203

			Application
kWh=	56,150	=	56,173
kWh=	8.88	=	8.9

Condenser Capacity	1,984,500	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	6	circuits	119,070
LT#1 Condensing Circuits	12	circuits	238,140
LT#2 Condensing Circuits	0	circuits	0
MT#1 Condensing Circuits	34	circuits	674,730
MT#2 Condensing Circuits	13	circuits	257,985
AC Condensing Circuits	35	circuits	694,575
Total Circuits	100		1,984,500

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	Refrigeration Case Load (Btuh)	Application Factor (unitless)	Calculated Application Factor, Check (unitless)	Equivalent Btuh rejected for case Load (Btuh)	Estimated Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	1.0	108,900	-	1.4	108,900	6.50	3.413	57,181		166,081	1.00	17
108	72	8.0	108,900	-	1.4	108,900	6.70	3.413	55,474		164,374	1.00	130
103	70	53.0	108,900	-	1.4	108,900	6.70	3.413	55,474		164,374	1.00	861
98	68	159.0	108,900	-	1.4	108,900	6.70	3.413	55,474		164,374	1.00	2,584
93	66	287.0	108,900	-	1.6	108,900	6.70	3.413	55,474		149,396	0.73	3,405
88	66	364.0	108,900	-	1.6	108,900	6.70	3.413	55,474		149,396	0.73	4,319
83	63	457.0	108,900	-	1.6	108,900	6.70	3.413	55,474		149,396	0.73	5,422
78	61	581.0	108,900	-	1.6	108,900	6.70	3.413	55,474		149,396	0.73	6,894
73	59	707.0	108,900	-	1.6	108,900	6.70	3.413	55,474		149,396	0.73	8,389
68	56	804.0	108,900	-	1.6	108,900	6.70	3.413	55,474		149,396	0.73	9,540
63	53	965.0	108,900	-	1.6	108,900	6.70	3.413	55,474		149,396	0.73	11,450
58	50	1100.0	108,900	-	1.6	108,900	6.70	3.413	55,474		149,396	0.73	13,052
53	47	1098.0	108,900	-	1.6	108,900	6.70	3.413	55,474		149,396	0.73	13,028
48	43	902.0	108,900	-	1.6	108,900	6.70	3.413	55,474		149,396	0.73	10,702
43	40	681.0	108,900	-	1.6	108,900	6.70	3.413	55,474		149,396	0.73	8,080
38	36	397.0	108,900	-	1.6	108,900	6.70	3.413	55,474		149,396	0.73	4,710
33	32	159.0	108,900	-	1.6	108,900	6.70	3.413	55,474		149,396	0.73	1,887
28	27	32.0	108,900	-	1.6	108,900	6.70	3.413	55,474		149,396	0.73	380

			Application
kWh=	104,850	=	104,551
kWh=	16.75	=	16.8

Condenser Capacity	1,984,500	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	6	circuits	119,070
LT#1 Condensing Circuits	12	circuits	238,140
LT#2 Condensing Circuits	0	circuits	0
MT#1 Condensing Circuits	34	circuits	674,730
MT#2 Condensing Circuits	13	circuits	257,985
AC Condensing Circuits	35	circuits	694,575
Total Circuits	100		1,984,500

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	Refrigeration Case Load (Btuh)	Application Factor (unitless)	Calculated Application Factor, Check (unitless)	Equivalent Btuh rejected for case Load (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	1.0	367,000	-	1.4	367,000	9.92	3.413	126,267	[redacted]	493,267	1.00	37
108	72	8.0	367,000	-	1.4	367,000	10.50	3.413	119,292	[redacted]	486,292	1.00	280
103	70	53.0	367,000	-	1.4	367,000	10.50	3.413	119,292	[redacted]	486,292	1.00	1,852
98	68	159.0	367,000	-	1.4	367,000	10.50	3.413	119,292	[redacted]	486,292	1.00	5,557
93	66	287.0	367,000	-	1.4	367,000	10.50	3.413	119,292	[redacted]	486,292	1.00	10,031
88	66	364.0	367,000	-	1.5	367,000	10.50	3.413	119,292	[redacted]	454,084	0.73	9,288
83	63	457.0	367,000	-	1.5	367,000	10.50	3.413	119,292	[redacted]	454,084	0.73	11,660
78	61	581.0	367,000	-	1.5	367,000	10.50	3.413	119,292	[redacted]	454,084	0.73	14,824
73	59	707.0	367,000	-	1.5	367,000	10.50	3.413	119,292	[redacted]	454,084	0.73	18,039
68	56	804.0	367,000	-	1.5	367,000	10.50	3.413	119,292	[redacted]	454,084	0.73	20,514
63	53	965.0	367,000	-	1.5	367,000	10.50	3.413	119,292	[redacted]	454,084	0.73	24,622
58	50	1100.0	367,000	-	1.5	367,000	10.50	3.413	119,292	[redacted]	454,084	0.73	28,067
53	47	1098.0	367,000	-	1.5	367,000	10.50	3.413	119,292	[redacted]	454,084	0.73	28,016
48	43	902.0	367,000	-	1.5	367,000	10.50	3.413	119,292	[redacted]	454,084	0.73	23,015
43	40	681.0	367,000	-	1.5	367,000	10.50	3.413	119,292	[redacted]	454,084	0.73	17,376
38	36	397.0	367,000	-	1.5	367,000	10.50	3.413	119,292	[redacted]	454,084	0.73	10,130
33	32	159.0	367,000	-	1.5	367,000	10.50	3.413	119,292	[redacted]	454,084	0.73	4,057
28	27	32.0	367,000	-	1.5	367,000	10.50	3.413	119,292	[redacted]	454,084	0.73	816

			Application
kWh=	228,182	=	225,576
kWh=	37.00	=	37

Condenser Capacity	1,984,500	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	6	circuits	119,070
LT#1 Condensing Circuits	12	circuits	238,140
LT#2 Condensing Circuits	0	circuits	0
MT#1 Condensing Circuits	34	circuits	674,730
MT#2 Condensing Circuits	13	circuits	257,985
AC Condensing Circuits	35	circuits	694,575
Total Circuits	100		1,984,500

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	Refrigeration Case Load (Btuh)	Application Factor (unitless)	Calculated Application Factor, Check (unitless)	Equivalent Btuh rejected for case Load (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	1.0	145,200	-	1.4	145,200	11.97	3.413	41,401		186,601	1.00	12
108	72	8.0	145,200	-	1.4	145,200	12.47	3.413	39,741		184,941	1.00	93
103	70	53.0	145,200	-	1.4	145,200	12.63	3.413	39,237		184,437	1.00	609
98	68	159.0	145,200	-	1.4	145,200	12.63	3.413	39,237		184,437	1.00	1,828
93	66	287.0	145,200	-	1.4	145,200	12.63	3.413	39,237		184,437	1.00	3,299
88	66	364.0	145,200	-	1.5	145,200	12.63	3.413	39,237		173,843	0.73	3,055
83	63	457.0	145,200	-	1.5	145,200	12.63	3.413	39,237		173,843	0.73	3,835
78	61	581.0	145,200	-	1.5	145,200	12.63	3.413	39,237		173,843	0.73	4,876
73	59	707.0	145,200	-	1.5	145,200	12.63	3.413	39,237		173,843	0.73	5,933
68	56	804.0	145,200	-	1.5	145,200	12.63	3.413	39,237		173,843	0.73	6,747
63	53	965.0	145,200	-	1.5	145,200	12.63	3.413	39,237		173,843	0.73	8,099
58	50	1100.0	145,200	-	1.5	145,200	12.63	3.413	39,237		173,843	0.73	9,232
53	47	1098.0	145,200	-	1.5	145,200	12.63	3.413	39,237		173,843	0.73	9,215
48	43	902.0	145,200	-	1.5	145,200	12.63	3.413	39,237		173,843	0.73	7,570
43	40	681.0	145,200	-	1.5	145,200	12.63	3.413	39,237		173,843	0.73	5,715
38	36	397.0	145,200	-	1.5	145,200	12.63	3.413	39,237		173,843	0.73	3,332
33	32	159.0	145,200	-	1.5	145,200	12.63	3.413	39,237		173,843	0.73	1,334
28	27	32.0	145,200	-	1.5	145,200	12.63	3.413	39,237		173,843	0.73	269

			Application
kWh=	75,054	=	74,145
kWh=	12.13	=	12.1

Condenser Capacity	1,984,500	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	6	circuits	119,070
LT#1 Condensing Circuits	12	circuits	238,140
LT#2 Condensing Circuits	0	circuits	0
MT#1 Condensing Circuits	34	circuits	674,730
MT#2 Condensing Circuits	13	circuits	257,985
AC Condensing Circuits	35	circuits	694,575
Total Circuits	100		1,984,500

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	AC Load (tons)	AC Load (Btuh)	Equivalent Btuh rejected for AC (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	1.0	37.00	444,000	444,000	22.34	3.413	67,832		511,832	1.00	20
108	72	8.0	37.00	444,000	444,000	23.66	3.413	64,048		508,048	1.00	150
103	70	53.0	37.58	450,960	450,960	24.29	3.413	63,365		514,325	1.00	984
98	68	159.0	31.80	381,600	381,600	26.83	3.413	48,543		430,143	1.00	2,261
93	66	287.0	26.02	312,240	312,240	26.83	3.413	39,720		351,960	1.00	3,340
88	66	364.0	20.23	242,760	242,760	26.83	3.413	30,881		273,641	1.00	3,294
83	63	457.0	14.45	173,400	173,400	26.83	3.413	22,058		195,458	1.00	2,954
78	61	581.0	8.67	104,040	104,040	26.83	3.413	13,235		117,275	1.00	2,253
73	59	707.0	2.89	34,680	34,680	26.83	3.413	4,412		39,092	1.00	914
68	56	804.0										
63	53	965.0										
58	50	1100.0										
53	47	1098.0										
48	43	902.0										
43	40	681.0										
38	36	397.0										
33	32	159.0										
28	27	32.0										

			Application
kWh=	16,169	=	16,171
kWh=	19.87	=	20

Notes

The application assumes a lower AC load in the post-measure #2 retrofit condition.

Condenser, Measure #1

Condenser Capacity	1,984,500	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	6	circuits	119,070
LT#1 Condensing Circuits	12	circuits	238,140
LT#2 Condensing Circuits	0	circuits	0
MT#1 Condensing Circuits	34	circuits	674,730
MT#2 Condensing Circuits	13	circuits	257,985
AC Condensing Circuits	35	circuits	694,575
Total Circuits	100		1,984,500

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	AC Heat Rejection (Btuh)	Refrigeration Heat Rejection (Btuh)	Condenser Load Factor (unitless)	Calculated Condenser Load Factor, Check (unitless)	Total Heat Rejection (Btuh)	Total Heat Rejection from the Application (MBtuh)	Total Heat Rejection from the Application (Btuh)	
113	74	1.0	511,832	925,683	-	1.4	1,437,515	1,477	1,477,000	
108	72	8.0	508,048	914,755	-	1.4	1,422,803	1,473	1,473,000	
103	70	53.0	514,325	914,251	-	1.4	1,428,576	1,479	1,479,000	
98	68	159.0	430,143	914,251	-	1.5	1,344,394	1,395	1,395,000	
93	66	287.0	351,960	891,252	-	1.6	1,243,212	1,317	1,317,000	
88	66	364.0	273,641	848,449	-	1.8	1,122,090	1,238	1,238,000	
83	63	457.0	195,458	848,449	-	1.9	1,043,907	1,160	1,160,000	
78	61	581.0	117,275	848,449	-	2.1	965,724	1,082	1,082,000	
73	59	707.0	39,092	848,449	-	2.2	887,541	1,004	1,004,000	
68	56	804.0	0	848,449	-	2.3	848,449	965	965,000	
63	53	965.0	0	848,449	-	2.3	848,449	964	964,000	
58	50	1100.0	0	848,449	-	2.3	848,449	964	964,000	
53	47	1098.0	0	848,449	-	2.3	848,449	964	964,000	
48	43	902.0	0	848,449	-	2.3	848,449	965	965,000	
43	40	681.0	0	848,449	-	2.3	848,449	965	965,000	
38	36	397.0	0	848,449	-	2.3	848,449	965	965,000	
33	32	159.0	0	848,449	-	2.3	848,449	965	965,000	
28	27	32.0	0	848,449	-	2.3	848,449	965	965,000	
						Total Rejected	18,531,806	20,307	20,307,000	Heat rejection differences are significant

Measure #2 Summary of Findings

Evaluation Compressor Savings	Pre-Retrofit Demand	Post-Retrofit Demand	Measure # Demand Savings		Pre-Retrofit Energy	Post-Retrofit Energy	Measure # Energy Savings	
Ice Cream Condensing Circuits	8.88	9.64	-0.76		56,150	48,907	7,242	
LT#1 Condensing Circuits	16.75	17.29	-0.53		104,850	92,955	11,896	
MT#1 Condensing Circuits	37.00	38.47	-1.47		228,182	195,862	32.320	
MT#2 Condensing Circuits	12.13	12.29	-0.16		75,054	64,555	10,499	
AC Condensing Circuits	19.87	19.12	0.75		16,169	15,513	656	
Total			-2.18	kW			62,614	kWh
Total Refer w/ Compressor		85.54				458,947		

Application Compressor Savings	Pre-Retrofit Demand	Post-Retrofit Demand	Measure # Demand Savings		Pre-Retrofit Energy	Post-Retrofit Energy	Measure # Energy Savings	
Ice Cream Condensing Circuits	8.90	9.60	-0.70		56,173	48,902	7,271	
LT#1 Condensing Circuits	16.80	17.20	-0.40		104,551	93,159	11,392	
MT#1 Condensing Circuits	37.00	38.50	-1.50		225,576	195,872	29,704	
MT#2 Condensing Circuits	12.10	12.30	-0.20		74,145	64,547	9,598	
AC Condensing Circuits	20.00	16.00	4.00		16,171	7,782	8,389	
Total			1.20	kW			66,354	kWh

Dark Green font is an estimate because this level of detail was missing from the application.

Applicaton Condenser Analysis	Pre-Retrofit Demand	Post-Retrofit Demand	Measure # Demand Savings	Pre-Retrofit Energy	Post-Retrofit Energy	Measure # Energy Savings (kWh)	Pre-Condenser Rejection (Btuh)	Post-Condenser Rejection (Btuh)	Difference in Condenser Heat Rejection (Btuh)	Measure Energy Savings per Condenser Heat Rejection (kWh/Btuh)
Condenser Fan Use	8.00	8.00	0.00	30,435	57,732	-27,297	20,307,000	18,549,000	1,758,000	-0.02
							0.0031124	4.3129E-07		

Evaluation Condenser Analysis	Pre-Condenser Rejection (Btuh)	Post-Condenser Rejection (Btuh)	Difference in Condenser Heat Rejection (Btuh)	Measure Energy Savings per Condenser Heat Rejection (kWh/Btuh)	Post-Energy	Post Demand
Condenser Fan Use	18,531,806	18,207,311	324,494	-5,039	56,669	7.8526331

Final Results for Measure #2		
Source	Demand Impact	Energy Impact
Evaluation	-2.18	57,576
Application	1.20	39,057

Condenser Capacity	1,917,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	3	circuits	57,510
LT#1 Condensing Circuits	24	circuits	460,080
LT#2 Condensing Circuits	3	circuits	57,510
MT#1 Condensing Circuits	23	circuits	440,910
MT#2 Condensing Circuits	14	circuits	268,380
AC Condensing Circuits	33	circuits	632,610
Total Circuits	100		1,917,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	Refrigeration Case Load (Btuh)	Application Factor (unitless)	Calculated Application Factor, Check (unitless)	Equivalent Btuh rejected for case Load (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	1.0	27,150	-	1.3	27,150	5.78	3.413	16,032		43,182	1.00	5
108	72	8.0	27,150	-	1.4	27,150	6.00	3.413	15,444		42,594	1.00	36
103	70	53.0	27,150	-	1.4	27,150	6.10	3.413	15,191		42,341	1.00	236
98	68	159.0	27,150	-	1.4	27,150	6.21	3.413	14,922		42,072	1.00	695
93	66	287.0	27,150	-	1.5	27,150	6.28	3.413	14,755		37,921	0.73	906
88	66	364.0	27,150	-	1.5	27,150	6.43	3.413	14,411		37,670	0.73	1,122
83	63	457.0	27,150	-	1.5	27,150	6.57	3.413	14,104		37,446	0.73	1,379
78	61	581.0	27,150	-	1.5	27,150	6.65	3.413	13,934		37,322	0.73	1,732
73	59	707.0	27,150	-	1.5	27,150	6.79	3.413	13,647		37,112	0.73	2,064
68	56	804.0	27,150	-	1.6	27,150	6.94	3.413	13,352		36,897	0.73	2,296
63	53	965.0	27,150	-	1.6	27,150	6.94	3.413	13,352		36,897	0.73	2,756
58	50	1100.0	27,150	-	1.6	27,150	6.94	3.413	13,352		36,897	0.73	3,141
53	47	1098.0	27,150	-	1.6	27,150	6.94	3.413	13,352		36,897	0.73	3,136
48	43	902.0	27,150	-	1.6	27,150	6.94	3.413	13,352		36,897	0.73	2,576
43	40	681.0	27,150	-	1.6	27,150	6.94	3.413	13,352		36,897	0.73	1,945
38	36	397.0	27,150	-	1.6	27,150	6.94	3.413	13,352		36,897	0.73	1,134
33	32	159.0	27,150	-	1.6	27,150	6.94	3.413	13,352		36,897	0.73	454
28	27	32.0	27,150	-	1.6	27,150	6.94	3.413	13,352		36,897	0.73	91

			Application
kWh=	25,703	=	25,700
kWh=	4.70	=	4.7

Condenser Capacity	1,917,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	3	circuits	57,510
LT#1 Condensing Circuits	24	circuits	460,080
LT#2 Condensing Circuits	3	circuits	57,510
MT#1 Condensing Circuits	23	circuits	440,910
MT#2 Condensing Circuits	14	circuits	268,380
AC Condensing Circuits	33	circuits	632,610
Total Circuits	100		1,917,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	Refrigeration Case Load (Btuh)	Application Factor (unitless)	Calculated Application Factor, Check (unitless)	Equivalent Btuh rejected for case Load (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	1.0	237,900	-	1.3	237,900	6.50	3.413	124,916		362,816	1.00	37
108	72	8.0	237,900	-	1.3	237,900	6.70	3.413	121,187		359,087	1.00	284
103	70	53.0	237,900	-	1.3	237,900	6.80	3.413	119,405		357,305	1.00	1,854
98	68	159.0	237,900	-	1.3	237,900	6.80	3.413	119,405		357,305	1.00	5,563
93	66	287.0	237,900	-	1.4	237,900	7.00	3.413	115,993		322,575	0.73	7,120
88	66	364.0	237,900	-	1.4	237,900	7.10	3.413	114,360		321,382	0.73	8,903
83	63	457.0	237,900	-	1.4	237,900	7.20	3.413	112,771		320,223	0.73	11,023
78	61	581.0	237,900	-	1.4	237,900	7.40	3.413	109,723		317,998	0.73	13,635
73	59	707.0	237,900	-	1.5	237,900	7.50	3.413	108,260		316,930	0.73	16,371
68	56	804.0	237,900	-	1.5	237,900	7.70	3.413	105,448		314,877	0.73	18,134
63	53	965.0	237,900	-	1.5	237,900	7.90	3.413	102,779		312,929	0.73	21,214
58	50	1100.0	237,900	-	1.5	237,900	8.00	3.413	101,494		311,991	0.73	23,879
53	47	1098.0	237,900	-	1.5	237,900	8.00	3.413	101,494		311,991	0.73	23,836
48	43	902.0	237,900	-	1.5	237,900	8.00	3.413	101,494		311,991	0.73	19,581
43	40	681.0	237,900	-	1.5	237,900	8.00	3.413	101,494		311,991	0.73	14,783
38	36	397.0	237,900	-	1.5	237,900	8.00	3.413	101,494		311,991	0.73	8,618
33	32	159.0	237,900	-	1.5	237,900	8.00	3.413	101,494		311,991	0.73	3,452
28	27	32.0	237,900	-	1.5	237,900	8.00	3.413	101,494		311,991	0.73	695

			Application
kWh=	196,982	=	199,416
kWh=	36.60	=	36.7

Condenser Capacity	1,917,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	3	circuits	57,510
LT#1 Condensing Circuits	24	circuits	460,080
LT#2 Condensing Circuits	3	circuits	57,510
MT#1 Condensing Circuits	23	circuits	440,910
MT#2 Condensing Circuits	14	circuits	268,380
AC Condensing Circuits	33	circuits	632,610
Total Circuits	100		1,917,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	Refrigeration Case Load (Btuh)	Application Factor (unitless)	Calculated Application Factor, Check (unitless)	Equivalent Btuh rejected for case Load (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	1.0	28,500	-	1.3	28,500	6.80	3.413	14,304		42,804	1.00	4
108	72	8.0	28,500	-	1.4	28,500	7.00	3.413	13,896		42,396	1.00	33
103	70	53.0	28,500	-	1.4	28,500	7.00	3.413	13,896		42,396	1.00	216
98	68	159.0	28,500	-	1.4	28,500	7.10	3.413	13,700		42,200	1.00	638
93	66	287.0	28,500	-	1.5	28,500	7.20	3.413	13,510		38,362	0.73	829
88	66	364.0	28,500	-	1.5	28,500	7.40	3.413	13,145		38,096	0.73	1,023
83	63	457.0	28,500	-	1.5	28,500	7.50	3.413	12,969		37,968	0.73	1,268
78	61	581.0	28,500	-	1.5	28,500	7.60	3.413	12,799		37,843	0.73	1,590
73	59	707.0	28,500	-	1.5	28,500	7.80	3.413	12,471		37,604	0.73	1,886
68	56	804.0	28,500	-	1.5	28,500	8.00	3.413	12,159		37,376	0.73	2,091
63	53	965.0	28,500	-	1.5	28,500	8.00	3.413	12,159		37,376	0.73	2,510
58	50	1100.0	28,500	-	1.5	28,500	8.00	3.413	12,159		37,376	0.73	2,861
53	47	1098.0	28,500	-	1.5	28,500	8.00	3.413	12,159		37,376	0.73	2,855
48	43	902.0	28,500	-	1.5	28,500	8.00	3.413	12,159		37,376	0.73	2,346
43	40	681.0	28,500	-	1.5	28,500	8.00	3.413	12,159		37,376	0.73	1,771
38	36	397.0	28,500	-	1.5	28,500	8.00	3.413	12,159		37,376	0.73	1,032
33	32	159.0	28,500	-	1.5	28,500	8.00	3.413	12,159		37,376	0.73	413
28	27	32.0	28,500	-	1.5	28,500	8.00	3.413	12,159		37,376	0.73	83

			Application
kWh=	23,450	=	23,507
kWh=	4.19	=	4.2

Condenser Capacity	1,917,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	3	circuits	57,510
LT#1 Condensing Circuits	24	circuits	460,080
LT#2 Condensing Circuits	3	circuits	57,510
MT#1 Condensing Circuits	23	circuits	440,910
MT#2 Condensing Circuits	14	circuits	268,380
AC Condensing Circuits	33	circuits	632,610
Total Circuits	100		1,917,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	Refrigeration Case Load (Btuh)	Application Factor (unitless)	Calculated Application Factor, Check (unitless)	Equivalent Btuh rejected for case Load (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	1.0	288,585	-	1.2	288,585	11.97	3.413	82,284		370,869	1.00	24
108	72	8.0	288,585	-	1.2	288,585	12.47	3.413	78,985		367,570	1.00	185
103	70	53.0	288,585	-	1.2	288,585	12.63	3.413	77,984		366,569	1.00	1,211
98	68	159.0	288,585	-	1.2	288,585	12.63	3.413	77,984		366,569	1.00	3,633
93	66	287.0	288,585	-	1.3	288,585	12.96	3.413	75,999		344,064	0.73	4,665
88	66	364.0	288,585	-	1.3	288,585	13.13	3.413	75,015		343,346	0.73	5,840
83	63	457.0	288,585	-	1.3	288,585	13.46	3.413	73,175		342,003	0.73	7,153
78	61	581.0	288,585	-	1.3	288,585	13.67	3.413	72,051		341,182	0.73	8,954
73	59	707.0	288,585	-	1.3	288,585	14.08	3.413	69,953		339,651	0.73	10,578
68	56	804.0	288,585	-	1.3	288,585	14.49	3.413	67,974		338,206	0.73	11,689
63	53	965.0	288,585	-	1.3	288,585	14.90	3.413	66,103		336,840	0.73	13,644
58	50	1100.0	288,585	-	1.3	288,585	15.31	3.413	64,333		335,548	0.73	15,136
53	47	1098.0	288,585	-	1.3	288,585	15.51	3.413	63,504		334,943	0.73	14,914
48	43	902.0	288,585	-	1.3	288,585	15.51	3.413	63,504		334,943	0.73	12,252
43	40	681.0	288,585	-	1.3	288,585	15.51	3.413	63,504		334,943	0.73	9,250
38	36	397.0	288,585	-	1.3	288,585	15.51	3.413	63,504		334,943	0.73	5,392
33	32	159.0	288,585	-	1.3	288,585	15.51	3.413	63,504		334,943	0.73	2,160
28	27	32.0	288,585	-	1.3	288,585	15.51	3.413	63,504		334,943	0.73	435

			Application
kWh=	127,114	=	127,119
kWh=	24.11	=	24.1

Condenser Capacity	1,917,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	3	circuits	57,510
LT#1 Condensing Circuits	24	circuits	460,080
LT#2 Condensing Circuits	3	circuits	57,510
MT#1 Condensing Circuits	23	circuits	440,910
MT#2 Condensing Circuits	14	circuits	268,380
AC Condensing Circuits	33	circuits	632,610
Total Circuits	100		1,917,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	Refrigeration Case Load (Btuh)	Application Factor (unitless)	Calculated Application Factor, Check (unitless)	Equivalent Btuh rejected for case Load (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	1.0	164,124	-	1.2	164,124	10.11	3.413	55,406	[redacted]	219,530	1.00	16
108	72	8.0	164,124	-	1.2	164,124	10.69	3.413	52,400	[redacted]	216,524	1.00	123
103	70	53.0	164,124	-	1.2	164,124	10.69	3.413	52,400	[redacted]	216,524	1.00	814
98	68	159.0	164,124	-	1.2	164,124	10.88	3.413	51,485	[redacted]	215,609	1.00	2,399
93	66	287.0	164,124	-	1.3	164,124	11.26	3.413	49,747	[redacted]	200,440	0.73	3,054
88	66	364.0	164,124	-	1.3	164,124	11.61	3.413	48,248	[redacted]	199,345	0.73	3,756
83	63	457.0	164,124	-	1.3	164,124	11.76	3.413	47,632	[redacted]	198,896	0.73	4,656
78	61	581.0	164,124	-	1.4	164,124	12.07	3.413	46,409	[redacted]	198,002	0.73	5,767
73	59	707.0	164,124	-	1.4	164,124	12.38	3.413	45,247	[redacted]	197,154	0.73	6,842
68	56	804.0	164,124	-	1.4	164,124	12.69	3.413	44,141	[redacted]	196,347	0.73	7,591
63	53	965.0	164,124	-	1.4	164,124	13.00	3.413	43,089	[redacted]	195,579	0.73	8,894
58	50	1100.0	164,124	-	1.4	164,124	13.00	3.413	43,089	[redacted]	195,579	0.73	10,138
53	47	1098.0	164,124	-	1.4	164,124	13.00	3.413	43,089	[redacted]	195,579	0.73	10,119
48	43	902.0	164,124	-	1.4	164,124	13.00	3.413	43,089	[redacted]	195,579	0.73	8,313
43	40	681.0	164,124	-	1.4	164,124	13.00	3.413	43,089	[redacted]	195,579	0.73	6,276
38	36	397.0	164,124	-	1.4	164,124	13.00	3.413	43,089	[redacted]	195,579	0.73	3,659
33	32	159.0	164,124	-	1.4	164,124	13.00	3.413	43,089	[redacted]	195,579	0.73	1,465
28	27	32.0	164,124	-	1.4	164,124	13.00	3.413	43,089	[redacted]	195,579	0.73	295

			Application
kWh=	84,177	=	84,182
kWh=	16.23	=	16.2

AC, Measure #2

Condenser Capacity	1,917,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	3	circuits	57,510
LT#1 Condensing Circuits	24	circuits	460,080
LT#2 Condensing Circuits	3	circuits	57,510
MT#1 Condensing Circuits	23	circuits	440,910
MT#2 Condensing Circuits	14	circuits	268,380
AC Condensing Circuits	33	circuits	632,610
Total Circuits	100		1,917,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	AC Load (tons)	AC Load (Btuh)	Equivalent Btuh rejected for AC (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	1.0	40.00	480,000	480,000	26.24	3.413	62,433		542,433	1.00	18
108	72	8.0	40.00	480,000	480,000	27.56	3.413	59,443		539,443	1.00	139
103	70	53.0	40.63	487,560	487,560	27.56	3.413	60,379		547,939	1.00	938
98	68	159.0	34.38	412,560	412,560	31.52	3.413	44,672		457,232	1.00	2,081
93	66	287.0	28.13	337,560	337,560	36.05	3.413	31,958		369,518	1.00	2,687
88	66	364.0	21.88	262,560	262,560	44.28	3.413	20,238		282,798	1.00	2,158
83	63	457.0	15.63	187,560	187,560	48.39	3.413	13,229		200,789	1.00	1,771
78	61	581.0	9.38	112,560	112,560	32.31	3.413	11,890		124,450	1.00	2,024
73	59	707.0	3.13	37,560	37,560	33.10	3.413	3,873		41,433	1.00	802
68	56	804.0										
63	53	965.0										
58	50	1100.0										
53	47	1098.0										
48	43	902.0										
43	40	681.0										
38	36	397.0										
33	32	159.0										
28	27	32.0										

			Application
kWh=	12,620	=	7,943
kWh=	18.29	=	16

Condenser, Measure #2

Condenser Capacity	1,917,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	3	circuits	57,510
LT#1 Condensing Circuits	24	circuits	460,080
LT#2 Condensing Circuits	3	circuits	57,510
MT#1 Condensing Circuits	23	circuits	440,910
MT#2 Condensing Circuits	14	circuits	268,380
AC Condensing Circuits	33	circuits	632,610
Total Circuits	100		1,917,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	AC Heat Rejection (Btuh)	Refrigeration Heat Rejection (Btuh)	Condenser Load Factor (unitless)	Calculated Condenser Load Factor, Check (unitless)	Total Heat Rejection (Btuh)	Total Heat Rejection from the Application (MBtuh)	Total Heat Rejection from the Application (Btuh)	
113	74	1.0	542,433	996,397	-	1.2	1,538,830	1,525	1,525,000	
108	72	8.0	539,443	985,775	-	1.3	1,525,217	1,517	1,517,000	
103	70	53.0	547,939	982,739	-	1.3	1,530,677	1,525	1,525,000	
98	68	159.0	457,232	981,554	-	1.3	1,438,787	1,435	1,435,000	
93	66	287.0	369,518	905,000	-	1.5	1,274,518	1,342	1,342,000	
88	66	364.0	282,798	901,743	-	1.6	1,184,540	1,253	1,253,000	
83	63	457.0	200,789	898,567	-	1.7	1,099,356	1,169	1,169,000	
78	61	581.0	124,450	894,505	-	1.9	1,018,955	1,024	1,024,000	
73	59	707.0	41,433	890,847	-	2.1	932,280	1,020	1,020,000	
68	56	804.0	0	886,327	-	2.2	886,327	1,015	1,015,000	
63	53	965.0	0	882,245	-	2.2	882,245	1,012	1,012,000	
58	50	1100.0	0	880,015	-	2.2	880,015	1,011	1,011,000	
53	47	1098.0	0	879,409	-	2.2	879,409	1,011	1,011,000	
48	43	902.0	0	879,409	-	2.2	879,409	1,011	1,011,000	
43	40	681.0	0	879,409	-	2.2	879,409	1,011	1,011,000	
38	36	397.0	0	879,409	-	2.2	879,409	1,011	1,011,000	
33	32	159.0	0	879,409	-	2.2	879,409	1,011	1,011,000	
28	27	32.0	0	879,409	-	2.2	879,409	1,011	1,011,000	
						Total Rejected	19,468,203	20,914	20,914,000	Heat rejection differences are significant

Condenser Capacity	1,917,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	3	circuits	57,510
LT#1 Condensing Circuits	24	circuits	460,080
LT#2 Condensing Circuits	3	circuits	57,510
MT#1 Condensing Circuits	23	circuits	440,910
MT#2 Condensing Circuits	14	circuits	268,380
AC Condensing Circuits	33	circuits	632,610
Total Circuits	100		1,917,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	Refrigeration Case Load (Btuh)	Application Factor (unitless)	Calculated Application Factor, Check (unitless)	Equivalent Btuh rejected for case Load (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	1.0	27,150	-	1.3	27,150	5.06	3.413	18,313		45,463	1.00	5
108	72	8.0	27,150	-	1.3	27,150	5.06	3.413	18,313		45,463	1.00	43
103	70	53.0	27,150	-	1.3	27,150	5.06	3.413	18,313		45,463	1.00	284
98	68	159.0	27,150	-	1.3	27,150	5.06	3.413	18,313		45,463	1.00	853
93	66	287.0	27,150	-	1.4	27,150	5.06	3.413	18,313		40,518	0.73	1,124
88	66	364.0	27,150	-	1.4	27,150	5.06	3.413	18,313		40,518	0.73	1,426
83	63	457.0	27,150	-	1.4	27,150	5.06	3.413	18,313		40,518	0.73	1,790
78	61	581.0	27,150	-	1.4	27,150	5.06	3.413	18,313		40,518	0.73	2,276
73	59	707.0	27,150	-	1.4	27,150	5.06	3.413	18,313		40,518	0.73	2,769
68	56	804.0	27,150	-	1.4	27,150	5.06	3.413	18,313		40,518	0.73	3,149
63	53	965.0	27,150	-	1.4	27,150	5.06	3.413	18,313		40,518	0.73	3,780
58	50	1100.0	27,150	-	1.4	27,150	5.06	3.413	18,313		40,518	0.73	4,309
53	47	1098.0	27,150	-	1.4	27,150	5.06	3.413	18,313		40,518	0.73	4,301
48	43	902.0	27,150	-	1.4	27,150	5.06	3.413	18,313		40,518	0.73	3,533
43	40	681.0	27,150	-	1.4	27,150	5.06	3.413	18,313		40,518	0.73	2,667
38	36	397.0	27,150	-	1.4	27,150	5.06	3.413	18,313		40,518	0.73	1,555
33	32	159.0	27,150	-	1.4	27,150	5.06	3.413	18,313		40,518	0.73	623
28	27	32.0	27,150	-	1.4	27,150	5.06	3.413	18,313		40,518	0.73	125

			Application
kWh=	34,613	=	34,614
kWh=	5.37	=	5.4

Condenser Capacity	1,917,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	3	circuits	57,510
LT#1 Condensing Circuits	24	circuits	460,080
LT#2 Condensing Circuits	3	circuits	57,510
MT#1 Condensing Circuits	23	circuits	440,910
MT#2 Condensing Circuits	14	circuits	268,380
AC Condensing Circuits	33	circuits	632,610
Total Circuits	100		1,917,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	Refrigeration Case Load (Btuh)	Application Factor (unitless)	Calculated Application Factor, Check (unitless)	Equivalent Btuh rejected for case Load (Btuh)	Estimated Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	1.0	237,900	-	1.2	237,900	6.00	3.413	135,325		373,225	1.00	40
108	72	8.0	237,900	-	1.2	237,900	6.00	3.413	135,325		373,225	1.00	317
103	70	53.0	237,900	-	1.2	237,900	6.00	3.413	135,325		373,225	1.00	2,101
98	68	159.0	237,900	-	1.2	237,900	6.00	3.413	135,325		373,225	1.00	6,304
93	66	287.0	237,900	-	1.4	237,900	6.00	3.413	135,325		336,688	0.73	8,307
88	66	364.0	237,900	-	1.4	237,900	6.00	3.413	135,325		336,688	0.73	10,536
83	63	457.0	237,900	-	1.4	237,900	6.00	3.413	135,325		336,688	0.73	13,228
78	61	581.0	237,900	-	1.4	237,900	6.00	3.413	135,325		336,688	0.73	16,817
73	59	707.0	237,900	-	1.4	237,900	6.00	3.413	135,325		336,688	0.73	20,464
68	56	804.0	237,900	-	1.4	237,900	6.00	3.413	135,325		336,688	0.73	23,271
63	53	965.0	237,900	-	1.4	237,900	6.00	3.413	135,325		336,688	0.73	27,931
58	50	1100.0	237,900	-	1.4	237,900	6.00	3.413	135,325		336,688	0.73	31,839
53	47	1098.0	237,900	-	1.4	237,900	6.00	3.413	135,325		336,688	0.73	31,781
48	43	902.0	237,900	-	1.4	237,900	6.00	3.413	135,325		336,688	0.73	26,108
43	40	681.0	237,900	-	1.4	237,900	6.00	3.413	135,325		336,688	0.73	19,711
38	36	397.0	237,900	-	1.4	237,900	6.00	3.413	135,325		336,688	0.73	11,491
33	32	159.0	237,900	-	1.4	237,900	6.00	3.413	135,325		336,688	0.73	4,602
28	27	32.0	237,900	-	1.4	237,900	6.00	3.413	135,325		336,688	0.73	926

			Application
kWh=	255,775	=	256,243
kWh=	39.65	=	39.7

Condenser Capacity	1,917,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	3	circuits	57,510
LT#1 Condensing Circuits	24	circuits	460,080
LT#2 Condensing Circuits	3	circuits	57,510
MT#1 Condensing Circuits	23	circuits	440,910
MT#2 Condensing Circuits	14	circuits	268,380
AC Condensing Circuits	33	circuits	632,610
Total Circuits	100		1,917,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	Refrigeration Case Load (Btuh)	Application Factor (unitless)	Calculated Application Factor, Check (unitless)	Equivalent Btuh rejected for case Load (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	1.0	28,500	-	0.0	28,500	5.90	3.413	16,487	[redacted]	44,987	1.00	5
108	72	8.0	28,500	-	1.3	28,500	6.00	3.413	16,212	[redacted]	44,712	1.00	38
103	70	53.0	28,500	-	1.3	28,500	6.00	3.413	16,212	[redacted]	44,712	1.00	252
98	68	159.0	28,500	-	1.3	28,500	6.00	3.413	16,212	[redacted]	44,712	1.00	755
93	66	287.0	28,500	-	1.4	28,500	6.00	3.413	16,212	[redacted]	40,335	0.73	995
88	66	364.0	28,500	-	1.4	28,500	6.00	3.413	16,212	[redacted]	40,335	0.73	1,262
83	63	457.0	28,500	-	1.4	28,500	6.00	3.413	16,212	[redacted]	40,335	0.73	1,585
78	61	581.0	28,500	-	1.4	28,500	6.00	3.413	16,212	[redacted]	40,335	0.73	2,015
73	59	707.0	28,500	-	1.4	28,500	6.00	3.413	16,212	[redacted]	40,335	0.73	2,452
68	56	804.0	28,500	-	1.4	28,500	6.00	3.413	16,212	[redacted]	40,335	0.73	2,788
63	53	965.0	28,500	-	1.4	28,500	6.00	3.413	16,212	[redacted]	40,335	0.73	3,346
58	50	1100.0	28,500	-	1.4	28,500	6.00	3.413	16,212	[redacted]	40,335	0.73	3,814
53	47	1098.0	28,500	-	1.4	28,500	6.00	3.413	16,212	[redacted]	40,335	0.73	3,807
48	43	902.0	28,500	-	1.4	28,500	6.00	3.413	16,212	[redacted]	40,335	0.73	3,128
43	40	681.0	28,500	-	1.4	28,500	6.00	3.413	16,212	[redacted]	40,335	0.73	2,361
38	36	397.0	28,500	-	1.4	28,500	6.00	3.413	16,212	[redacted]	40,335	0.73	1,377
33	32	159.0	28,500	-	1.4	28,500	6.00	3.413	16,212	[redacted]	40,335	0.73	551
28	27	32.0	28,500	-	1.4	28,500	6.00	3.413	16,212	[redacted]	40,335	0.73	111

			Application
kWh=	30,641	=	30,697
kWh=	4.83	=	4.8

Condenser Capacity	1,917,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	3	circuits	57,510
LT#1 Condensing Circuits	24	circuits	460,080
LT#2 Condensing Circuits	3	circuits	57,510
MT#1 Condensing Circuits	23	circuits	440,910
MT#2 Condensing Circuits	14	circuits	268,380
AC Condensing Circuits	33	circuits	632,610
Total Circuits	100		1,917,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	Refrigeration Case Load (Btuh)	Application Factor (unitless)	Calculated Application Factor, Check (unitless)	Equivalent Btuh rejected for case Load (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	1.0	288,585	-	1.2	288,585	11.12	3.413	88,574	[redacted]	377,159	1.00	26
108	72	8.0	288,585	-	1.2	288,585	11.12	3.413	88,574	[redacted]	377,159	1.00	208
103	70	53.0	288,585	-	1.2	288,585	11.12	3.413	88,574	[redacted]	377,159	1.00	1,375
98	68	159.0	288,585	-	1.2	288,585	11.12	3.413	88,574	[redacted]	377,159	1.00	4,126
93	66	287.0	288,585	-	1.2	288,585	11.12	3.413	88,574	[redacted]	353,244	0.73	5,437
88	66	364.0	288,585	-	1.2	288,585	11.12	3.413	88,574	[redacted]	353,244	0.73	6,896
83	63	457.0	288,585	-	1.2	288,585	11.12	3.413	88,574	[redacted]	353,244	0.73	8,658
78	61	581.0	288,585	-	1.2	288,585	11.12	3.413	88,574	[redacted]	353,244	0.73	11,007
73	59	707.0	288,585	-	1.2	288,585	11.12	3.413	88,574	[redacted]	353,244	0.73	13,394
68	56	804.0	288,585	-	1.2	288,585	11.12	3.413	88,574	[redacted]	353,244	0.73	15,232
63	53	965.0	288,585	-	1.2	288,585	11.12	3.413	88,574	[redacted]	353,244	0.73	18,282
58	50	1100.0	288,585	-	1.2	288,585	11.12	3.413	88,574	[redacted]	353,244	0.73	20,839
53	47	1098.0	288,585	-	1.2	288,585	11.12	3.413	88,574	[redacted]	353,244	0.73	20,801
48	43	902.0	288,585	-	1.2	288,585	11.12	3.413	88,574	[redacted]	353,244	0.73	17,088
43	40	681.0	288,585	-	1.2	288,585	11.12	3.413	88,574	[redacted]	353,244	0.73	12,901
38	36	397.0	288,585	-	1.2	288,585	11.12	3.413	88,574	[redacted]	353,244	0.73	7,521
33	32	159.0	288,585	-	1.2	288,585	11.12	3.413	88,574	[redacted]	353,244	0.73	3,012
28	27	32.0	288,585	-	1.2	288,585	11.12	3.413	88,574	[redacted]	353,244	0.73	606

			Application
kWh=	167,411	=	167,448
kWh=	25.95	=	26

Condenser Capacity	1,917,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	3	circuits	57,510
LT#1 Condensing Circuits	24	circuits	460,080
LT#2 Condensing Circuits	3	circuits	57,510
MT#1 Condensing Circuits	23	circuits	440,910
MT#2 Condensing Circuits	14	circuits	268,380
AC Condensing Circuits	33	circuits	632,610
Total Circuits	100		1,917,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	Refrigeration Case Load (Btuh)	Application Factor (unitless)	Calculated Application Factor, Check (unitless)	Equivalent Btuh rejected for case Load (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	1.0	164,124	-	1.2	164,124	9.30	3.413	60,232	[redacted]	224,356	1.00	18
108	72	8.0	164,124	-	1.2	164,124	9.30	3.413	60,232	[redacted]	224,356	1.00	141
103	70	53.0	164,124	-	1.2	164,124	9.30	3.413	60,232	[redacted]	224,356	1.00	935
98	68	159.0	164,124	-	1.2	164,124	9.30	3.413	60,232	[redacted]	224,356	1.00	2,806
93	66	287.0	164,124	-	1.3	164,124	9.30	3.413	60,232	[redacted]	208,093	0.73	3,697
88	66	364.0	164,124	-	1.3	164,124	9.30	3.413	60,232	[redacted]	208,093	0.73	4,689
83	63	457.0	164,124	-	1.3	164,124	9.30	3.413	60,232	[redacted]	208,093	0.73	5,887
78	61	581.0	164,124	-	1.3	164,124	9.30	3.413	60,232	[redacted]	208,093	0.73	7,485
73	59	707.0	164,124	-	1.3	164,124	9.30	3.413	60,232	[redacted]	208,093	0.73	9,108
68	56	804.0	164,124	-	1.3	164,124	9.30	3.413	60,232	[redacted]	208,093	0.73	10,358
63	53	965.0	164,124	-	1.3	164,124	9.30	3.413	60,232	[redacted]	208,093	0.73	12,432
58	50	1100.0	164,124	-	1.3	164,124	9.30	3.413	60,232	[redacted]	208,093	0.73	14,171
53	47	1098.0	164,124	-	1.3	164,124	9.30	3.413	60,232	[redacted]	208,093	0.73	14,145
48	43	902.0	164,124	-	1.3	164,124	9.30	3.413	60,232	[redacted]	208,093	0.73	11,620
43	40	681.0	164,124	-	1.3	164,124	9.30	3.413	60,232	[redacted]	208,093	0.73	8,773
38	36	397.0	164,124	-	1.3	164,124	9.30	3.413	60,232	[redacted]	208,093	0.73	5,114
33	32	159.0	164,124	-	1.3	164,124	9.30	3.413	60,232	[redacted]	208,093	0.73	2,048
28	27	32.0	164,124	-	1.3	164,124	9.30	3.413	60,232	[redacted]	208,093	0.73	412

			Application
kWh=	113,842	=	113,889
kWh=	17.65	=	17.7

Condenser Capacity	1,917,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	3	circuits	57,510
LT#1 Condensing Circuits	24	circuits	460,080
LT#2 Condensing Circuits	3	circuits	57,510
MT#1 Condensing Circuits	23	circuits	440,910
MT#2 Condensing Circuits	14	circuits	268,380
AC Condensing Circuits	33	circuits	632,610
Total Circuits	100		1,917,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	AC Load (tons)	AC Load (Btuh)	Equivalent Btuh rejected for AC (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	1.0	40.00	480,000	480,000	24.11	3.413	67,949		547,949	1.00	20
108	72	8.0	40.00	480,000	480,000	24.11	3.413	67,949		547,949	1.00	159
103	70	53.0	40.63	487,560	487,560	24.11	3.413	69,019		556,579	1.00	1,072
98	68	159.0	34.38	412,560	412,560	24.11	3.413	58,402		470,962	1.00	2,721
93	66	287.0	28.13	337,560	337,560	24.11	3.413	47,785		385,345	1.00	4,018
88	66	364.0	21.88	262,560	262,560	24.11	3.413	37,168		299,728	1.00	3,964
83	63	457.0	15.63	187,560	187,560	24.11	3.413	26,551		214,111	1.00	3,555
78	61	581.0	9.38	112,560	112,560	24.11	3.413	15,934		128,494	1.00	2,712
73	59	707.0	3.13	37,560	37,560	24.11	3.413	5,317		42,877	1.00	1,101
68	56	804.0										
63	53	965.0										
58	50	1100.0										
53	47	1098.0										
48	43	902.0										
43	40	681.0										
38	36	397.0										
33	32	159.0										
28	27	32.0										

			Application
kWh=	19,323	=	19,318
kWh=	19.91	=	20

Notes

The application assumes a lower AC load in the post-measure #2 retrofit condition.

Condenser Capacity	1,917,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	3	circuits	57,510
LT#1 Condensing Circuits	24	circuits	460,080
LT#2 Condensing Circuits	3	circuits	57,510
MT#1 Condensing Circuits	23	circuits	440,910
MT#2 Condensing Circuits	14	circuits	268,380
AC Condensing Circuits	33	circuits	632,610
Total Circuits	100		1,917,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	AC Heat Rejection (Btuh)	Refrigeration Heat Rejection (Btuh)	Condenser Load Factor (unitless)	Calculated Condenser Load Factor, Check (unitless)	Total Heat Rejection (Btuh)	Total Heat Rejection from the Application (MBtuh)	Total Heat Rejection from the Application (Btuh)	
113	74	1.0	547,949	1,020,203	-	1.2	1,568,151	1,642	1,642,000	
108	72	8.0	547,949	1,020,203	-	1.2	1,568,151	1,642	1,642,000	
103	70	53.0	556,579	1,020,203	-	1.2	1,576,782	1,651	1,651,000	
98	68	159.0	470,962	1,020,203	-	1.3	1,491,165	1,565	1,565,000	
93	66	287.0	385,345	938,543	-	1.4	1,323,888	1,479	1,479,000	
88	66	364.0	299,728	938,543	-	1.5	1,238,271	1,394	1,394,000	
83	63	457.0	214,111	938,543	-	1.7	1,152,654	1,308	1,308,000	
78	61	581.0	128,494	938,543	-	1.8	1,067,037	1,222	1,222,000	
73	59	707.0	42,877	938,543	-	2.0	981,420	1,137	1,137,000	
68	56	804.0	0	938,543	-	2.0	938,543	1,094	1,094,000	
63	53	965.0	0	938,543	-	2.0	938,543	1,094	1,094,000	
58	50	1100.0	0	938,543	-	2.0	938,543	1,094	1,094,000	
53	47	1098.0	0	938,543	-	2.0	938,543	1,094	1,094,000	
48	43	902.0	0	938,543	-	2.0	938,543	1,094	1,094,000	
43	40	681.0	0	938,543	-	2.0	938,543	1,094	1,094,000	
38	36	397.0	0	938,543	-	2.0	938,543	1,094	1,094,000	
33	32	159.0	0	938,543	-	2.0	938,543	1,094	1,094,000	
28	27	32.0	0	938,543	-	2.0	938,543	1,094	1,094,000	
						Total Rejected	20,414,405	22,886	22,886,000	Heat rejection differences are significant

Measure #2 Summary of Findings

Evaluation Compressor Savings	Pre-Retrofit Demand	Post-Retrofit Demand	Measure # Demand Savings	Pre-Retrofit Energy	Post-Retrofit Energy	Measure # Energy Savings	
Ice Cream Condensing Circuits	5.37	4.70	0.67	34,613	25,703	8,910	
LT#1 Condensing Circuits	39.65	36.60	3.05	255,775	198,982	56,793	
LT#2 Condensing Circuits	4.83	4.19	0.64	30,641	23,450	7,191	
MT#1 Condensing Circuits	25.95	24.11	1.84	167,411	127,114	40,297	
MT#2 Condensing Circuits	17.65	16.23	1.41	113,842	84,177	29,666	
AC Condensing Circuits	19.91	18.29	1.62	19,323	12,620	6,703	
Total			9.23	kW		149,560	kWh
Total Refer w/ Compressor		97.00			519,727		

Application Compressor Savings	Pre-Retrofit Demand	Post-Retrofit Demand	Measure # Demand Savings	Pre-Retrofit Energy	Post-Retrofit Energy	Measure # Energy Savings	
Ice Cream Condensing Circuits	5.40	4.70	0.70	34,614	25,700	8,914	
LT#1 Condensing Circuits	39.70	36.70	3.00	256,243	199,416	56,827	
LT#2 Condensing Circuits	4.80	4.20	0.60	30,697	23,507	7,190	
MT#1 Condensing Circuits	26.00	24.10	1.90	167,448	127,119	40,329	
MT#2 Condensing Circuits	17.70	16.20	1.50	113,889	84,182	29,707	
AC Condensing Circuits	20.00	16.00	4.00	19,318	7,943	11,375	
Total			11.70	kW		154,342	kWh

Dark Green font is an estimate because this level of detail was missing from the application.

Applicaton Condenser Analysis	Pre-Retrofit Demand	Post-Retrofit Demand	Measure # Demand Savings	Pre-Retrofit Energy	Post-Retrofit Energy	Measure # Energy Savings (kWh)	Pre-Condenser Rejection (Btuh)	Post-Condenser Rejection (Btuh)	Difference in Condenser Heat Rejection (Btuh)	Measure Energy Savings per Condenser Heat Rejection (kWh/Btuh)
Condenser Fan Use	12.00	12.00	0.00	33,645	64,780	-31,135	22,886,000	20,914,000	1,972,000	-0.02
							0.00309745	5.7378E-07		

Evaluation Condenser Analysis	Pre-Condenser Rejection (Btuh)	Post-Condenser Rejection (Btuh)	Difference in Condenser Heat Rejection (Btuh)	Measure Energy Savings per Condenser Heat Rejection (kWh/Btuh)	Post-Energy	Post Demand
Condenser Fan Use	20,414,405	19,468,203	946,203	-14,939	60,302	11.1704328

Final Results for Measure #2

Source	Demand Impact	Energy Impact
Evaluation	9.23	134,621
Application	11.70	123,207

Condenser Capacity	1,300,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	2	circuits	26,263
LT#1 Condensing Circuits	7	circuits	91,919
MT#1 Condensing Circuits	18	circuits	236,364
MT#2 Condensing Circuits	27	circuits	354,545
AC Condensing Circuits	45	circuits	590,909
Total Circuits	99		

Total Refer w/ Compressor 6.50 26,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	Refrigeration Case Load (Btuh)	Application Factor (unitless)	Calculated Application Factor, Check (unitless)	Equivalent Btuh rejected for case Load (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	1.8	26,000	1.2	0.6	26,000	5.04	3.413	17,607		43,607	1.00	9
108	72	27.6	26,000	1.3	0.6	26,000	5.06	3.413	17,537		43,537	1.00	142
103	70	138.8	26,000	1.2	0.6	26,000	5.08	3.413	17,468		43,468	1.00	710
98	68	246.9	26,000	1.2	0.6	26,000	5.11	3.413	17,366		43,366	1.00	1,256
93	66	322.0	26,000	1.2	0.7	26,000	5.13	3.413	17,298		38,627	0.73	1,191
88	66	380.8	26,000	1.2	0.7	26,000	5.13	3.413	17,298		38,627	0.73	1,409
83	63	526.0	26,000	1.1	0.7	26,000	5.13	3.413	17,298		38,627	0.73	1,946
78	61	530.6	26,000	1.1	0.7	26,000	5.15	3.413	17,231		38,578	0.73	1,955
73	59	671.0	26,000	1.1	0.7	26,000	5.25	3.413	16,902		38,339	0.73	2,426
68	56	683.7	26,000	1.1	0.7	26,000	5.47	3.413	16,223		37,843	0.73	2,372
63	53	851.7	26,000	1.1	0.7	26,000	5.68	3.413	15,623		37,405	0.73	2,846
58	50	871.3	26,000	1.1	0.7	26,000	5.89	3.413	15,066		36,998	0.73	2,808
53	47	1041.7	26,000	1.1	0.7	26,000	5.89	3.413	15,066		36,998	0.73	3,357
48	43	854.2	26,000	1.1	0.7	26,000	5.89	3.413	15,066		36,998	0.73	2,753
43	40	754.1	26,000	1.1	0.7	26,000	5.89	3.413	15,066		36,998	0.73	2,430
38	36	488.9	26,000	1.1	0.7	26,000	5.89	3.413	15,066		36,998	0.73	1,575
33	32	258.7	26,000	1.1	0.7	26,000	5.89	3.413	15,066		36,998	0.73	834
28	27	87.2	26,000	1.1	0.7	26,000	6.50	3.413	13.652		35,966	0.73	255

			Application
kWh=	30.274	>	16,375
kWh=	5.16	>	2.5

Condenser Capacity	1,300,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	2	circuits	26,263
LT#1 Condensing Circuits	7	circuits	91,919
MT#1 Condensing Circuits	18	circuits	236,364
MT#2 Condensing Circuits	27	circuits	354,545
AC Condensing Circuits	45	circuits	590,909
Total Circuits	99		

Total Refer w/ Compressor 7.70 116,249

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	Refrigeration Case Load (Btuh)	Application Factor (unitless)	Calculated Application Factor, Check (unitless)	Equivalent Btuh rejected for case Load (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	1.8	116,249	1.2	0.5	116,249	6.80	3.413	58,347		174,596	1.00	31
108	72	27.6	116,249	1.1	0.5	116,249	6.20	3.413	63,993		180,242	1.00	517
103	70	138.8	116,249	1.1	0.5	116,249	6.30	3.413	62,977		179,226	1.00	2,561
98	68	246.9	116,249	1.1	0.5	116,249	6.40	3.413	61,993		178,242	1.00	4,485
93	66	322.0	116,249	1.1	0.6	116,249	6.50	3.413	61,040		158,977	0.70	4,031
88	66	380.8	116,249	1.1	0.6	116,249	6.50	3.413	61,040		158,977	0.70	4,767
83	63	526.0	116,249	1.1	0.6	116,249	6.60	3.413	60,115		158,329	0.70	6,485
78	61	530.6	116,249	1.1	0.6	116,249	6.70	3.413	59,218		157,701	0.70	6,444
73	59	671.0	116,249	1.1	0.6	116,249	6.80	3.413	58,347		157,092	0.70	8,030
68	56	683.7	116,249	1.0	0.6	116,249	6.80	3.413	58,347		157,092	0.70	8,182
63	53	851.7	116,249	1.0	0.6	116,249	6.80	3.413	58,347		157,092	0.70	10,192
58	50	871.3	116,249	1.0	0.6	116,249	7.00	3.413	56,680		155,925	0.70	10,129
53	47	1041.7	116,249	1.0	0.6	116,249	7.00	3.413	56,680		155,925	0.70	12,110
48	43	854.2	116,249	1.0	0.6	116,249	7.00	3.413	56,680		155,925	0.70	9,930
43	40	754.1	116,249	0.9	0.6	116,249	7.00	3.413	56,680		155,925	0.70	8,766
38	36	488.9	116,249	0.9	0.6	116,249	7.00	3.413	56,680		155,925	0.70	5,683
33	32	258.7	116,249	0.9	0.6	116,249	7.00	3.413	56,680		155,925	0.70	3,007
28	27	87.2	116,249	0.9	0.6	116,249	7.70	3.413	51,527		152,318	0.70	922

			Application
kWh=	106,273	>	57,258
kWh=	17.10	>	8.8

Condenser Capacity	1,300,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	2	circuits	26,263
LT#1 Condensing Circuits	7	circuits	91,919
MT#1 Condensing Circuits	18	circuits	236,364
MT#2 Condensing Circuits	27	circuits	354,545
AC Condensing Circuits	45	circuits	590,909
Total Circuits	99		

Total Refer w/ Compressor 13.00 151,600

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	Refrigeration Case Load (Btuh)	Application Factor (unitless)	Calculated Application Factor, Check (unitless)	Equivalent Btuh rejected for case Load (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	1.8	151,600	1.1	1.1	151,600	9.15	3.413	56,548	[redacted]	208,148	1.00	30
108	72	27.6	151,600	1.1	1.1	151,600	9.15	3.413	56,548	[redacted]	208,148	1.00	457
103	70	138.8	151,600	1.1	1.1	151,600	9.25	3.413	55,936	[redacted]	207,536	1.00	2,275
98	68	246.9	151,600	1.1	1.1	151,600	9.34	3.413	55,397	[redacted]	206,997	1.00	4,007
93	66	322.0	151,600	1.1	1.2	151,600	9.39	3.413	55,102	[redacted]	191,825	0.73	3,795
88	66	380.8	151,600	1.1	1.2	151,600	9.39	3.413	55,102	[redacted]	191,825	0.73	4,488
83	63	526.0	151,600	1.1	1.2	151,600	9.49	3.413	54,522	[redacted]	191,401	0.73	6,134
78	61	530.6	151,600	1.1	1.2	151,600	9.54	3.413	54,236	[redacted]	191,192	0.73	6,155
73	59	671.0	151,600	1.1	1.2	151,600	9.73	3.413	53,177	[redacted]	190,419	0.73	7,632
68	56	683.7	151,600	1.2	1.3	151,600	10.11	3.413	51,178	[redacted]	188,960	0.73	7,484
63	53	851.7	151,600	1.2	1.3	151,600	10.69	3.413	48,401	[redacted]	186,933	0.73	8,817
58	50	871.3	151,600	1.2	1.3	151,600	11.07	3.413	46,740	[redacted]	185,720	0.73	8,710
53	47	1041.7	151,600	1.2	1.3	151,600	11.07	3.413	46,740	[redacted]	185,720	0.73	10,414
48	43	854.2	151,600	1.2	1.3	151,600	11.07	3.413	46,740	[redacted]	185,720	0.73	8,540
43	40	754.1	151,600	1.2	1.3	151,600	11.07	3.413	46,740	[redacted]	185,720	0.73	7,539
38	36	488.9	151,600	1.2	1.3	151,600	11.07	3.413	46,740	[redacted]	185,720	0.73	4,888
33	32	258.7	151,600	1.2	1.3	151,600	11.07	3.413	46,740	[redacted]	185,720	0.73	2,586
28	27	87.2	151,600	1.2	1.3	151,600	13.00	3.413	39,801	[redacted]	180,655	0.73	742

			Application
kWh=	94,694	=	91,310
kWh=	16.57	=	16.6

Condenser Capacity	1,300,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	2	circuits	26,263
LT#1 Condensing Circuits	7	circuits	91,919
MT#1 Condensing Circuits	18	circuits	236,364
MT#2 Condensing Circuits	27	circuits	354,545
AC Condensing Circuits	45	circuits	590,909
Total Circuits	99		
Total Refer w/ Compressor	15 51		239,371

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	Refrigeration Case Load (Btuh)	Application Factor (unitless)	Calculated Application Factor, Check (unitless)	Equivalent Btuh rejected for case Load (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	1.8	239,371	1.1	1.1	239,371	10.57	3.413	77,292		316,663	1.00	41
108	72	27.6	239,371	1.1	1.1	239,371	10.70	3.413	76,353		315,724	1.00	617
103	70	138.8	239,371	1.1	1.1	239,371	10.84	3.413	75,367		314,738	1.00	3,065
98	68	246.9	239,371	1.1	1.1	239,371	11.26	3.413	72,555		311,926	1.00	5,249
93	66	322.0	239,371	1.1	1.2	239,371	11.39	3.413	71,727		291,732	0.73	4,940
88	66	380.8	239,371	1.1	1.2	239,371	11.39	3.413	71,727		291,732	0.73	5,842
83	63	526.0	239,371	1.1	1.2	239,371	11.67	3.413	70,006		290,476	0.73	7,876
78	61	530.6	239,371	1.1	1.2	239,371	11.81	3.413	69,176		289,870	0.73	7,851
73	59	671.0	239,371	1.1	1.2	239,371	11.97	3.413	68,252		289,195	0.73	9,795
68	56	683.7	239,371	1.1	1.2	239,371	12.30	3.413	66,421		287,858	0.73	9,713
63	53	851.7	239,371	1.1	1.2	239,371	12.63	3.413	64,685		286,591	0.73	11,784
58	50	871.3	239,371	1.2	1.2	239,371	12.96	3.413	63,038		285,389	0.73	11,748
53	47	1041.7	239,371	1.2	1.2	239,371	12.96	3.413	63,038		285,389	0.73	14,045
48	43	854.2	239,371	1.2	1.2	239,371	12.96	3.413	63,038		285,389	0.73	11,517
43	40	754.1	239,371	1.2	1.2	239,371	12.96	3.413	63,038		285,389	0.73	10,168
38	36	488.9	239,371	1.2	1.2	239,371	12.96	3.413	63,038		285,389	0.73	6,592
33	32	258.7	239,371	1.2	1.2	239,371	12.96	3.413	63,038		285,389	0.73	3,488
28	27	87.2	239,371	1.2	1.3	239,371	15.51	3.413	52,674		277,823	0.73	982

			Application
kWh=	125,313	=	121,005
kWh=	22.65	=	22.8

Condenser Capacity	1,300,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	2	circuits	26,263
LT#1 Condensing Circuits	7	circuits	91,919
MT#1 Condensing Circuits	18	circuits	236,364
MT#2 Condensing Circuits	27	circuits	354,545
AC Condensing Circuits	45	circuits	590,909
Total Circuits	99		
Total Refer w/ Compressor		0.00	

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	AC Load (tons)	AC Load (Btuh)	Equivalent Btuh rejected for AC (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	1.8	30.00	360,000	360,000	21.90	3.413	56,104		416,104	1.00	30
108	72	27.6	30.00	360,000	360,000	22.34	3.413	54,999		414,999	1.00	445
103	70	138.8	28.68	344,160	344,160	24.93	3.413	47,117		391,277	1.00	1,916
98	68	246.9	24.26	291,120	291,120	28.73	3.413	34,584		325,704	1.00	2,502
93	66	322.0	19.85	238,200	238,200	35.06	3.413	23,188		261,388	1.00	2,188
88	66	380.8	15.44	185,280	185,280	36.07	3.413	17,531		202,811	1.00	1,956
83	63	526.0	11.03	132,360	132,360	40.12	3.413	11,260		143,620	1.00	1,735
78	61	530.6	6.62	79,440	79,440	40.12	3.413	6,758		86,198	1.00	1,051
73	59	671.0	2.21	26,520	26,520	23.66	4.413	4,946		36,413	2.00	1,504
68	56	683.7										
63	53	851.7										
58	50	871.3										
53	47	1041.7										
48	43	854.2										
43	40	754.1										
38	36	488.9										
33	32	258.7										
28	27	87.2										

			Application
kWh=	13,326	=	9,084
kWh=	16.44	=	16

Condenser, Measure #2

Condenser Capacity	1,300,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	2	circuits	26,263
LT#1 Condensing Circuits	7	circuits	91,919
MT#1 Condensing Circuits	18	circuits	236,364
MT#2 Condensing Circuits	27	circuits	354,545
AC Condensing Circuits	45	circuits	590,909
Total Circuits	99		1,300,000
Total Refer w/ Compressor	646761.46		

2

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	AC Heat Rejection (Btuh)	Refrigeration Heat Rejection (Btuh)	Condenser Load Factor (unitless)	Calculated Condenser Load Factor, Check (unitless)	Total Heat Rejection (Btuh)	Total Heat Rejection from the Application (MBtuh)	Total Heat Rejection from the Application (Btuh)	
113	74	1.8	416,104	743,013	1.3	1.1	1,159,117	1,038	1,038,000	
108	72	27.6	414,999	747,651	1.2	1.1	1,162,650	1,045	1,045,000	
103	70	138.8	391,277	744,968	1.3	1.1	1,136,245	968	968,000	
98	68	246.9	325,704	740,532	1.4	1.2	1,066,235	901	901,000	
93	66	322.0	261,388	681,161	1.6	1.4	942,549	837	837,000	
88	66	380.8	202,811	681,161	1.7	1.5	883,972	778	778,000	
83	63	526.0	143,620	678,833	1.8	1.6	822,453	720	720,000	
78	61	530.6	86,198	677,342	2.0	1.7	763,540	661	661,000	
73	59	671.0	36,413	675,044	2.1	1.8	711,457	623	623,000	
68	56	683.7	0	671,752	2.1	1.9	671,752	626	626,000	
63	53	851.7	0	668,021	2.1	1.9	668,021	621	621,000	
58	50	871.3	0	664,032	2.1	2.0	664,032	618	618,000	
53	47	1041.7	0	664,032	3.1	2.0	664,032	619	619,000	
48	43	854.2	0	664,032	4.1	2.0	664,032	620	620,000	
43	40	754.1	0	664,032	5.1	2.0	664,032	621	621,000	
38	36	488.9	0	664,032	6.1	2.0	664,032	622	622,000	
33	32	258.7	0	664,032	7.1	2.0	664,032	623	623,000	
28	27	87.2	0	646,761	2.1	2.0	646,761	610	610,000	
						Total Rejected	14,618,943	13,151	13,151,000	Heat rejection differences are significant

Ice Cream, Measure #1

Condenser Capacity	1,300,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	2	circuits	26,263
LT#1 Condensing Circuits	7	circuits	91,919
MT#1 Condensing Circuits	18	circuits	236,364
MT#2 Condensing Circuits	27	circuits	354,545
AC Condensing Circuits	45	circuits	590,909
Total Circuits	99		1,300,000

Total Refer w/ Compressor 5.06 26,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	Refrigeration Case Load (Btuh)	Application Factor (unitless)	Calculated Application Factor, Check (unitless)	Equivalent Btuh rejected for case Load (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	1.8	26,000	1.3	0.6	26,000	5.04	3.413	17,607		43,607	1.00	9
108	72	27.6	26,000	1.3	0.6	26,000	5.06	3.413	17,537		43,537	1.00	142
103	70	138.8	26,000	1.2	0.6	26,000	5.06	3.413	17,537		43,537	1.00	713
98	68	246.9	26,000	1.2	0.6	26,000	5.06	3.413	17,537		43,537	1.00	1,269
93	66	322.0	26,000	1.2	0.6	26,000	5.06	3.413	17,537		43,537	1.00	1,655
88	66	380.8	26,000	1.2	0.7	26,000	5.06	3.413	17,537		38,802	0.73	1,428
83	63	526.0	26,000	1.2	0.7	26,000	5.06	3.413	17,537		38,802	0.73	1,973
78	61	530.6	26,000	1.2	0.7	26,000	5.06	3.413	17,537		38,802	0.73	1,990
73	59	671.0	26,000	1.2	0.7	26,000	5.06	3.413	17,537		38,802	0.73	2,517
68	56	683.7	26,000	1.2	0.7	26,000	5.06	3.413	17,537		38,802	0.73	2,565
63	53	851.7	26,000	1.2	0.7	26,000	5.06	3.413	17,537		38,802	0.73	3,195
58	50	871.3	26,000	1.2	0.7	26,000	5.06	3.413	17,537		38,802	0.73	3,268
53	47	1041.7	26,000	1.2	0.7	26,000	5.06	3.413	17,537		38,802	0.73	3,907
48	43	854.2	26,000	1.2	0.7	26,000	5.06	3.413	17,537		38,802	0.73	3,204
43	40	754.1	26,000	1.2	0.7	26,000	5.06	3.413	17,537		38,802	0.73	2,829
38	36	488.9	26,000	1.2	0.7	26,000	5.06	3.413	17,537		38,802	0.73	1,834
33	32	258.7	26,000	1.2	0.7	26,000	5.06	3.413	17,537		38,802	0.73	970
28	27	87.2	26,000	1.2	0.7	26,000	5.06	3.413	17,537		38,802	0.73	327

			Application
kWh=	33,795	>	16,000
kWh=	5.16	>	2.5

Condenser Capacity	1,300,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	2	circuits	26,263
LT#1 Condensing Circuits	7	circuits	91,919
MT#1 Condensing Circuits	18	circuits	236,364
MT#2 Condensing Circuits	27	circuits	354,545
AC Condensing Circuits	45	circuits	590,909
Total Circuits	99		1,300,000

Total Refer w/ Compressor 6.50 116,249

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	Refrigeration Case Load (Btuh)	Application Factor (unitless)	Calculated Application Factor, Check (unitless)	Equivalent Btuh rejected for case Load (Btuh)	Estimated Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	1.8	116,249	1.1	0.5	116,249	6.30	3.413	62,977		179,226	1.00	33
108	72	27.6	116,249	1.1	0.5	116,249	6.20	3.413	63,993		180,242	1.00	517
103	70	138.8	116,249	1.1	0.5	116,249	6.30	3.413	62,977		179,226	1.00	2,561
98	68	246.9	116,249	1.1	0.5	116,249	6.40	3.413	61,993		178,242	1.00	4,485
93	66	322.0	116,249	1.1	0.5	116,249	6.50	3.413	61,040		177,289	1.00	5,759
88	66	380.8	116,249	1.1	0.6	116,249	6.50	3.413	61,040		158,977	0.70	4,767
83	63	526.0	116,249	1.1	0.6	116,249	6.50	3.413	61,040		158,977	0.70	6,585
78	61	530.6	116,249	1.1	0.6	116,249	6.50	3.413	61,040		158,977	0.70	6,643
73	59	671.0	116,249	1.1	0.6	116,249	6.50	3.413	61,040		158,977	0.70	8,400
68	56	683.7	116,249	1.1	0.6	116,249	6.50	3.413	61,040		158,977	0.70	8,559
63	53	851.7	116,249	1.1	0.6	116,249	6.50	3.413	61,040		158,977	0.70	10,663
58	50	871.3	116,249	1.1	0.6	116,249	6.50	3.413	61,040		158,977	0.70	10,908
53	47	1041.7	116,249	1.1	0.6	116,249	6.50	3.413	61,040		158,977	0.70	13,041
48	43	854.2	116,249	1.1	0.6	116,249	6.50	3.413	61,040		158,977	0.70	10,694
43	40	754.1	116,249	1.1	0.6	116,249	6.50	3.413	61,040		158,977	0.70	9,441
38	36	488.9	116,249	1.1	0.6	116,249	6.50	3.413	61,040		158,977	0.70	6,121
33	32	258.7	116,249	1.1	0.6	116,249	6.50	3.413	61,040		158,977	0.70	3,239
28	27	87.2	116,249	1.1	0.6	116,249	6.50	3.413	61,040		158,977	0.70	1,092

			Application
kWh=	113,507	>	55,770
kWh=	16.45	>	8.8

Condenser Capacity	1,300,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	2	circuits	26,263
LT#1 Condensing Circuits	7	circuits	91,919
MT#1 Condensing Circuits	18	circuits	236,364
MT#2 Condensing Circuits	27	circuits	354,545
AC Condensing Circuits	45	circuits	590,909
Total Circuits	99		1,300,000

Total Refer w/ Compressor 9.30 151,600

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	Refrigeration Case Load (Btuh)	Application Factor (unitless)	Calculated Application Factor, Check (unitless)	Equivalent Btuh rejected for case Load (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	1.8	151,600	1.1	1.1	151,600	9.15	3.413	56,548		208,148	1.00	30
108	72	27.6	151,600	1.1	1.1	151,600	9.15	3.413	56,548		208,148	1.00	457
103	70	138.8	151,600	1.1	1.1	151,600	9.25	3.413	55,936		207,536	1.00	2,275
98	68	246.9	151,600	1.1	1.1	151,600	9.30	3.413	55,636		207,236	1.00	4,025
93	66	322.0	151,600	1.1	1.2	151,600	9.30	3.413	55,636		192,214	0.73	3,832
88	66	380.8	151,600	1.1	1.2	151,600	9.30	3.413	55,636		192,214	0.73	4,531
83	63	526.0	151,600	1.1	1.2	151,600	9.30	3.413	55,636		192,214	0.73	6,259
78	61	530.6	151,600	1.1	1.2	151,600	9.30	3.413	55,636		192,214	0.73	6,314
73	59	671.0	151,600	1.1	1.2	151,600	9.30	3.413	55,636		192,214	0.73	7,985
68	56	683.7	151,600	1.1	1.2	151,600	9.30	3.413	55,636		192,214	0.73	8,136
63	53	851.7	151,600	1.1	1.2	151,600	9.30	3.413	55,636		192,214	0.73	10,135
58	50	871.3	151,600	1.1	1.2	151,600	9.30	3.413	55,636		192,214	0.73	10,368
53	47	1041.7	151,600	1.1	1.2	151,600	9.30	3.413	55,636		192,214	0.73	12,396
48	43	854.2	151,600	1.1	1.2	151,600	9.30	3.413	55,636		192,214	0.73	10,165
43	40	754.1	151,600	1.1	1.2	151,600	9.30	3.413	55,636		192,214	0.73	8,974
38	36	488.9	151,600	1.1	1.2	151,600	9.30	3.413	55,636		192,214	0.73	5,818
33	32	258.7	151,600	1.1	1.2	151,600	9.30	3.413	55,636		192,214	0.73	3,078
28	27	87.2	151,600	1.1	1.2	151,600	9.30	3.413	55,636		192,214	0.73	1,038

			Application
kWh=	105,815	=	105,858
kWh=	16.57	=	16.6

Condenser Capacity	1,300,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	2	circuits	26,263
LT#1 Condensing Circuits	7	circuits	91,919
MT#1 Condensing Circuits	18	circuits	236,364
MT#2 Condensing Circuits	27	circuits	354,545
AC Condensing Circuits	45	circuits	590,909
Total Circuits	99		1,300,000
Total Refer w/ Compressor	11.12		240,600

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	Refrigeration Case Load (Btuh)	Application Factor (unitless)	Calculated Application Factor, Check (unitless)	Equivalent Btuh rejected for case Load (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	1.8	240,600	1.1	1.1	240,600	10.57	3.413	77,689		318,289	1.00	41
108	72	27.6	240,600	1.1	1.1	240,600	10.70	3.413	76,745		317,345	1.00	621
103	70	138.8	240,600	1.1	1.1	240,600	10.84	3.413	75,753		316,353	1.00	3,081
98	68	246.9	240,600	1.1	1.1	240,600	11.12	3.413	73,846		314,446	1.00	5,342
93	66	322.0	240,600	1.1	1.2	240,600	11.12	3.413	73,846		294,508	0.73	5,086
88	66	380.8	240,600	1.1	1.2	240,600	11.12	3.413	73,846		294,508	0.73	6,015
83	63	526.0	240,600	1.1	1.2	240,600	11.12	3.413	73,846		294,508	0.73	8,308
78	61	530.6	240,600	1.1	1.2	240,600	11.12	3.413	73,846		294,508	0.73	8,381
73	59	671.0	240,600	1.1	1.2	240,600	11.12	3.413	73,846		294,508	0.73	10,598
68	56	683.7	240,600	1.1	1.2	240,600	11.12	3.413	73,846		294,508	0.73	10,799
63	53	851.7	240,600	1.1	1.2	240,600	11.12	3.413	73,846		294,508	0.73	13,452
58	50	871.3	240,600	1.1	1.2	240,600	11.12	3.413	73,846		294,508	0.73	13,762
53	47	1041.7	240,600	1.1	1.2	240,600	11.12	3.413	73,846		294,508	0.73	16,453
48	43	854.2	240,600	1.1	1.2	240,600	11.12	3.413	73,846		294,508	0.73	13,492
43	40	754.1	240,600	1.1	1.2	240,600	11.12	3.413	73,846		294,508	0.73	11,911
38	36	488.9	240,600	1.1	1.2	240,600	11.12	3.413	73,846		294,508	0.73	7,722
33	32	258.7	240,600	1.1	1.2	240,600	11.12	3.413	73,846		294,508	0.73	4,086
28	27	87.2	240,600	1.1	1.2	240,600	11.12	3.413	73,846		294,508	0.73	1,377

			Application
kWh=	140,527	=	140,557
kWh=	22.76	=	22.8

AC, Measure #1

Condenser Capacity	1,300,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	2	circuits	26,263
LT#1 Condensing Circuits	7	circuits	91,919
MT#1 Condensing Circuits	18	circuits	236,364
MT#2 Condensing Circuits	27	circuits	354,545
AC Condensing Circuits	45	circuits	590,909
Total Circuits	99		1,300,000
Total Refer w/ Compressor		0.00	

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	AC Load (tons)	AC Load (Btuh)	Equivalent Btuh rejected for AC (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	1.8	30.00	360,000	360,000	21.47	3.413	57,228		417,228	1.00	30
108	72	27.6	30.00	360,000	360,000	21.47	3.413	57,228		417,228	1.00	463
103	70	138.8	28.68	344,160	344,160	21.47	3.413	54,710		398,870	1.00	2,225
98	68	246.9	24.26	291,120	291,120	21.47	3.413	46,278		337,398	1.00	3,348
93	66	322.0	19.85	238,200	238,200	21.47	3.413	37,866		276,066	1.00	3,572
88	66	380.8	15.44	185,280	185,280	21.47	3.413	29,453		214,733	1.00	3,286
83	63	526.0	11.03	132,360	132,360	21.47	3.413	21,041		153,401	1.00	3,243
78	61	530.6	6.62	79,440	79,440	21.47	3.413	12,628		92,068	1.00	1,963
73	59	671.0	2.21	26,520	26,520	21.47	3.413	4,216		34,952	2.00	1,658
68	56	683.7										
63	53	851.7										
58	50	871.3										
53	47	1041.7										
48	43	854.2										
43	40	754.1										
38	36	488.9										
33	32	258.7										
28	27	87.2										

			Application
kWh=	19,788	=	18,970
kWh=	16.77	=	17

Notes

The application assumes a lower AC load in the post-measure #2 retrofit condition.

Condenser Capacity	1,300,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	2	circuits	26,263
LT#1 Condensing Circuits	7	circuits	91,919
MT#1 Condensing Circuits	18	circuits	236,364
MT#2 Condensing Circuits	27	circuits	354,545
AC Condensing Circuits	45	circuits	590,909
Total Circuits	99		1,300,000
Total Refer w/ Compressor	684500.45		

2

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	AC Heat Rejection (Btuh)	Refrigeration Heat Rejection (Btuh)	Condenser Load Factor (unitless)	Calculated Condenser Load Factor, Check (unitless)	Total Heat Rejection (Btuh)	Total Heat Rejection from the Application (MBtuh)	Total Heat Rejection from the Application (Btuh)
113	74	1.8	417,228	749,269	1.2	1.1	1,166,497	1,049	1,049,000
108	72	27.6	417,228	749,272	1.2	1.1	1,166,499	1,047	1,047,000
103	70	138.8	398,870	746,653	1.3	1.1	1,145,523	1,027	1,027,000
98	68	246.9	337,398	743,461	1.3	1.2	1,080,859	965	965,000
93	66	322.0	276,066	707,547	1.4	1.3	983,613	903	903,000
88	66	380.8	214,733	684,500	1.5	1.4	899,234	842	842,000
83	63	526.0	153,401	684,500	1.7	1.6	837,901	781	781,000
78	61	530.6	92,068	684,500	1.8	1.7	776,569	719	719,000
73	59	671.0	34,952	684,500	2.0	1.8	719,452	658	658,000
68	56	683.7	0	684,500	2.1	1.9	684,500	627	627,000
63	53	851.7	0	684,500	2.1	1.9	684,500	627	627,000
58	50	871.3	0	684,500	2.1	1.9	684,500	627	627,000
53	47	1041.7	0	684,500	3.1	1.9	684,500	628	628,000
48	43	854.2	0	684,500	4.1	1.9	684,500	629	629,000
43	40	754.1	0	684,500	5.1	1.9	684,500	630	630,000
38	36	488.9	0	684,500	6.1	1.9	684,500	631	631,000
33	32	258.7	0	684,500	7.1	1.9	684,500	632	632,000
28	27	87.2	0	684,500	2.1	1.9	684,500	627	627,000
						Total Rejected	14,936,652	13,649	13,649,000

Heat rejection differences are significant

Measure #2 Summary of Findings

Evaluation Compressor Savings	Pre-Retrofit Demand	Post-Retrofit Demand	Measure # Demand Savings		Pre-Retrofit Energy	Post-Retrofit Energy	Measure # Energy Savings	
Ice Cream Condensing Circuits	5.16	5.16	0.00		33,795	30,274	3,521	
LT#1 Condensing Circuits	18.45	17.10	1.36		113,507	106,273	7,234	
MT#1 Condensing Circuits	16.57	16.57	0.00		105,815	94,694	11,122	
MT#2 Condensing Circuits	22.76	22.65	0.12		140,527	125,313	15,214	
AC Condensing Circuits	16.77	16.44	0.33		19,788	13,326	6,462	
Total			1.80	kW			43,552	kWh
Total Refer w/ Compressor		61.47				356,563		

Application Compressor Savings	Pre-Retrofit Demand	Post-Retrofit Demand	Measure # Demand Savings		Pre-Retrofit Energy	Post-Retrofit Energy	Measure # Energy Savings	
Ice Cream Condensing Circuits	2.50	2.50	0.00		16,000	16,375	-375	
LT#1 Condensing Circuits	8.80	8.80	0.00		55,770	57,258	-1,488	
MT#1 Condensing Circuits	16.60	16.60	0.00		105,858	91,310	14,548	
MT#2 Condensing Circuits	22.80	22.80	0.00		140,557	121,005	19,552	
AC Condensing Circuits	17.00	16.00	1.00		18,970	9,084	9,886	
Total			1.00	kW			42,123	kWh

Dark Green font is an estimate because this level of detail was missing from the application.

Applicaton Condenser Analysis	Pre-Retrofit Demand	Post-Retrofit Demand	Measure # Demand Savings	Pre-Retrofit Energy	Post-Retrofit Energy	Measure # Energy Savings (kWh)	Pre-Condenser Rejection (Btuh)	Post-Condenser Rejection (Btuh)	Difference in Condenser Heat Rejection (Btuh)	Measure Energy Savings per Condenser Heat Rejection (kWh/Btuh)
Condenser Fan Use	8.00	8.00	0.00	20,877	56,971	-36,094	13,649,000	13,151,000	498,000	-0.07
						0.00152956	5.8612E-07			

Evaluation Condenser Analysis	Pre-Condenser Rejection (Btuh)	Post-Condenser Rejection (Btuh)	Difference in Condenser Heat Rejection (Btuh)	Post-Energy	Post Demand
Condenser Fan Use	14,936,652	14,618,943	317,708	22,847	8.75472297

Final Results for Measure #2		
Source	Demand Impact	Energy Impact
Evaluation	1.80	66,399
Application	1.00	6,029

Condenser Capacity	2,425,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	8	circuits	195,960
LT#1 Condensing Circuits	14	circuits	342,929
LT#2 Condensing Circuits	0	circuits	0
MT#1 Condensing Circuits	35	circuits	857,323
MT#2 Condensing Circuits	24	circuits	587,879
AC Condensing Circuits	18	circuits	440,909
Total Circuits	99		2,425,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	Refrigeration Case Load (Btuh)	Application Factor (unitless)	Calculated Application Factor, Check (unitless)	Equivalent Btuh rejected for case Load (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	2.0	147,847	1.5	1.5	147,847	6.10	3.413	82,722		230,569	1.00	48
108	72	28.0	147,847	1.5	1.5	147,847	6.20	3.413	81,387		229,234	1.00	668
103	70	139.0	147,847	1.5	1.5	147,847	6.30	3.413	80,096		227,943	1.00	3,262
98	68	247.0	147,847	1.5	1.5	147,847	6.50	3.413	77,631		225,478	1.00	5,618
93	66	322.0	147,847	1.5	1.7	147,847	6.60	3.413	76,455		201,365	0.70	5,049
88	66	381.0	147,847	1.5	1.7	147,847	6.60	3.413	76,455		201,365	0.70	5,974
83	63	526.0	147,847	1.5	1.7	147,847	6.80	3.413	74,206		199,791	0.70	8,005
78	61	531.0	147,847	1.5	1.7	147,847	6.90	3.413	73,131		199,038	0.70	7,964
73	59	671.0	147,847	1.6	1.7	147,847	7.00	3.413	72,086		198,307	0.70	9,921
68	56	684.0	147,847	1.6	1.7	147,847	7.20	3.413	70,084		196,906	0.70	9,832
63	53	852.0	147,847	1.6	1.8	147,847	7.40	3.413	68,189		195,580	0.70	11,916
58	50	871.0	147,847	1.6	1.8	147,847	7.50	3.413	67,280		194,943	0.70	12,019
53	47	1042.0	147,847	1.6	1.8	147,847	7.80	3.413	64,693		193,132	0.70	13,826
48	43	854.0	147,847	1.6	1.8	147,847	8.60	3.413	58,675		188,919	0.70	10,277
43	40	754.0	147,847	1.7	1.8	147,847	8.70	3.413	58,000		188,447	0.70	8,969
38	36	489.0	147,847	1.7	1.8	147,847	8.70	3.413	58,000		188,447	0.70	5,817
33	32	259.0	147,847	1.7	1.8	147,847	8.70	3.413	58,000		188,447	0.70	3,081
28	27	87.0	147,847	1.7	1.8	147,847	8.70	3.413	58,000		188,447	0.70	1,035

			Application
kWh=	123,282	<	128,092
kWh=	24.24	=	24.1

Condenser Capacity	2,425,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	8	circuits	195,960
LT#1 Condensing Circuits	14	circuits	342,929
LT#2 Condensing Circuits	0	circuits	0
MT#1 Condensing Circuits	35	circuits	857,323
MT#2 Condensing Circuits	24	circuits	587,879
AC Condensing Circuits	18	circuits	440,909
Total Circuits	99		2,425,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	Refrigeration Case Load (Btuh)	Application Factor (unitless)	Calculated Application Factor, Check (unitless)	Equivalent Btuh rejected for case Load (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	2.0	428885	1.00	0.6	428,885	9.39	3.413	155,888	[redacted]	584,773	1.00	91
108	72	28.0	428885	1.00	0.6	428,885	9.39	3.413	155,888	[redacted]	584,773	1.00	1,279
103	70	139.0	428885	1.00	0.6	428,885	9.49	3.413	154,245	[redacted]	583,130	1.00	6,282
98	68	247.0	428885	1.00	0.6	428,885	9.73	3.413	150,440	[redacted]	579,325	1.00	10,887
93	66	322.0	428885	0.73	0.6	428,885	9.92	3.413	147,559	[redacted]	536,603	0.73	10,163
88	66	381.0	428885	0.73	0.6	428,885	9.92	3.413	147,559	[redacted]	536,603	0.73	12,025
83	63	526.0	428885	0.73	0.6	428,885	10.50	3.413	139,408	[redacted]	530,653	0.73	15,684
78	61	531.0	428885	0.73	0.6	428,885	10.50	3.413	139,408	[redacted]	530,653	0.73	15,833
73	59	671.0	428885	0.73	0.7	428,885	10.88	3.413	134,539	[redacted]	527,098	0.73	19,309
68	56	684.0	428885	0.73	0.7	428,885	11.26	3.413	129,999	[redacted]	523,784	0.73	19,019
63	53	852.0	428885	0.73	0.7	428,885	11.61	3.413	126,080	[redacted]	520,923	0.73	22,976
58	50	871.0	428885	0.73	0.7	428,885	11.92	3.413	122,801	[redacted]	518,530	0.73	22,877
53	47	1042.0	428885	0.73	0.7	428,885	12.38	3.413	118,238	[redacted]	515,199	0.73	26,352
48	43	854.0	428885	0.73	0.7	428,885	13.97	3.413	104,781	[redacted]	505,375	0.73	19,139
43	40	754.0	428885	0.73	0.7	428,885	14.39	3.413	101,722	[redacted]	503,142	0.73	16,405
38	36	489.0	428885	0.73	0.7	428,885	14.39	3.413	101,722	[redacted]	503,142	0.73	10,639
33	32	259.0	428885	0.73	0.7	428,885	14.39	3.413	101,722	[redacted]	503,142	0.73	5,635
28	27	87.0	428885	0.73	0.7	428,885	14.39	3.413	101,722	[redacted]	503,142	0.73	1,893

			Application
kWh=	236,488	=	236,435
kWh=	45.67	=	45.7

Condenser Capacity	2,425,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	8	circuits	195,960
LT#1 Condensing Circuits	14	circuits	342,929
LT#2 Condensing Circuits	0	circuits	0
MT#1 Condensing Circuits	35	circuits	857,323
MT#2 Condensing Circuits	24	circuits	587,879
AC Condensing Circuits	18	circuits	440,909
Total Circuits	99		2,425,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	Refrigeration Case Load (Btuh)	Application Factor (unitless)	Calculated Application Factor, Check (unitless)	Equivalent Btuh rejected for case Load (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	2.0	307,541	1.5	2.2	307,541	12.26	3.413	85,615		393,156	1.00	50
108	72	28.0	307,541	1.5	2.2	307,541	12.41	3.413	84,580		392,121	1.00	694
103	70	139.0	307,541	1.5	2.2	307,541	12.72	3.413	82,519		390,060	1.00	3,361
98	68	247.0	307,541	1.5	2.2	307,541	13.09	3.413	80,186		387,727	1.00	5,803
93	66	322.0	307,541	1.5	2.3	307,541	13.28	3.413	79,039		365,239	0.73	5,444
88	66	381.0	307,541	1.5	2.3	307,541	13.28	3.413	79,039		365,239	0.73	6,441
83	63	526.0	307,541	1.5	2.4	307,541	13.84	3.413	75,841		362,905	0.73	8,532
78	61	531.0	307,541	1.5	2.4	307,541	13.84	3.413	75,841		362,905	0.73	8,614
73	59	671.0	307,541	1.5	2.4	307,541	14.21	3.413	73,866		361,463	0.73	10,601
68	56	684.0	307,541	1.5	2.4	307,541	14.58	3.413	71,992		360,095	0.73	10,532
63	53	852.0	307,541	1.5	2.4	307,541	15.05	3.413	69,743		358,454	0.73	12,710
58	50	871.0	307,541	1.6	2.4	307,541	15.76	3.413	66,601		356,160	0.73	12,408
53	47	1042.0	307,541	1.6	2.4	307,541	16.23	3.413	64,673		354,752	0.73	14,414
48	43	854.0	307,541	1.6	2.5	307,541	18.63	3.413	56,341		348,670	0.73	10,291
43	40	754.0	307,541	1.6	2.5	307,541	19.05	3.413	55,099		347,763	0.73	8,886
38	36	489.0	307,541	1.6	2.5	307,541	19.05	3.413	55,099		347,763	0.73	5,763
33	32	259.0	307,541	1.6	2.5	307,541	19.05	3.413	55,099		347,763	0.73	3,052
28	27	87.0	307,541	1.6	2.5	307,541	19.05	3.413	55,099		347,763	0.73	1,025

			Application
kWh=	128,621	=	128,596
kWh=	25.08	=	25.1

Condenser Capacity	2,425,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	8	circuits	195,960
LT#1 Condensing Circuits	14	circuits	342,929
LT#2 Condensing Circuits	0	circuits	0
MT#1 Condensing Circuits	35	circuits	857,323
MT#2 Condensing Circuits	24	circuits	587,879
AC Condensing Circuits	18	circuits	440,909
Total Circuits	99		2,425,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	AC Load (tons)	AC Load (Btuh)	Equivalent Btuh rejected for AC (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	2.0	50.00	600,000	600,000	17.77	3.413	115,239		715,239	1.00	68
108	72	28.0	44.12	529,440	529,440	19.24	3.413	93,918		623,358	1.00	770
103	70	139.0	38.24	458,880	458,880	21.44	3.413	73,048		531,928	1.00	2,975
98	68	247.0	32.35	388,200	388,200	25.17	3.413	52,639		440,839	1.00	3,810
93	66	322.0	26.47	317,640	317,640	29.94	3.413	36,209		353,849	1.00	3,416
88	66	381.0	20.59	247,080	247,080	34.68	3.413	24,316		271,396	1.00	2,714
83	63	526.0	14.71	176,520	176,520	49.62	3.413	12,142		188,662	1.00	1,871
78	61	531.0	8.82	105,840	105,840	55.79	3.413	6,475		112,315	1.00	1,007
73	59	671.0	2.94	35,280	35,280	60.72	3.413	1,983		37,263	1.00	390
68	56	684.0										
63	53	852.0										
58	50	871.0										
53	47	1042.0										
48	43	854.0										
43	40	754.0										
38	36	489.0										
33	32	259.0										
28	27	87.0										

			Application
kWh=	17,022	=	16,995
kWh=	33.76	=	34

Condenser, Measure #2

Condenser Capacity	2425000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	8	circuits	195,960
LT#1 Condensing Circuits	14	circuits	342,929
LT#2 Condensing Circuits	0	circuits	0
MT#1 Condensing Circuits	35	circuits	857,323
MT#2 Condensing Circuits	24	circuits	587,879
AC Condensing Circuits	18	circuits	440,909
Total Circuits	99		2,425,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	AC Heat Rejection (Btuh)	Refrigeration Heat Rejection (Btuh)	Condenser Load Factor (unitless)	Calculated Condenser Load Factor, Check (unitless)	Total Heat Rejection (Btuh)	Total Heat Rejection from the Application (MBtuh)	Total Heat Rejection from the Application (Btuh)
113	74	2.0	715,239	1,381,868	1.2	1.2	2,097,107	2,097	2,097,000
108	72	28.0	623,358	1,379,499	1.2	1.2	2,002,857	2,005	2,005,000
103	70	139.0	531,928	1,374,230	1.3	1.3	1,906,158	1,907	1,907,000
98	68	247.0	440,839	1,363,645	1.3	1.3	1,804,485	1,810	1,810,000
93	66	322.0	353,849	1,256,121	1.4	1.5	1,609,970	1,717	1,717,000
88	66	381.0	271,396	1,256,121	1.5	1.6	1,527,517	1,635	1,635,000
83	63	526.0	188,662	1,241,749	1.6	1.7	1,430,411	1,545	1,545,000
78	61	531.0	112,315	1,240,996	1.7	1.8	1,353,311	1,466	1,466,000
73	59	671.0	37,263	1,235,269	1.8	1.9	1,272,532	1,386	1,386,000
68	56	684.0	0	1,228,350	1.8	2.0	1,228,350	1,344	1,344,000
63	53	852.0	0	1,219,798	1.8	2.0	1,219,798	1,340	1,340,000
58	50	871.0	0	1,214,474	1.8	2.0	1,214,474	1,334	1,334,000
53	47	1042.0	0	1,206,531	1.8	2.0	1,206,531	1,329	1,329,000
48	43	854.0	0	1,181,579	1.8	2.1	1,181,579	1,312	1,312,000
43	40	754.0	0	1,178,887	1.9	2.1	1,178,887	1,309	1,309,000
38	36	489.0	0	1,178,887	1.9	2.1	1,178,887	1,309	1,309,000
33	32	259.0	0	1,178,887	1.9	2.1	1,178,887	1,309	1,309,000
28	27	87.0	0	1,178,887	1.9	2.1	1,178,887	1,309	1,309,000
						Total Rejected	25,770,629	27,463	27,463,000

Condenser Capacity	2,425,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	8	circuits	195,960
LT#1 Condensing Circuits	14	circuits	342,929
LT#2 Condensing Circuits	0	circuits	0
MT#1 Condensing Circuits	35	circuits	857,323
MT#2 Condensing Circuits	24	circuits	587,879
AC Condensing Circuits	18	circuits	440,909
Total Circuits	99		2,425,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	Refrigeration Case Load (Btuh)	Application Factor (unitless)	Calculated Application Factor, Check (unitless)	Equivalent Btuh rejected for case Load (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	2.0	103,700	1.2	1.1	103,700	4.70	3.413	75,304	[redacted]	179,004	1.00	44
108	72	28.0	103,700	1.2	1.1	103,700	4.70	3.413	75,304	[redacted]	179,004	1.00	618
103	70	139.0	103,700	1.2	1.1	103,700	4.70	3.413	75,304	[redacted]	179,004	1.00	3,067
98	68	247.0	103,700	1.2	1.1	103,700	4.70	3.413	75,304	[redacted]	179,004	1.00	5,450
93	66	322.0	103,700	1.2	1.2	103,700	4.70	3.413	75,304	[redacted]	158,672	0.73	5,186
88	66	381.0	103,700	1.2	1.2	103,700	4.70	3.413	75,304	[redacted]	158,672	0.73	6,137
83	63	526.0	103,700	1.2	1.2	103,700	4.70	3.413	75,304	[redacted]	158,672	0.73	8,472
78	61	531.0	103,700	1.2	1.2	103,700	4.70	3.413	75,304	[redacted]	158,672	0.73	8,553
73	59	671.0	103,700	1.2	1.2	103,700	4.70	3.413	75,304	[redacted]	158,672	0.73	10,808
68	56	684.0	103,700	1.2	1.2	103,700	4.70	3.413	75,304	[redacted]	158,672	0.73	11,017
63	53	852.0	103,700	1.2	1.2	103,700	4.70	3.413	75,304	[redacted]	158,672	0.73	13,723
58	50	871.0	103,700	1.2	1.2	103,700	4.70	3.413	75,304	[redacted]	158,672	0.73	14,029
53	47	1042.0	103,700	1.2	1.2	103,700	4.70	3.413	75,304	[redacted]	158,672	0.73	16,783
48	43	854.0	103,700	1.2	1.2	103,700	4.70	3.413	75,304	[redacted]	158,672	0.73	13,755
43	40	754.0	103,700	1.2	1.2	103,700	4.70	3.413	75,304	[redacted]	158,672	0.73	12,144
38	36	489.0	103,700	1.2	1.2	103,700	4.70	3.413	75,304	[redacted]	158,672	0.73	7,876
33	32	259.0	103,700	1.2	1.2	103,700	4.70	3.413	75,304	[redacted]	158,672	0.73	4,172
28	27	87.0	103,700	1.2	1.2	103,700	4.70	3.413	75,304	[redacted]	158,672	0.73	1,401

			Application
kWh=	143,234	=	143,337
kWh=	22.06	=	22.1

Condenser Capacity	2,425,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	8	circuits	195,960
LT#1 Condensing Circuits	14	circuits	342,929
LT#2 Condensing Circuits	0	circuits	0
MT#1 Condensing Circuits	35	circuits	857,323
MT#2 Condensing Circuits	24	circuits	587,879
AC Condensing Circuits	18	circuits	440,909
Total Circuits	99		2,425,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	Refrigeration Case Load (Btuh)	Application Factor (unitless)	Calculated Application Factor, Check (unitless)	Equivalent Btuh rejected for case Load (Btuh)	Estimated Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	2.0	147,847	1.1	1.4	147,847	5.30	3.413	95,208		243,055	1.00	56
108	72	28.0	147,847	1.1	1.4	147,847	5.30	3.413	95,208		243,055	1.00	781
103	70	139.0	147,847	1.1	1.4	147,847	5.30	3.413	95,208		243,055	1.00	3,877
98	68	247.0	147,847	1.1	1.4	147,847	5.30	3.413	95,208		243,055	1.00	6,890
93	66	322.0	147,847	1.1	1.6	147,847	5.30	3.413	95,208		217,349	0.73	6,557
88	66	381.0	147,847	1.1	1.6	147,847	5.30	3.413	95,208		217,349	0.73	7,759
83	63	526.0	147,847	1.1	1.6	147,847	5.30	3.413	95,208		217,349	0.73	10,711
78	61	531.0	147,847	1.1	1.6	147,847	5.30	3.413	95,208		217,349	0.73	10,813
73	59	671.0	147,847	1.1	1.6	147,847	5.30	3.413	95,208		217,349	0.73	13,664
68	56	684.0	147,847	1.1	1.6	147,847	5.30	3.413	95,208		217,349	0.73	13,929
63	53	852.0	147,847	1.1	1.6	147,847	5.30	3.413	95,208		217,349	0.73	17,350
58	50	871.0	147,847	1.1	1.6	147,847	5.30	3.413	95,208		217,349	0.73	17,737
53	47	1042.0	147,847	1.1	1.6	147,847	5.30	3.413	95,208		217,349	0.73	21,219
48	43	854.0	147,847	1.1	1.6	147,847	5.30	3.413	95,208		217,349	0.73	17,391
43	40	754.0	147,847	1.1	1.6	147,847	5.30	3.413	95,208		217,349	0.73	15,354
38	36	489.0	147,847	1.1	1.6	147,847	5.30	3.413	95,208		217,349	0.73	9,958
33	32	259.0	147,847	1.1	1.6	147,847	5.30	3.413	95,208		217,349	0.73	5,274
28	27	87.0	147,847	1.1	1.6	147,847	5.30	3.413	95,208		217,349	0.73	1,772

			Application
kWh=	181,093	=	179,932
kWh=	27.90	=	27.7

Condenser Capacity	2,425,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	8	circuits	195,960
LT#1 Condensing Circuits	14	circuits	342,929
LT#2 Condensing Circuits	0	circuits	0
MT#1 Condensing Circuits	35	circuits	857,323
MT#2 Condensing Circuits	24	circuits	587,879
AC Condensing Circuits	18	circuits	440,909
Total Circuits	99		2,425,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	Refrigeration Case Load (Btuh)	Application Factor (unitless)	Calculated Application Factor, Check (unitless)	Equivalent Btuh rejected for case Load (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	2.0	428,885	1.1	0.0	428,885	8.58	3.413	170,604	[redacted]	599,489	1.00	100
108	72	28.0	428,885	1.1	0.0	428,885	8.58	3.413	170,604	[redacted]	599,489	1.00	1,400
103	70	139.0	428,885	1.1	0.0	428,885	8.58	3.413	170,604	[redacted]	599,489	1.00	6,948
98	68	247.0	428,885	1.1	0.0	428,885	8.58	3.413	170,604	[redacted]	599,489	1.00	12,347
93	66	322.0	428,885	1.2	0.0	428,885	8.58	3.413	170,604	[redacted]	553,426	0.73	11,750
88	66	381.0	428,885	1.2	0.0	428,885	8.58	3.413	170,604	[redacted]	553,426	0.73	13,903
83	63	526.0	428,885	1.2	0.0	428,885	8.58	3.413	170,604	[redacted]	553,426	0.73	19,194
78	61	531.0	428,885	1.2	0.0	428,885	8.58	3.413	170,604	[redacted]	553,426	0.73	19,376
73	59	671.0	428,885	1.2	0.0	428,885	8.58	3.413	170,604	[redacted]	553,426	0.73	24,485
68	56	684.0	428,885	1.2	0.0	428,885	8.58	3.413	170,604	[redacted]	553,426	0.73	24,959
63	53	852.0	428,885	1.2	0.0	428,885	8.58	3.413	170,604	[redacted]	553,426	0.73	31,090
58	50	871.0	428,885	1.2	0.0	428,885	8.58	3.413	170,604	[redacted]	553,426	0.73	31,783
53	47	1042.0	428,885	1.2	0.0	428,885	8.58	3.413	170,604	[redacted]	553,426	0.73	38,023
48	43	854.0	428,885	1.2	0.0	428,885	8.58	3.413	170,604	[redacted]	553,426	0.73	31,163
43	40	754.0	428,885	1.2	0.0	428,885	8.58	3.413	170,604	[redacted]	553,426	0.73	27,514
38	36	489.0	428,885	1.2	0.0	428,885	8.58	3.413	170,604	[redacted]	553,426	0.73	17,844
33	32	259.0	428,885	1.1	0.0	428,885	8.58	3.413	170,604	[redacted]	553,426	0.73	9,451
28	27	87.0	428,885	1.1	0.0	428,885	8.58	3.413	170,604	[redacted]	553,426	0.73	3,175

			Application
kWh=	324,502	=	324,536
kWh=	49.99	=	50

Condenser Capacity	2,425,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	8	circuits	195,960
LT#1 Condensing Circuits	14	circuits	342,929
LT#2 Condensing Circuits	0	circuits	0
MT#1 Condensing Circuits	35	circuits	857,323
MT#2 Condensing Circuits	24	circuits	587,879
AC Condensing Circuits	18	circuits	440,909
Total Circuits	99		2,425,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	Refrigeration Case Load (Btuh)	Application Factor (unitless)	Calculated Application Factor, Check (unitless)	Equivalent Btuh rejected for case Load (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	2.0	307,541	1.1	1.4	307,541	10.54	3.413	99,586	[redacted]	407,127	1.00	58
108	72	28.0	307,541	1.1	1.4	307,541	10.54	3.413	99,586	[redacted]	407,127	1.00	817
103	70	139.0	307,541	1.1	1.4	307,541	10.54	3.413	99,586	[redacted]	407,127	1.00	4,056
98	68	247.0	307,541	1.1	1.4	307,541	10.54	3.413	99,586	[redacted]	407,127	1.00	7,207
93	66	322.0	307,541	1.1	1.5	307,541	10.54	3.413	99,586	[redacted]	380,239	0.73	6,859
88	66	381.0	307,541	1.1	1.5	307,541	10.54	3.413	99,586	[redacted]	380,239	0.73	8,115
83	63	526.0	307,541	1.1	1.5	307,541	10.54	3.413	99,586	[redacted]	380,239	0.73	11,204
78	61	531.0	307,541	1.1	1.5	307,541	10.54	3.413	99,586	[redacted]	380,239	0.73	11,310
73	59	671.0	307,541	1.1	1.5	307,541	10.54	3.413	99,586	[redacted]	380,239	0.73	14,292
68	56	684.0	307,541	1.1	1.5	307,541	10.54	3.413	99,586	[redacted]	380,239	0.73	14,569
63	53	852.0	307,541	1.1	1.5	307,541	10.54	3.413	99,586	[redacted]	380,239	0.73	18,148
58	50	871.0	307,541	1.1	1.5	307,541	10.54	3.413	99,586	[redacted]	380,239	0.73	18,553
53	47	1042.0	307,541	1.1	1.5	307,541	10.54	3.413	99,586	[redacted]	380,239	0.73	22,195
48	43	854.0	307,541	1.1	1.5	307,541	10.54	3.413	99,586	[redacted]	380,239	0.73	18,190
43	40	754.0	307,541	1.1	1.5	307,541	10.54	3.413	99,586	[redacted]	380,239	0.73	16,060
38	36	489.0	307,541	1.1	1.5	307,541	10.54	3.413	99,586	[redacted]	380,239	0.73	10,416
33	32	259.0	307,541	1.1	1.5	307,541	10.54	3.413	99,586	[redacted]	380,239	0.73	5,517
28	27	87.0	307,541	1.1	1.5	307,541	10.54	3.413	99,586	[redacted]	380,239	0.73	1,853

			Application
kWh=	189,420	=	189,271
kWh=	29.18	=	29.2

Condenser Capacity	2,425,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	8	circuits	195,960
LT#1 Condensing Circuits	14	circuits	342,929
LT#2 Condensing Circuits	0	circuits	0
MT#1 Condensing Circuits	35	circuits	857,323
MT#2 Condensing Circuits	24	circuits	587,879
AC Condensing Circuits	18	circuits	440,909
Total Circuits	99		2,425,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	AC Load (tons)	AC Load (Btuh)	Equivalent Btuh rejected for AC (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	2.0	50.00	600,000	600,000	23.58	3.413	86,845		686,845	1.00	51
108	72	28.0	44.12	529,440	529,440	24.11	3.413	74,947		604,387	1.00	615
103	70	139.0	38.24	458,880	458,880	24.11	3.413	64,959		523,839	1.00	2,646
98	68	247.0	32.35	388,200	388,200	24.11	3.413	54,953		443,153	1.00	3,977
93	66	322.0	26.47	317,640	317,640	24.11	3.413	44,965		362,605	1.00	4,242
88	66	381.0	20.59	247,080	247,080	24.11	3.413	34,977		282,057	1.00	3,904
83	63	526.0	14.71	176,520	176,520	24.11	3.413	24,988		201,508	1.00	3,851
78	61	531.0	8.82	105,840	105,840	24.11	3.413	14,983		120,823	1.00	2,331
73	59	671.0	2.94	35,280	35,280	24.11	3.413	4,994		40,274	1.00	982
68	56	684.0										
63	53	852.0										
58	50	871.0										
53	47	1042.0										
48	43	854.0										
43	40	754.0										
38	36	489.0										
33	32	259.0										
28	27	87.0										

			Application
kWh=	22,599	=	22,578
kWh=	25.45	=	25

Notes

The application assumes a lower AC load in the post-measure #2 retrofit condition.

Condenser, Measure #1

Condenser Capacity	2,425,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	8	circuits	195,960
LT#1 Condensing Circuits	14	circuits	342,929
LT#2 Condensing Circuits	0	circuits	0
MT#1 Condensing Circuits	35	circuits	857,323
MT#2 Condensing Circuits	24	circuits	587,879
AC Condensing Circuits	18	circuits	440,909
Total Circuits	99		2,425,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	AC Heat Rejection (Btuh)	Refrigeration Heat Rejection (Btuh)	Condenser Load Factor (unitless)	Calculated Condenser Load Factor, Check (unitless)	Total Heat Rejection (Btuh)	Total Heat Rejection from the Application (MBtuh)	Total Heat Rejection from the Application (Btuh)	
113	74	2.0	686,845	1,428,675	1.2	1.1	2,115,520	2,106	2,106,000	
108	72	28.0	604,387	1,428,675	1.2	1.2	2,033,062	2,024	2,024,000	
103	70	139.0	523,839	1,428,675	1.2	1.2	1,952,514	1,943	1,943,000	
98	68	247.0	443,153	1,428,675	1.3	1.3	1,871,828	1,862	1,862,000	
93	66	322.0	362,605	1,309,686	1.4	1.5	1,672,290	1,782	1,782,000	
88	66	381.0	282,057	1,309,686	1.4	1.5	1,591,742	1,701	1,701,000	
83	63	526.0	201,508	1,309,686	1.5	1.6	1,511,194	1,620	1,620,000	
78	61	531.0	120,823	1,309,686	1.6	1.7	1,430,508	1,540	1,540,000	
73	59	671.0	40,274	1,309,686	1.7	1.8	1,349,960	1,459	1,459,000	
68	56	684.0	0	1,309,686	1.7	1.9	1,309,686	1,419	1,419,000	
63	53	852.0	0	1,309,686	1.7	1.9	1,309,686	1,419	1,419,000	
58	50	871.0	0	1,309,686	1.7	1.9	1,309,686	1,419	1,419,000	
53	47	1042.0	0	1,309,686	1.7	1.9	1,309,686	1,419	1,419,000	
48	43	854.0	0	1,309,686	1.7	1.9	1,309,686	1,419	1,419,000	
43	40	754.0	0	1,309,686	1.7	1.9	1,309,686	1,419	1,419,000	
38	36	489.0	0	1,309,686	1.7	1.9	1,309,686	1,419	1,419,000	
33	32	259.0	0	1,309,686	1.7	1.9	1,309,686	1,419	1,419,000	
28	27	87.0	0	1,309,686	1.7	1.9	1,309,686	1,419	1,419,000	
						Total Rejected	27,315,788	28,808	28,808,000	Heat rejection differences are significant

Measure #2 Summary of Findings

Evaluation Compressor Savings	Pre-Retrofit Demand	Post-Retrofit Demand	Measure # Demand Savings		Pre-Retrofit Energy	Post-Retrofit Energy	Measure # Energy Savings	
Ice Cream Condensing Circuits	22.06	20.41	1.65		143,234	108,202	35,032	
LT#1 Condensing Circuits	27.90	24.24	3.66		181,093	123,282	57,811	
MT#1 Condensing Circuits	49.99	45.67	4.31		324,502	236,488	88,014	
MT#2 Condensing Circuits	29.18	25.08	4.09		189,420	128,621	60,800	
AC Condensing Circuits	25.45	33.76	-8.32		22,599	17,022	5,577	
Total			5.39	kW			247,234	kWh
Total Refer w/ Compressor		122.92				668,919		

Application Compressor Savings	Pre-Retrofit Demand	Post-Retrofit Demand	Measure # Demand Savings		Pre-Retrofit Energy	Post-Retrofit Energy	Measure # Energy Savings	
Ice Cream Condensing Circuits	22.10	20.40	1.70		143,337	108,153	35,184	
LT#1 Condensing Circuits	27.70	24.10	3.60		179,932	128,092	51,840	
MT#1 Condensing Circuits	50.00	45.70	4.30		324,536	236,435	88,101	
MT#2 Condensing Circuits	29.20	25.10	4.10		189,271	128,596	60,675	
AC Condensing Circuits	25.00	34.00	-9.00		22,578	16,995	5,583	
Total			4.70	kW			241,383	kWh

Applicaton Condenser Analysis	Pre-Retrofit Demand	Post-Retrofit Demand	Measure # Demand Savings	Pre-Retrofit Energy	Post-Retrofit Energy	Measure # Energy Savings (kWh)	Pre-Condenser Rejection (Btuh)	Post-Condenser Rejection (Btuh)	Difference in Condenser Heat Rejection (Btuh)	Measure Energy Savings per Condenser Heat Rejection (kWh/Btuh)
Condenser Fan Use	8.00	8.00	0.00	20,720	77,076	-56,356	28,808,000	27,463,000	1,345,000	-0.04
							0.00280654	2.913E-07		

Evaluation Condenser Analysis	Pre-Condenser Rejection (Btuh)	Post-Condenser Rejection (Btuh)	Difference in Condenser Heat Rejection (Btuh)	Measure Energy Savings per Condenser Heat Rejection (kWh/Btuh)	Post-Energy	Post Demand
Condenser Fan Use	27,315,788	25,770,629	1,545,160	-64,743	72,326	7.5070105

Final Results for Measure #2		
Source	Demand Impact	Energy Impact
Evaluation	5.39	182,491
Application	4.70	185,027

Condenser Capacity	2,425,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	5	circuits	121,250
LT#1 Condensing Circuits	12	circuits	291,000
MT#1 Condensing Circuits	33	circuits	800,250
MT#2 Condensing Circuits	20	circuits	485,000
AC Condensing Circuits	30	circuits	727,500
Total Circuits	100		

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	Refrigeration Case Load (Btuh)	Application Factor (unitless)	Calculated Application Factor, Check (unitless)	Equivalent Btuh rejected for case Load (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	1.8	36,457	2.1	2.0	36,457	5.36	3.413	23,214		59,671	1.00	12
108	72	27.6	36,457	2.0	2.0	36,457	5.47	3.413	22,747		59,204	1.00	184
103	70	138.8	36,457	2.1	2.1	36,457	5.68	3.413	21,906		58,363	1.00	891
98	68	246.9	36,457	2.1	2.1	36,457	6.00	3.413	20,738		57,195	1.00	1,500
93	66	322.0	36,457	2.1	2.4	36,457	6.10	3.413	20,398		51,348	0.73	1,405
88	66	380.8	36,457	2.1	2.4	36,457	6.10	3.413	20,398		51,348	0.73	1,661
83	63	526.0	36,457	2.2	2.4	36,457	6.35	3.413	19,595		50,761	0.73	2,205
78	61	530.6	36,457	2.2	2.4	36,457	6.43	3.413	19,351		50,583	0.73	2,196
73	59	671.0	36,457	2.2	2.4	36,457	6.50	3.413	19,143		50,431	0.73	2,747
68	56	683.7	36,457	2.2	2.4	36,457	6.72	3.413	18,516		49,974	0.73	2,708
63	53	851.7	36,457	2.2	2.4	36,457	6.87	3.413	18,112		49,679	0.73	3,299
58	50	871.3	36,457	2.2	2.4	36,457	6.94	3.413	17,929		49,545	0.73	3,341
53	47	1041.7	36,457	2.2	2.4	36,457	6.94	3.413	17,929		49,545	0.73	3,995
48	43	854.2	36,457	2.2	2.4	36,457	6.94	3.413	17,929		49,545	0.73	3,276
43	40	754.1	36,457	2.2	2.4	36,457	6.94	3.413	17,929		49,545	0.73	2,892
38	36	488.9	36,457	2.2	2.4	36,457	6.94	3.413	17,929		49,545	0.73	1,875
33	32	258.7	36,457	2.2	2.4	36,457	6.94	3.413	17,929		49,545	0.73	992
28	27	87.2	36,457	2.2	2.4	36,457	6.94	3.413	17,929		49,545	0.73	334

			Application
kWh=	35,513	Agrees	35,513
kWh=	6.80	Agrees	6.8

LT#1, Measure #2

Condenser Capacity	2,425,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	5	circuits	121,250
LT#1 Condensing Circuits	12	circuits	291,000
MT#1 Condensing Circuits	33	circuits	800,250
MT#2 Condensing Circuits	20	circuits	485,000
AC Condensing Circuits	30	circuits	727,500
Total Circuits	100		

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	Refrigeration Case Load (Btuh)	Application Factor (unitless)	Calculated Application Factor, Check (unitless)	Equivalent Btuh rejected for case Load (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	1.8	139,450	1.8	1.4	139,450	6.90	3.413	68,977		208,427	1.00	36
108	72	27.6	139,450	1.8	1.4	139,450	6.90	·3.413	68,977		208,427	1.00	558
103	70	138.8	139,450	1.8	1.4	139,450	7.10	3.413	67,034		206,484	1.00	2,726
98	68	246.9	139,450	1.8	1.4	139,450	7.30	3.413	65,198		204,648	1.00	4,716
93	66	322.0	139,450	1.8	1.6	139,450	7.40	3.413	64,317		184,472	0.70	4,248
88	66	380.8	139,450	1.8	1.6	139,450	7.40	3.413	64,317		184,472	0.70	5,023
83	63	526.0	139,450	1.8	1.6	139,450	7.60	3.413	62,624		183,287	0.70	6,756
78	61	530.6	139,450	1.8	1.6	139,450	7.70	3.413	61,811		182,718	0.70	6,727
73	59	671.0	139,450	1.8	1.6	139,450	7.80	3.413	61,018		182,163	0.70	8,397
68	56	683.7	139,450	1.8	1.6	139,450	8.00	3.413	59,493		181,095	0.70	8,342
63	53	851.7	139,450	1.8	1.6	139,450	8.20	3.413	58,042		180,079	0.70	10,139
58	50	871.3	139,450	1.8	1.6	139,450	8.40	3.413	56,660		179,112	0.70	10,125
53	47	1041.7	139,450	1.8	1.6	139,450	8.70	3.413	54,706		177,744	0.70	11,688
48	43	854.2	139,450	1.8	1.6	139,450	8.70	3.413	54,706		177,744	0.70	9,584
43	40	754.1	139,450	1.8	1.6	139,450	8.70	3.413	54,706		177,744	0.70	8,461
38	36	488.9	139,450	1.8	1.6	139,450	8.70	3.413	54,706		177,744	0.70	5,486
33	32	258.7	139,450	1.8	1.6	139,450	8.70	3.413	54,706		177,744	0.70	2,903
28	27	87.2	139,450	1.8	1.6	139,450	8.70	3.413	54,706		177,744	0.70	978

			Application
kWh=	106,894	Different Result	92,228
kWh=	20.21	Different Result	15.8

Condenser Capacity	2,425,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	5	circuits	121,250
LT#1 Condensing Circuits	12	circuits	291,000
MT#1 Condensing Circuits	33	circuits	800,250
MT#2 Condensing Circuits	20	circuits	485,000
AC Condensing Circuits	30	circuits	727,500
Total Circuits	100		

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	Refrigeration Case Load (Btuh)	Application Factor (unitless)	Calculated Application Factor, Check (unitless)	Equivalent Btuh rejected for case Load (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	1.8	363,886	1.9	1.6	363,886	9.92	3.413	125,196		489,082	1.00	66
108	72	27.6	363,886	1.9	1.6	363,886	9.92	3.413	125,196		489,082	1.00	1,012
103	70	138.8	363,886	1.9	1.7	363,886	10.30	3.413	120,577		484,463	1.00	4,904
98	68	246.9	363,886	2.0	1.7	363,886	10.69	3.413	116,178		480,064	1.00	8,404
93	66	322.0	363,886	2.0	1.8	363,886	11.07	3.413	112,190		445,785	0.73	7,727
88	66	380.8	363,886	2.0	1.8	363,886	11.07	3.413	112,190		445,785	0.73	9,138
83	63	526.0	363,886	1.9	1.8	363,886	11.45	3.413	108,467		443,067	0.73	12,203
78	61	530.6	363,886	1.9	1.8	363,886	11.61	3.413	106,972		441,975	0.73	12,140
73	59	671.0	363,886	1.9	1.8	363,886	11.76	3.413	105,607		440,979	0.73	15,157
68	56	683.7	363,886	2.0	1.8	363,886	12.23	3.413	101,549		438,017	0.73	14,850
63	53	851.7	363,886	2.0	1.8	363,886	12.53	3.413	99,118		436,242	0.73	18,056
58	50	871.3	363,886	2.0	1.8	363,886	12.84	3.413	96,725		434,495	0.73	18,026
53	47	1041.7	363,886	2.0	1.9	363,886	13.28	3.413	93,520		432,155	0.73	20,837
48	43	854.2	363,886	2.0	1.9	363,886	14.11	3.413	88,019		428,140	0.73	16,081
43	40	754.1	363,886	1.9	1.9	363,886	14.39	3.413	86,306		426,889	0.73	13,921
38	36	488.9	363,886	1.9	1.9	363,886	14.39	3.413	86,306		426,889	0.73	9,025
33	32	258.7	363,886	1.9	1.9	363,886	14.39	3.413	86,306		426,889	0.73	4,776
28	27	87.2	363,886	1.9	1.9	363,886	14.39	3.413	86,306		426,889	0.73	1,610

			Application
kWh=	187,932	Different Result	160,882
kWh=	36.68	Different Result	29.6

Condenser Capacity	2,425,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	5	circuits	121,250
LT#1 Condensing Circuits	12	circuits	291,000
MT#1 Condensing Circuits	33	circuits	800,250
MT#2 Condensing Circuits	20	circuits	485,000
AC Condensing Circuits	30	circuits	727,500
Total Circuits	100		

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	Refrigeration Case Load (Btuh)	Application Factor (unitless)	Calculated Application Factor, Check (unitless)	Equivalent Btuh rejected for case Load (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	1.8	199,000	2.0	2.0	199,000	14.31	3.413	47,462	[redacted]	246,462	1.00	25
108	72	27.6	199,000	2.0	2.0	199,000	14.53	3.413	46,744	[redacted]	245,744	1.00	378
103	70	138.8	199,000	2.0	2.0	199,000	14.74	3.413	46,078	[redacted]	245,078	1.00	1,874
98	68	246.9	199,000	2.0	2.0	199,000	15.40	3.413	44,103	[redacted]	243,103	1.00	3,190
93	66	322.0	199,000	2.0	2.1	199,000	15.61	3.413	43,510	[redacted]	230,762	0.73	2,997
88	66	380.8	199,000	2.0	2.1	199,000	15.61	3.413	43,510	[redacted]	230,762	0.73	3,544
83	63	526.0	199,000	2.0	2.1	199,000	16.33	3.413	41,591	[redacted]	229,362	0.73	4,679
78	61	530.6	199,000	2.0	2.1	199,000	16.60	3.413	40,915	[redacted]	228,868	0.73	4,643
73	59	671.0	199,000	2.0	2.1	199,000	16.88	3.413	40,236	[redacted]	228,372	0.73	5,775
68	56	683.7	199,000	2.0	2.1	199,000	17.71	3.413	38,350	[redacted]	226,996	0.73	5,608
63	53	851.7	199,000	2.1	2.1	199,000	18.26	3.413	37,195	[redacted]	226,153	0.73	6,776
58	50	871.3	199,000	2.1	2.2	199,000	19.07	3.413	35,615	[redacted]	224,999	0.73	6,637
53	47	1041.7	199,000	2.1	2.2	199,000	19.81	3.413	34,285	[redacted]	224,028	0.73	7,639
48	43	854.2	199,000	2.1	2.2	199,000	20.81	3.413	32,638	[redacted]	222,825	0.73	5,963
43	40	754.1	199,000	2.1	2.2	199,000	21.31	3.413	31,872	[redacted]	222,266	0.73	5,141
38	36	488.9	199,000	2.1	2.2	199,000	21.31	3.413	31,872	[redacted]	222,266	0.73	3,333
33	32	258.7	199,000	2.1	2.2	199,000	21.31	3.413	31,872	[redacted]	222,266	0.73	1,764
28	27	87.2	199,000	2.1	2.2	199,000	21.31	3.413	31,872	[redacted]	222,266	0.73	594

			Application
kWh=	70,560	Agrees	70,559
kWh=	13.91	Agrees	13.9

Condenser Capacity	2,425,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	5	circuits	121,250
LT#1 Condensing Circuits	12	circuits	291,000
MT#1 Condensing Circuits	33	circuits	800,250
MT#2 Condensing Circuits	20	circuits	485,000
AC Condensing Circuits	30	circuits	727,500
Total Circuits	100		

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	AC Load (tons)	AC Load (Btuh)	Equivalent Btuh rejected for AC (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	1.8	34.00	408,000	408,000	20.38	3.413	68,327		476,327	1.00	36
108	72	27.6	34.00	408,000	408,000	20.74	3.413	67,141		475,141	1.00	543
103	70	138.8	34.39	412,680	412,680	21.11	3.413	66,721		479,401	1.00	2,713
98	68	246.9	27.30	327,600	327,600	24.18	3.413	46,241		373,841	1.00	3,345
93	66	322.0	21.30	255,600	255,600	30.10	3.413	28,982		284,582	1.00	2,734
88	66	380.8	15.20	182,400	182,400	32.03	3.413	19,436		201,836	1.00	2,169
83	63	526.0	9.10	109,200	109,200	35.91	3.413	10,379		119,579	1.00	1,600
78	61	530.6	3.10	37,200	37,200	35.91	3.413	3,536		40,736	1.00	550
73	59	671.0										
68	56	683.7										
63	53	851.7										
58	50	871.3										
53	47	1041.7										
48	43	854.2										
43	40	754.1										
38	36	488.9										
33	32	258.7										
28	27	87.2										

			Application
kWh=	13,690	Agrees	13,699
kWh=	20.02	Agrees	20

Condenser, Measure #2

Condenser Capacity	2,425,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	5	circuits	121,250
LT#1 Condensing Circuits	12	circuits	291,000
MT#1 Condensing Circuits	33	circuits	800,250
MT#2 Condensing Circuits	20	circuits	485,000
AC Condensing Circuits	30	circuits	727,500
Total Circuits	100		2,425,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	AC Heat Rejection (Btuh)	Refrigeration Heat Rejection (Btuh)	Condenser Load Factor (unitless)	Calculated Condenser Load Factor, Check (unitless)	Total Heat Rejection (Btuh)	Total Heat Rejection from the Application (MBtuh)	Total Heat Rejection from the Application (Btuh)	
113	74	1.8	476,327	1,003,643	1.8	1.6	1,479,970	1,353	1,353,000	
108	72	27.6	475,141	1,002,457	1.8	1.6	1,477,598	1,359	1,359,000	
103	70	138.8	479,401	994,388	1.8	1.6	1,473,789	1,357	1,357,000	
98	68	246.9	373,841	985,010	1.9	1.8	1,358,850	1,247	1,247,000	
93	66	322.0	284,582	912,366	2.1	2.0	1,196,948	1,154	1,154,000	
88	66	380.8	201,836	912,366	2.3	2.2	1,114,202	1,072	1,072,000	
83	63	526.0	119,579	906,476	2.5	2.4	1,026,055	990	990,000	
78	61	530.6	40,736	904,144	2.7	2.6	944,880	909	909,000	
73	59	671.0	0	901,946	2.8	2.7	901,946	870	870,000	
68	56	683.7	0	896,081	2.8	2.7	896,081	866	866,000	
63	53	851.7	0	892,152	2.8	2.7	892,152	864	864,000	
58	50	871.3	0	888,151	2.8	2.7	888,151	863	863,000	
53	47	1041.7	0	883,473	2.8	2.7	883,473	862	862,000	
48	43	854.2	0	878,254	2.8	2.8	878,254	862	862,000	
43	40	754.1	0	876,445	2.8	2.8	876,445	863	863,000	
38	36	488.9	0	876,445	2.8	2.8	876,445	863	863,000	
33	32	258.7	0	876,445	2.8	2.8	876,445	863	863,000	
28	27	87.2	0	876,445	2.8	2.8	876,445	863	863,000	
						Total Rejected	18,918,131	18,080	18,080,000	Heat rejection differences are significant

Ice Cream, Measure #1

Condenser Capacity	2,425,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	4	circuits	97,000
LT#1 Condensing Circuits	11	circuits	266,750
MT#1 Condensing Circuits	29	circuits	703,250
MT#2 Condensing Circuits	17	circuits	412,250
AC Condensing Circuits	38	circuits	921,500
High Temperature	1	circuits	24,250
Total Circuits	100		2,425,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	Refrigeration Case Load (Btuh)	Application Factor (unitless)	Calculated Application Factor, Check (unitless)	Equivalent Btuh rejected for case Load (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	1.8	36,457	1.6	1.6	36,457	5.06	3.413	24,590	[redacted]	61,047	1.00	13
108	72	27.6	36,457	1.6	1.6	36,457	5.06	3.413	24,590	[redacted]	61,047	1.00	199
103	70	138.8	36,457	1.6	1.6	36,457	5.06	3.413	24,590	[redacted]	61,047	1.00	1,000
98	68	246.9	36,457	1.6	1.6	36,457	5.06	3.413	24,590	[redacted]	61,047	1.00	1,779
93	66	322.0	36,457	1.6	1.8	36,457	5.06	3.413	24,590	[redacted]	54,408	0.73	1,694
88	66	380.8	36,457	1.6	1.8	36,457	5.06	3.413	24,590	[redacted]	54,408	0.73	2,003
83	63	526.0	36,457	1.6	1.8	36,457	5.06	3.413	24,590	[redacted]	54,408	0.73	2,767
78	61	530.6	36,457	1.6	1.8	36,457	5.06	3.413	24,590	[redacted]	54,408	0.73	2,791
73	59	671.0	36,457	1.6	1.8	36,457	5.06	3.413	24,590	[redacted]	54,408	0.73	3,529
68	56	683.7	36,457	1.6	1.8	36,457	5.06	3.413	24,590	[redacted]	54,408	0.73	3,596
63	53	851.7	36,457	1.6	1.8	36,457	5.06	3.413	24,590	[redacted]	54,408	0.73	4,480
58	50	871.3	36,457	1.6	1.8	36,457	5.06	3.413	24,590	[redacted]	54,408	0.73	4,583
53	47	1041.7	36,457	1.6	1.8	36,457	5.06	3.413	24,590	[redacted]	54,408	0.73	5,479
48	43	854.2	36,457	1.6	1.8	36,457	5.06	3.413	24,590	[redacted]	54,408	0.73	4,493
43	40	754.1	36,457	1.6	1.8	36,457	5.06	3.413	24,590	[redacted]	54,408	0.73	3,966
38	36	488.9	36,457	1.6	1.8	36,457	5.06	3.413	24,590	[redacted]	54,408	0.73	2,571
33	32	258.7	36,457	1.6	1.8	36,457	5.06	3.413	24,590	[redacted]	54,408	0.73	1,361
28	27	87.2	36,457	1.6	1.8	36,457	5.06	3.413	24,590	[redacted]	54,408	0.73	459

			Application
kWh=	46,761	Agrees	46,762
kWh=	7.20	Agrees	7.2

Condenser Capacity	2,425,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	4	circuits	97,000
LT#1 Condensing Circuits	11	circuits	266,750
MT#1 Condensing Circuits	29	circuits	703,250
MT#2 Condensing Circuits	17	circuits	412,250
AC Condensing Circuits	38	circuits	921,500
High Temperature	1	circuits	24,250
Total Circuits	100		2,425,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	Refrigeration Case Load (Btuh)	Application Factor (unitless)	Calculated Application Factor, Check (unitless)	Equivalent Btuh rejected for case Load (Btuh)	Estimated Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	1.8	139,450		1.2	139,450	6.30	3.413	75,546		214,996	1.00	40
108	72	27.6	139,450		1.2	139,450	6.30	3.413	75,546		214,996	1.00	611
103	70	138.8	139,450		1.2	139,450	6.30	3.413	75,546		214,996	1.00	3,072
98	68	246.9	139,450		1.2	139,450	6.30	3.413	75,546		214,996	1.00	5,465
93	66	322.0	139,450		1.4	139,450	6.30	3.413	75,546		192,333	0.70	4,989
88	66	380.8	139,450		1.4	139,450	6.30	3.413	75,546		192,333	0.70	5,900
83	63	526.0	139,450		1.4	139,450	6.30	3.413	75,546		192,333	0.70	8,150
78	61	530.6	139,450		1.4	139,450	6.30	3.413	75,546		192,333	0.70	8,221
73	59	671.0	139,450		1.4	139,450	6.30	3.413	75,546		192,333	0.70	10,397
68	56	683.7	139,450		1.4	139,450	6.30	3.413	75,546		192,333	0.70	10,594
63	53	851.7	139,450		1.4	139,450	6.30	3.413	75,546		192,333	0.70	13,197
58	50	871.3	139,450		1.4	139,450	6.30	3.413	75,546		192,333	0.70	13,500
53	47	1041.7	139,450		1.4	139,450	6.30	3.413	75,546		192,333	0.70	16,141
48	43	854.2	139,450		1.4	139,450	6.30	3.413	75,546		192,333	0.70	13,235
43	40	754.1	139,450		1.4	139,450	6.30	3.413	75,546		192,333	0.70	11,684
38	36	488.9	139,450		1.4	139,450	6.30	3.413	75,546		192,333	0.70	7,575
33	32	258.7	139,450		1.4	139,450	6.30	3.413	75,546		192,333	0.70	4,008
28	27	87.2	139,450		1.4	139,450	6.30	3.413	75,546		192,333	0.70	1,351

		Application
kWh=	138,131	No Application for Comparison
kWh=	22.13	No Application for Comparison

Condenser Capacity	2,425,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	4	circuits	97,000
LT#1 Condensing Circuits	11	circuits	266,750
MT#1 Condensing Circuits	29	circuits	703,250
MT#2 Condensing Circuits	17	circuits	412,250
AC Condensing Circuits	38	circuits	921,500
High Temperature	1	circuits	24,250
Total Circuits	100		2,425,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	Refrigeration Case Load (Btuh)	Application Factor (unitless)	Calculated Application Factor, Check (unitless)	Equivalent Btuh rejected for case Load (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	1.8	363,886	1.7	1.4	363,886	9.30	3.413	133,542		497,428	1.00	70
108	72	27.6	363,886	1.7	1.4	363,886	9.30	3.413	133,542		497,428	1.00	1,080
103	70	138.8	363,886	1.7	1.4	363,886	9.30	3.413	133,542		497,428	1.00	5,431
98	68	246.9	363,886	1.7	1.4	363,886	9.30	3.413	133,542		497,428	1.00	9,661
93	66	322.0	363,886	1.7	1.5	363,886	9.30	3.413	133,542		461,372	0.73	9,197
88	66	380.8	363,886	1.7	1.5	363,886	9.30	3.413	133,542		461,372	0.73	10,877
83	63	526.0	363,886	1.7	1.5	363,886	9.30	3.413	133,542		461,372	0.73	15,024
78	61	530.6	363,886	1.7	1.5	363,886	9.30	3.413	133,542		461,372	0.73	15,156
73	59	671.0	363,886	1.7	1.5	363,886	9.30	3.413	133,542		461,372	0.73	19,166
68	56	683.7	363,886	1.7	1.5	363,886	9.30	3.413	133,542		461,372	0.73	19,529
63	53	851.7	363,886	1.7	1.5	363,886	9.30	3.413	133,542		461,372	0.73	24,327
58	50	871.3	363,886	1.7	1.5	363,886	9.30	3.413	133,542		461,372	0.73	24,887
53	47	1041.7	363,886	1.7	1.5	363,886	9.30	3.413	133,542		461,372	0.73	29,754
48	43	854.2	363,886	1.7	1.5	363,886	9.30	3.413	133,542		461,372	0.73	24,399
43	40	754.1	363,886	1.7	1.5	363,886	9.30	3.413	133,542		461,372	0.73	21,539
38	36	488.9	363,886	1.7	1.5	363,886	9.30	3.413	133,542		461,372	0.73	13,964
33	32	258.7	363,886	1.7	1.5	363,886	9.30	3.413	133,542		461,372	0.73	7,389
28	27	87.2	363,886	1.7	1.5	363,886	9.30	3.413	133,542		461,372	0.73	2,491

			Application
kWh=	253,941	Different Result	195,786
kWh=	39.13	Different Result	30.2

Condenser Capacity	2,425,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	4	circuits	97,000
LT#1 Condensing Circuits	11	circuits	266,750
MT#1 Condensing Circuits	29	circuits	703,250
MT#2 Condensing Circuits	17	circuits	412,250
AC Condensing Circuits	38	circuits	921,500
High Temperature	1	circuits	24,250
Total Circuits	100		2,425,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	Refrigeration Case Load (Btuh)	Application Factor (unitless)	Calculated Application Factor, Check (unitless)	Equivalent Btuh rejected for case Load (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	1.8	199,000	1.6	1.6	199,000	12.99	3.413	52,285		251,285	1.00	28
108	72	27.6	199,000	1.6	1.6	199,000	12.99	3.413	52,285		251,285	1.00	423
103	70	138.8	199,000	1.6	1.6	199,000	12.99	3.413	52,285		251,285	1.00	2,126
98	68	246.9	199,000	1.6	1.6	199,000	12.99	3.413	52,285		251,285	1.00	3,782
93	66	322.0	199,000	1.6	1.7	199,000	12.99	3.413	52,285		237,168	0.73	3,601
88	66	380.8	199,000	1.6	1.7	199,000	12.99	3.413	52,285		237,168	0.73	4,259
83	63	526.0	199,000	1.6	1.7	199,000	12.99	3.413	52,285		237,168	0.73	5,882
78	61	530.6	199,000	1.6	1.7	199,000	12.99	3.413	52,285		237,168	0.73	5,934
73	59	671.0	199,000	1.6	1.7	199,000	12.99	3.413	52,285		237,168	0.73	7,504
68	56	683.7	199,000	1.6	1.7	199,000	12.99	3.413	52,285		237,168	0.73	7,646
63	53	851.7	199,000	1.6	1.7	199,000	12.99	3.413	52,285		237,168	0.73	9,525
58	50	871.3	199,000	1.6	1.7	199,000	12.99	3.413	52,285		237,168	0.73	9,744
53	47	1041.7	199,000	1.6	1.7	199,000	12.99	3.413	52,285		237,168	0.73	11,650
48	43	854.2	199,000	1.6	1.7	199,000	12.99	3.413	52,285		237,168	0.73	9,553
43	40	754.1	199,000	1.6	1.7	199,000	12.99	3.413	52,285		237,168	0.73	8,433
38	36	488.9	199,000	1.6	1.7	199,000	12.99	3.413	52,285		237,168	0.73	5,467
33	32	258.7	199,000	1.6	1.7	199,000	12.99	3.413	52,285		237,168	0.73	2,893
28	27	87.2	199,000	1.6	1.7	199,000	12.99	3.413	52,285		237,168	0.73	975

			Application
kWh=	99,425	Agrees	99,435
kWh=	15.32	Agrees	15.3

Condenser Capacity	2,425,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	4	circuits	97,000
LT#1 Condensing Circuits	11	circuits	266,750
MT#1 Condensing Circuits	29	circuits	703,250
MT#2 Condensing Circuits	17	circuits	412,250
AC Condensing Circuits	38	circuits	921,500
High Temperature	1	circuits	24,250
Total Circuits	100		2,425,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	AC Load (tons)	AC Load (Btuh)	Equivalent Btuh rejected for AC (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	1.8	34.00	408,000	408,000	19.29	3.413	72,188		480,188	1.00	38
108	72	27.6	34.00	408,000	408,000	19.29	3.413	72,188		480,188	1.00	584
103	70	138.8	34.39	412,680	412,680	19.29	3.413	73,016		485,696	1.00	2,969
98	68	246.9	27.30	327,600	327,600	19.29	3.413	57,963		385,563	1.00	4,193
93	66	322.0	21.30	255,600	255,600	19.29	3.413	45,224		300,824	1.00	4,267
88	66	380.8	15.20	182,400	182,400	19.29	3.413	32,272		214,672	1.00	3,601
83	63	526.0	9.10	109,200	109,200	19.29	3.413	19,321		128,521	1.00	2,978
78	61	530.6	3.10	37,200	37,200	19.29	3.413	6,582		43,782	1.00	1,023
73	59	671.0										
68	56	683.7										
63	53	851.7										
58	50	871.3										
53	47	1041.7										
48	43	854.2										
43	40	754.1										
38	36	488.9										
33	32	258.7										
28	27	87.2										

			Application
kWh=	19,653	Disagrees	28,417
kWh=	21.15	Disagrees	25

Notes

The application assumes a lower AC load in the post-measure #2 retrofit condition.

Condenser, Measure #1

Condenser Capacity	2,425,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	4	circuits	97,000
LT#1 Condensing Circuits	11	circuits	266,750
MT#1 Condensing Circuits	29	circuits	703,250
MT#2 Condensing Circuits	17	circuits	412,250
AC Condensing Circuits	38	circuits	921,500
High Temperature	1	circuits	24,250
Total Circuits	100		2,425,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	AC Heat Rejection (Btuh)	Refrigeration Heat Rejection (Btuh)	Condenser Load Factor (unitless)	Calculated Condenser Load Factor, Check (unitless)	Total Heat Rejection (Btuh)	Total Heat Rejection from the Application (MBtuh)	Total Heat Rejection from the Application (Btuh)	
113	74	1.8	480,188	1,024,758	1.7	1.6	1,504,945	1,452	1,452,000	
108	72	27.6	480,188	1,024,758	1.7	1.6	1,504,945	1,452	1,452,000	
103	70	138.8	485,696	1,024,758	1.7	1.6	1,510,453	1,432	1,432,000	
98	68	246.9	385,563	1,024,758	1.8	1.7	1,410,320	1,348	1,348,000	
93	66	322.0	300,824	945,281	1.9	1.9	1,246,104	1,264	1,264,000	
88	66	380.8	214,672	945,281	2.1	2.1	1,159,953	1,180	1,180,000	
83	63	526.0	128,521	945,281	2.2	2.3	1,073,802	1,096	1,096,000	
78	61	530.6	43,782	945,281	2.4	2.5	989,063	1,013	1,013,000	
73	59	671.0	0	945,281	2.6	2.6	945,281	929	929,000	
68	56	683.7	0	945,281	2.7	2.6	945,281	887	887,000	
63	53	851.7	0	945,281	2.7	2.6	945,281	887	887,000	
58	50	871.3	0	945,281	2.7	2.6	945,281	887	887,000	
53	47	1041.7	0	945,281	2.7	2.6	945,281	887	887,000	
48	43	854.2	0	945,281	2.7	2.6	945,281	887	887,000	
43	40	754.1	0	945,281	2.7	2.6	945,281	887	887,000	
38	36	488.9	0	945,281	2.7	2.6	945,281	887	887,000	
33	32	258.7	0	945,281	2.7	2.6	945,281	887	887,000	
28	27	87.2	0	945,281	2.7	2.6	945,281	887	887,000	
						Total Rejected	19,852,393	19,149	19,149,000	Heat rejection differences are significant

Measure #2 Summary of Findings

Evaluation Compressor Savings	Pre-Retrofit Demand	Post-Retrofit Demand	Measure # Demand Savings		Pre-Retrofit Energy	Post-Retrofit Energy	Measure # Energy Savings	
Ice Cream Condensing Circuits	7.20	6.80	0.40		46,761	35,513	11,247	
LT#1 Condensing Circuits	22.13	20.21	1.92		138,131	106,894	31,238	
MT#1 Condensing Circuits	39.13	36.68	2.45		253,941	187,932	66,009	
MT#2 Condensing Circuits	15.32	13.91	1.41		99,425	70,560	28,865	
AC Condensing Circuits	21.15	20.02	1.13		19,653	13,690	5,963	
Total			7.32	kW			143,322	kWh
Total Refer w/ Compressor		85.97				450,145		

Application Compressor Savings	Pre-Retrofit Demand	Post-Retrofit Demand	Measure # Demand Savings		Pre-Retrofit Energy	Post-Retrofit Energy	Measure # Energy Savings	
Ice Cream Condensing Circuits	7.20	6.80	0.40		46,762	35,513	11,249	
LT#1 Condensing Circuits	16.40	15.80	0.60		105,450	92,228	13,222	
MT#1 Condensing Circuits	30.20	29.60	0.60		195,786	160,882	34,904	
MT#2 Condensing Circuits	15.30	13.90	1.40		99,435	70,559	28,876	
AC Condensing Circuits	25.00	20.00	5.00		28,417	13,699	14,718	
Total			8.00	kW			102,969	kWh
			8				102969	

Dark Green font is an estimate because this level of detail was missing from the application.

Applicaton Condenser Analysis	Pre-Retrofit Demand	Post-Retrofit Demand	Measure # Demand Savings	Pre-Retrofit Energy	Post-Retrofit Energy	Measure # Energy Savings (kWh)	Pre-Condenser Rejection (Btuh)	Post-Condenser Rejection (Btuh)	Difference in Condenser Heat Rejection (Btuh)	Measure Energy Savings per Condenser Heat Rejection (kWh/Btuh)
Condenser Fan Use	8.00	8.00	0.00	11,643	47,064	-35,421	19,149,000	18,080,000	1,069,000	-0.03
							0.0026031	4.4248E-07		

Evaluation Condenser Analysis	Pre-Condenser Rejection (Btuh)	Post-Condenser Rejection (Btuh)	Difference in Condenser Heat Rejection (Btuh)	Measure Energy Savings per Condenser Heat Rejection (kWh/Btuh)	Post-Energy	Post Demand
Condenser Fan Use	19,852,393	18,918,131	934,262	-30,957	49,246	8.37085443

Final Results for Measure #2		
Source	Demand Impact	Energy Impact
Evaluation	7.32	112,366
Application	8.00	67,548

Condenser Capacity	1,150,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	3	circuits	34,848
LT#1 Condensing Circuits	7	circuits	81,313
LT#2 Condensing Circuits	5	circuits	58,081
MT#1 Condensing Circuits	23	circuits	267,172
MT#2 Condensing Circuits	26	circuits	302,020
AC Condensing Circuits	35	circuits	406,566
Total Circuits	99		1,150,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	Refrigeration Case Load (Btuh)	Application Factor (unitless)	Calculated Application Factor, Check (unitless)	Equivalent Btuh rejected for case Load (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	1.0	39,300	-	0.5	39,300	4.42	3.413	30,346		69,646	1.00	9
108	72	8.0	39,300	-	0.5	39,300	4.42	3.413	30,346		69,646	1.00	71
103	70	53.0	39,300	-	0.5	39,300	4.42	3.413	30,346		69,646	1.00	471
98	68	159.0	39,300	-	0.5	39,300	4.42	3.413	30,346		69,646	1.00	1,414
93	66	287.0	39,300	-	0.6	39,300	4.42	3.413	30,346		61,453	0.73	1,863
88	66	364.0	39,300	-	0.6	39,300	4.42	3.413	30,346		61,453	0.73	2,363
83	63	457.0	39,300	-	0.6	39,300	4.42	3.413	30,346		61,453	0.73	2,966
78	61	581.0	39,300	-	0.6	39,300	4.42	3.413	30,346		61,453	0.73	3,771
73	59	707.0	39,300	-	0.6	39,300	4.42	3.413	30,346		61,453	0.73	4,589
68	56	804.0	39,300	-	0.6	39,300	4.42	3.413	30,346		61,453	0.73	5,219
63	53	965.0	39,300	-	0.6	39,300	4.42	3.413	30,346		61,453	0.73	6,264
58	50	1100.0	39,300	-	0.6	39,300	4.42	3.413	30,346		61,453	0.73	7,140
53	47	1098.0	39,300	-	0.6	39,300	4.42	3.413	30,346		61,453	0.73	7,127
48	43	902.0	39,300	-	0.6	39,300	4.42	3.413	30,346		61,453	0.73	5,855
43	40	681.0	39,300	-	0.6	39,300	4.42	3.413	30,346		61,453	0.73	4,420
38	36	397.0	39,300	-	0.6	39,300	4.42	3.413	30,346		61,453	0.73	2,577
33	32	159.0	39,300	-	0.6	39,300	4.42	3.413	30,346		61,453	0.73	1,032
28	27	32.0	39,300	-	0.6	39,300	4.42	3.413	30,346		61,453	0.73	208

			Application
kWh=	57,357	=	57,364
kWh=	8.89	=	8.9

Condenser Capacity	1,150,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	3	circuits	34,848
LT#1 Condensing Circuits	7	circuits	81,313
LT#2 Condensing Circuits	5	circuits	58,081
MT#1 Condensing Circuits	23	circuits	267,172
MT#2 Condensing Circuits	26	circuits	302,020
AC Condensing Circuits	35	circuits	406,566
Total Circuits	99		1,150,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	Refrigeration Case Load (Btuh)	Application Factor (unitless)	Calculated Application Factor, Check (unitless)	Equivalent Btuh rejected for case Load (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	1.0	99,900	-	0.5	99,900	5.00	3.413	68,192		168,092	1.00	20
108	72	8.0	99,900	-	0.5	99,900	5.00	3.413	68,192		168,092	1.00	160
103	70	53.0	99,900	-	0.5	99,900	5.00	3.413	68,192		168,092	1.00	1,059
98	68	159.0	99,900	-	0.5	99,900	5.00	3.413	68,192		168,092	1.00	3,177
93	66	287.0	99,900	-	0.6	99,900	5.00	3.413	68,192		147,634	0.70	4,014
88	66	364.0	99,900	-	0.6	99,900	5.00	3.413	68,192		147,634	0.70	5,091
83	63	457.0	99,900	-	0.6	99,900	5.00	3.413	68,192		147,634	0.70	6,392
78	61	581.0	99,900	-	0.6	99,900	5.00	3.413	68,192		147,634	0.70	8,126
73	59	707.0	99,900	-	0.6	99,900	5.00	3.413	68,192		147,634	0.70	9,888
68	56	804.0	99,900	-	0.6	99,900	5.00	3.413	68,192		147,634	0.70	11,245
63	53	965.0	99,900	-	0.6	99,900	5.00	3.413	68,192		147,634	0.70	13,496
58	50	1100.0	99,900	-	0.6	99,900	5.00	3.413	68,192		147,634	0.70	15,385
53	47	1098.0	99,900	-	0.6	99,900	5.00	3.413	68,192		147,634	0.70	15,357
48	43	902.0	99,900	-	0.6	99,900	5.00	3.413	68,192		147,634	0.70	12,615
43	40	681.0	99,900	-	0.6	99,900	5.00	3.413	68,192		147,634	0.70	9,524
38	36	397.0	99,900	-	0.6	99,900	5.00	3.413	68,192		147,634	0.70	5,552
33	32	159.0	99,900	-	0.6	99,900	5.00	3.413	68,192		147,634	0.70	2,224
28	27	32.0	99,900	-	0.6	99,900	5.00	3.413	68,192		147,634	0.70	448

			Application
kWh=	123,772	=	128,288
kWh=	19.98	=	19.9

Condenser Capacity	1,150,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	3	circuits	34,848
LT#1 Condensing Circuits	7	circuits	81,313
LT#2 Condensing Circuits	5	circuits	58,081
MT#1 Condensing Circuits	23	circuits	267,172
MT#2 Condensing Circuits	26	circuits	302,020
AC Condensing Circuits	35	circuits	406,566
Total Circuits	99		1,150,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	Refrigeration Case Load (Btuh)	Application Factor (unitless)	Calculated Application Factor, Check (unitless)	Equivalent Btuh rejected for case Load (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	1.0	87,100	-	0.4	87,100	5.00	3.413	59,454		146,554	1.00	17
108	72	8.0	87,100	-	0.4	87,100	5.00	3.413	59,454		146,554	1.00	139
103	70	53.0	87,100	-	0.4	87,100	5.00	3.413	59,454		146,554	1.00	923
98	68	159.0	87,100	-	0.4	87,100	5.00	3.413	59,454		146,554	1.00	2,770
93	66	287.0	87,100	-	0.4	87,100	5.00	3.413	59,454		146,554	1.00	5,000
88	66	364.0	87,100	-	0.4	87,100	5.00	3.413	59,454		130,502	0.73	4,629
83	63	457.0	87,100	-	0.4	87,100	5.00	3.413	59,454		130,502	0.73	5,811
78	61	581.0	87,100	-	0.4	87,100	5.00	3.413	59,454		130,502	0.73	7,388
73	59	707.0	87,100	-	0.4	87,100	5.00	3.413	59,454		130,502	0.73	8,991
68	56	804.0	87,100	-	0.4	87,100	5.00	3.413	59,454		130,502	0.73	10,224
63	53	965.0	87,100	-	0.4	87,100	5.00	3.413	59,454		130,502	0.73	12,272
58	50	1100.0	87,100	-	0.4	87,100	5.00	3.413	59,454		130,502	0.73	13,988
53	47	1098.0	87,100	-	0.4	87,100	5.00	3.413	59,454		130,502	0.73	13,963
48	43	902.0	87,100	-	0.4	87,100	5.00	3.413	59,454		130,502	0.73	11,470
43	40	681.0	87,100	-	0.4	87,100	5.00	3.413	59,454		130,502	0.73	8,660
38	36	397.0	87,100	-	0.4	87,100	5.00	3.413	59,454		130,502	0.73	5,048
33	32	159.0	87,100	-	0.4	87,100	5.00	3.413	59,454		130,502	0.73	2,022
28	27	32.0	87,100	-	0.4	87,100	5.00	3.413	59,454		130,502	0.73	407

			Application
kWh=	113,723	=	113,282
kWh=	17.42	=	17.4

Condenser Capacity	1,150,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	3	circuits	34,848
LT#1 Condensing Circuits	7	circuits	81,313
LT#2 Condensing Circuits	5	circuits	58,081
MT#1 Condensing Circuits	23	circuits	267,172
MT#2 Condensing Circuits	26	circuits	302,020
AC Condensing Circuits	35	circuits	406,566
Total Circuits	99		1,150,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	Refrigeration Case Load (Btuh)	Application Factor (unitless)	Calculated Application Factor, Check (unitless)	Equivalent Btuh rejected for case Load (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	1.0	198,450	-	1.0	198,450	8.77	3.413	77,230		275,680	1.00	23
108	72	8.0	198,450	-	1.0	198,450	8.96	3.413	75,593		274,043	1.00	177
103	70	53.0	198,450	-	1.0	198,450	9.05	3.413	74,841		273,291	1.00	1,162
98	68	159.0	198,450	-	1.0	198,450	9.10	3.413	74,430		272,880	1.00	3,467
93	66	287.0	198,450	-	1.1	198,450	9.15	3.413	74,023		252,487	0.73	4,544
88	66	364.0	198,450	-	1.1	198,450	9.20	3.413	73,621		252,193	0.73	5,732
83	63	457.0	198,450	-	1.1	198,450	9.25	3.413	73,223		251,903	0.73	7,157
78	61	581.0	198,450	-	1.1	198,450	9.34	3.413	72,517		251,387	0.73	9,012
73	59	707.0	198,450	-	1.1	198,450	9.39	3.413	72,131		251,106	0.73	10,908
68	56	804.0	198,450	-	1.1	198,450	9.49	3.413	71,371		250,551	0.73	12,273
63	53	965.0	198,450	-	1.1	198,450	9.54	3.413	70,997		250,278	0.73	14,654
58	50	1100.0	198,450	-	1.1	198,450	9.92	3.413	68,277		248,292	0.73	16,064
53	47	1098.0	198,450	-	1.1	198,450	10.30	3.413	65,758		246,454	0.73	15,443
48	43	902.0	198,450	-	1.1	198,450	11.07	3.413	61,184		243,115	0.73	11,804
43	40	681.0	198,450	-	1.1	198,450	12.07	3.413	56,115		239,414	0.73	8,174
38	36	397.0	198,450	-	1.1	198,450	12.07	3.413	56,115		239,414	0.73	4,765
33	32	159.0	198,450	-	1.1	198,450	12.07	3.413	56,115		239,414	0.73	1,908
28	27	32.0	198,450	-	1.1	198,450	12.07	3.413	56,115		239,414	0.73	384

			Application
kWh=	127,651	=	127,637
kWh=	22.63	=	22.6

Condenser Capacity	1,150,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	3	circuits	34,848
LT#1 Condensing Circuits	7	circuits	81,313
LT#2 Condensing Circuits	5	circuits	58,081
MT#1 Condensing Circuits	23	circuits	267,172
MT#2 Condensing Circuits	26	circuits	302,020
AC Condensing Circuits	35	circuits	406,566
Total Circuits	99		1,150,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	Refrigeration Case Load (Btuh)	Application Factor (unitless)	Calculated Application Factor, Check (unitless)	Equivalent Btuh rejected for case Load (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	1.0	239,000	-	0.9	239,000	9.96	3.413	81,898		320,898	1.00	24
108	72	8.0	239,000	-	0.9	239,000	10.20	3.413	79,971		318,971	1.00	187
103	70	53.0	239,000	-	0.9	239,000	10.31	3.413	79,118		318,118	1.00	1,229
98	68	159.0	239,000	-	1.0	239,000	10.43	3.413	78,208		317,208	1.00	3,643
93	66	287.0	239,000	-	1.0	239,000	10.57	3.413	77,172		295,335	0.73	4,737
88	66	364.0	239,000	-	1.0	239,000	10.70	3.413	76,234		294,651	0.73	5,935
83	63	457.0	239,000	-	1.0	239,000	10.98	3.413	74,290		293,232	0.73	7,262
78	61	581.0	239,000	-	1.0	239,000	11.12	3.413	73,355		292,549	0.73	9,116
73	59	707.0	239,000	-	1.0	239,000	11.26	3.413	72,443		291,883	0.73	10,955
68	56	804.0	239,000	-	1.0	239,000	11.53	3.413	70,746		290,645	0.73	12,166
63	53	965.0	239,000	-	1.0	239,000	11.81	3.413	69,069		289,421	0.73	14,256
58	50	1100.0	239,000	-	1.0	239,000	11.97	3.413	68,146		288,747	0.73	16,033
53	47	1098.0	239,000	-	1.1	239,000	12.30	3.413	66,318		287,412	0.73	15,575
48	43	902.0	239,000	-	1.1	239,000	12.96	3.413	62,940		284,946	0.73	12,143
43	40	681.0	239,000	-	1.1	239,000	14.08	3.413	57,934		281,292	0.73	8,438
38	36	397.0	239,000	-	1.1	239,000	14.08	3.413	57,934		281,292	0.73	4,919
33	32	159.0	239,000	-	1.1	239,000	14.08	3.413	57,934		281,292	0.73	1,970
28	27	32.0	239,000	-	1.1	239,000	14.08	3.413	57,934		281,292	0.73	397

			Application
kWh=	128,985	=	128,992
kWh=	24.00	=	24

AC, Measure #2

Condenser Capacity	1,150,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	3	circuits	34,848
LT#1 Condensing Circuits	7	circuits	81,313
LT#2 Condensing Circuits	5	circuits	58,081
MT#1 Condensing Circuits	23	circuits	267,172
MT#2 Condensing Circuits	26	circuits	302,020
AC Condensing Circuits	35	circuits	406,566
Total Circuits	99		1,150,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	AC Load (tons)	AC Load (Btuh)	Equivalent Btuh rejected for AC (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	1.0	30.00	360,000	360,000	18.33	3.413	67,031		427,031	1.00	20
108	72	8.0	30.00	360,000	360,000	18.96	3.413	64,804		424,804	1.00	152
103	70	53.0	30.47	365,640	365,640	20.15	3.413	61,932		427,572	1.00	962
98	68	159.0	25.78	309,360	309,360	22.78	3.413	46,350		355,710	1.00	2,159
93	66	287.0	21.09	253,080	253,080	26.19	3.413	32,981		286,061	1.00	2,773
88	66	364.0	16.41	196,920	196,920	31.01	3.413	21,673		218,593	1.00	2,311
83	63	457.0	11.72	140,640	140,640	38.09	3.413	12,602		153,242	1.00	1,687
78	61	581.0	7.03	84,360	84,360	40.12	3.413	7,176		91,536	1.00	1,222
73	59	707.0	2.34	28,080	28,080	23.66	3.413	4,051		32,131	1.00	839
68	56	804.0										
63	53	965.0										
58	50	1100.0										
53	47	1098.0										
48	43	902.0										
43	40	681.0										
38	36	397.0										
33	32	159.0										
28	27	32.0										

			Application
kWh=	12,125	>	8,754
kWh=	19.64	=	20

Condenser, Measure #2

Condenser Capacity	1,150,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	3	circuits	34,848
LT#1 Condensing Circuits	7	circuits	81,313
LT#2 Condensing Circuits	5	circuits	58,081
MT#1 Condensing Circuits	23	circuits	267,172
MT#2 Condensing Circuits	26	circuits	302,020
AC Condensing Circuits	35	circuits	406,566
Total Circuits	99		1,150,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	AC Heat Rejection (Btuh)	Refrigeration Heat Rejection (Btuh)	Condenser Load Factor (unitless)	Calculated Condenser Load Factor, Check (unitless)	Total Heat Rejection (Btuh)	Total Heat Rejection from the Application (MBtuh)	Total Heat Rejection from the Application (Btuh)
113	74	1.0	427,031	834,317	-	0.9	1,261,348	1,407	1,407,000
108	72	8.0	424,804	830,752	-	0.9	1,255,556	1,402	1,402,000
103	70	53.0	427,572	829,147	-	0.9	1,256,719	1,352	1,352,000
98	68	159.0	355,710	827,826	-	1.0	1,183,535	1,280	1,280,000
93	66	287.0	286,061	756,909	-	1.1	1,042,970	1,210	1,210,000
88	66	364.0	218,593	755,931	-	1.2	974,524	1,142	1,142,000
83	63	457.0	153,242	754,222	-	1.3	907,463	1,075	1,075,000
78	61	581.0	91,536	753,024	-	1.4	844,560	1,012	1,012,000
73	59	707.0	32,131	752,076	-	1.5	784,207	966	966,000
68	56	804.0	0	750,283	-	1.5	750,283	963	963,000
63	53	965.0	0	748,785	-	1.5	748,785	961	961,000
58	50	1100.0	0	746,126	-	1.5	746,126	957	957,000
53	47	1098.0	0	742,952	-	1.5	742,952	953	953,000
48	43	902.0	0	737,148	-	1.6	737,148	945	945,000
43	40	681.0	0	729,793	-	1.6	729,793	935	935,000
38	36	397.0	0	729,793	-	1.6	729,793	935	935,000
33	32	159.0	0	729,793	-	1.6	729,793	935	935,000
28	27	32.0	0	729,793	-	1.6	729,793	935	935,000
						Total Rejected	16,155,348	19,365	19,365,000

Condenser Capacity	1,150,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	3	circuits	34,848
LT#1 Condensing Circuits	7	circuits	81,313
LT#2 Condensing Circuits	5	circuits	58,081
MT#1 Condensing Circuits	23	circuits	267,172
MT#2 Condensing Circuits	26	circuits	302,020
AC Condensing Circuits	35	circuits	406,566
Total Circuits	99		1,150,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	Refrigeration Case Load (Btuh)	Application Factor (unitless)	Calculated Application Factor, Check (unitless)	Equivalent Btuh rejected for case Load (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	1.0	39,300	-	0.5	39,300	4.42	3.413	30,346	[redacted]	69,646	1.00	9
108	72	8.0	39,300	-	0.5	39,300	4.42	3.413	30,346	[redacted]	69,646	1.00	71
103	70	53.0	39,300	-	0.5	39,300	4.42	3.413	30,346	[redacted]	69,646	1.00	471
98	68	159.0	39,300	-	0.5	39,300	4.42	3.413	30,346	[redacted]	69,646	1.00	1,414
93	66	287.0	39,300	-	0.6	39,300	4.42	3.413	30,346	[redacted]	61,453	0.73	1,863
88	66	364.0	39,300	-	0.6	39,300	4.42	3.413	30,346	[redacted]	61,453	0.73	2,363
83	63	457.0	39,300	-	0.6	39,300	4.42	3.413	30,346	[redacted]	61,453	0.73	2,966
78	61	581.0	39,300	-	0.6	39,300	4.42	3.413	30,346	[redacted]	61,453	0.73	3,771
73	59	707.0	39,300	-	0.6	39,300	4.42	3.413	30,346	[redacted]	61,453	0.73	4,589
68	56	804.0	39,300	-	0.6	39,300	4.42	3.413	30,346	[redacted]	61,453	0.73	5,219
63	53	965.0	39,300	-	0.6	39,300	4.42	3.413	30,346	[redacted]	61,453	0.73	6,264
58	50	1100.0	39,300	-	0.6	39,300	4.42	3.413	30,346	[redacted]	61,453	0.73	7,140
53	47	1098.0	39,300	-	0.6	39,300	4.42	3.413	30,346	[redacted]	61,453	0.73	7,127
48	43	902.0	39,300	-	0.6	39,300	4.42	3.413	30,346	[redacted]	61,453	0.73	5,855
43	40	681.0	39,300	-	0.6	39,300	4.42	3.413	30,346	[redacted]	61,453	0.73	4,420
38	36	397.0	39,300	-	0.6	39,300	4.42	3.413	30,346	[redacted]	61,453	0.73	2,577
33	32	159.0	39,300	-	0.6	39,300	4.42	3.413	30,346	[redacted]	61,453	0.73	1,032
28	27	32.0	39,300	-	0.6	39,300	4.42	3.413	30,346	[redacted]	61,453	0.73	208

			Application
kWh=	57,357	=	57,364
kWh=	8.89	=	8.9

Condenser Capacity	1,150,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	3	circuits	34,848
LT#1 Condensing Circuits	7	circuits	81,313
LT#2 Condensing Circuits	5	circuits	58,081
MT#1 Condensing Circuits	23	circuits	267,172
MT#2 Condensing Circuits	26	circuits	302,020
AC Condensing Circuits	35	circuits	406,566
Total Circuits	99		1,150,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	Refrigeration Case Load (Btuh)	Application Factor (unitless)	Calculated Application Factor, Check (unitless)	Equivalent Btuh rejected for case Load (Btuh)	Estimated Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	1.0	99,900	-	0.5	99,900	5.00	3.413	68,192		168,092	1.00	20
108	72	8.0	99,900	-	0.5	99,900	5.00	3.413	68,192		168,092	1.00	160
103	70	53.0	99,900	-	0.5	99,900	5.00	3.413	68,192		168,092	1.00	1,059
98	68	159.0	99,900	-	0.5	99,900	5.00	3.413	68,192		168,092	1.00	3,177
93	66	287.0	99,900	-	0.6	99,900	5.00	3.413	68,192		147,634	0.70	4.014
88	66	364.0	99,900	-	0.6	99,900	5.00	3.413	68,192		147,634	0.70	5,091
83	63	457.0	99,900	-	0.6	99,900	5.00	3.413	68,192		147,634	0.70	6,392
78	61	581.0	99,900	-	0.6	99,900	5.00	3.413	68,192		147,634	0.70	8,128
73	59	707.0	99,900	-	0.6	99,900	5.00	3.413	68,192		147,634	0.70	9,888
68	56	804.0	99,900	-	0.6	99,800	5.00	3.413	68,192		147,634	0.70	11,245
63	53	965.0	99,900	-	0.6	99,900	5.00	3.413	68,192		147,634	0.70	13,496
58	50	1100.0	99,900	-	0.6	99,900	5.00	3.413	68,192		147,634	0.70	15,385
53	47	1098.0	99,900	-	0.6	99,800	5.00	3.413	68,192		147,634	0.70	15,357
48	43	902.0	99,900	-	0.6	99,900	5.00	3.413	68,192		147,634	0.70	12,615
43	40	681.0	99,900	-	0.6	99,900	5.00	3.413	68,192		147,634	0.70	9.524
38	36	397.0	99,900	-	0.6	99,900	5.00	3.413	68,192		147,634	0.70	5,552
33	32	159.0	99,900	-	0.6	99,900	5.00	3.413	68,192		147,634	0.70	2,224
28	27	32.0	99,900	-	0.6	99,900	5.00	3.413	68,192		147,634	0.70	448

			Application
kWh=	123.772	=	128,387
kWh=	19.98	<	19.9

Condenser Capacity	1,150,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	3	circuits	34,848
LT#1 Condensing Circuits	7	circuits	81,313
LT#2 Condensing Circuits	5	circuits	58,081
MT#1 Condensing Circuits	23	circuits	267,172
MT#2 Condensing Circuits	26	circuits	302,020
AC Condensing Circuits	35	circuits	406,566
Total Circuits	99		1,150,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	Refrigeration Case Load (Btuh)	Application Factor (unitless)	Calculated Application Factor, Check (unitless)	Equivalent Btuh rejected for case Load (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	1.0	87,100	-	0.0	87,100	5.00	3.413	59,454		146,554	1.00	17
108	72	8.0	87,100	-	0.4	87,100	5.00	3.413	59,454		146,554	1.00	139
103	70	53.0	87,100	-	0.4	87,100	5.00	3.413	59,454		146,554	1.00	923
98	68	159.0	87,100	-	0.4	87,100	5.00	3.413	59,454		146,554	1.00	2,770
93	66	287.0	87,100	-	0.4	87,100	5.00	3.413	59,454		146,554	1.00	5,000
88	66	364.0	87,100	-	0.4	87,100	5.00	3.413	59,454		130,502	0.73	4,629
83	63	457.0	87,100	-	0.4	87,100	5.00	3.413	59,454		130,502	0.73	5,811
78	61	581.0	87,100	-	0.4	87,100	5.00	3.413	59,454		130,502	0.73	7,388
73	59	707.0	87,100	-	0.4	87,100	5.00	3.413	59,454		130,502	0.73	8,991
68	56	804.0	87,100	-	0.4	87,100	5.00	3.413	59,454		130,502	0.73	10,224
63	53	965.0	87,100	-	0.4	87,100	5.00	3.413	59,454		130,502	0.73	12,272
58	50	1100.0	87,100	-	0.4	87,100	5.00	3.413	59,454		130,502	0.73	13,988
53	47	1098.0	87,100	-	0.4	87,100	5.00	3.413	59,454		130,502	0.73	13,963
48	43	902.0	87,100	-	0.4	87,100	5.00	3.413	59,454		130,502	0.73	11,470
43	40	681.0	87,100	-	0.4	87,100	5.00	3.413	59,454		130,502	0.73	8,660
38	36	397.0	87,100	-	0.4	87,100	5.00	3.413	59,454		130,502	0.73	5,048
33	32	159.0	87,100	-	0.4	87,100	5.00	3.413	59,454		130,502	0.73	2,022
28	27	32.0	87,100	-	0.4	87,100	5.00	3.413	59,454		130,502	0.73	407

			Application
kWh=	113,723	=	113,282
kWh=	17.42	=	17.4

Condenser Capacity	1,150,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	3	circuits	34,848
LT#1 Condensing Circuits	7	circuits	81,313
LT#2 Condensing Circuits	5	circuits	58,081
MT#1 Condensing Circuits	23	circuits	267,172
MT#2 Condensing Circuits	26	circuits	302,020
AC Condensing Circuits	35	circuits	406,566
Total Circuits	99		1,150,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	Refrigeration Case Load (Btuh)	Application Factor (unitless)	Calculated Application Factor, Check (unitless)	Equivalent Btuh rejected for case Load (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	1.0	198,450	-	1.0	198,450	8.58	3.413	78,941		277,391	1.00	23
108	72	8.0	198,450	-	1.0	198,450	8.58	3.413	78,941		277,391	1.00	185
103	70	53.0	198,450	-	1.0	198,450	8.58	3.413	78,941		277,391	1.00	1,226
98	68	159.0	198,450	-	1.0	198,450	8.58	3.413	78,941		277,391	1.00	3,678
93	66	287.0	198,450	-	1.0	198,450	8.58	3.413	78,941		277,391	1.00	6,638
88	66	364.0	198,450	-	1.0	198,450	8.58	3.413	78,941		256,077	0.73	6,146
83	63	457.0	198,450	-	1.0	198,450	8.58	3.413	78,941		256,077	0.73	7,716
78	61	581.0	198,450	-	1.0	198,450	8.58	3.413	78,941		256,077	0.73	9,810
73	59	707.0	198,450	-	1.0	198,450	8.58	3.413	78,941		256,077	0.73	11,937
68	56	804.0	198,450	-	1.0	198,450	8.58	3.413	78,941		256,077	0.73	13,575
63	53	965.0	198,450	-	1.0	198,450	8.58	3.413	78,941		256,077	0.73	16,293
58	50	1100.0	198,450	-	1.0	198,450	8.58	3.413	78,941		256,077	0.73	18,573
53	47	1098.0	198,450	-	1.0	198,450	8.58	3.413	78,941		256,077	0.73	18,539
48	43	902.0	198,450	-	1.0	198,450	8.58	3.413	78,941		256,077	0.73	15,230
43	40	681.0	198,450	-	1.0	198,450	8.58	3.413	78,941		256,077	0.73	11,498
38	36	397.0	198,450	-	1.0	198,450	8.58	3.413	78,941		256,077	0.73	6,703
33	32	159.0	198,450	-	1.0	198,450	8.58	3.413	78,941		256,077	0.73	2,685
28	27	32.0	198,450	-	1.0	198,450	8.58	3.413	78,941		256,077	0.73	540

			Application
kWh=	150,996	=	149,258
kWh=	23.13	=	23.1

Condenser Capacity	1,150,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	3	circuits	34,848
LT#1 Condensing Circuits	7	circuits	81,313
LT#2 Condensing Circuits	5	circuits	58,081
MT#1 Condensing Circuits	23	circuits	267,172
MT#2 Condensing Circuits	26	circuits	302,020
AC Condensing Circuits	35	circuits	406,566
Total Circuits	99		1,150,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	Refrigeration Case Load (Btuh)	Application Factor (unitless)	Calculated Application Factor, Check (unitless)	Equivalent Btuh rejected for case Load (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	1.0	239,000	-	0.9	239,000	9.85	3.413	82,813		321,813	1.00	24
108	72	8.0	239,000	-	0.9	239,000	9.85	3.413	82,813		321,813	1.00	194
103	70	53.0	239,000	-	0.9	239,000	9.85	3.413	82,813		321,813	1.00	1,286
98	68	159.0	239,000	-	0.9	239,000	9.85	3.413	82,813		321,813	1.00	3,858
93	66	287.0	239,000	-	0.9	239,000	9.85	3.413	82,813		321,813	1.00	6,964
88	66	364.0	239,000	-	1.0	239,000	9.85	3.413	82,813		299,453	0.73	6,447
83	63	457.0	239,000	-	1.0	239,000	9.85	3.413	82,813		299,453	0.73	8,095
78	61	581.0	239,000	-	1.0	239,000	9.85	3.413	82,813		299,453	0.73	10,291
73	59	707.0	239,000	-	1.0	239,000	9.85	3.413	82,813		299,453	0.73	12,523
68	56	804.0	239,000	-	1.0	239,000	9.85	3.413	82,813		299,453	0.73	14,241
63	53	965.0	239,000	-	1.0	239,000	9.85	3.413	82,813		299,453	0.73	17,093
58	50	1100.0	239,000	-	1.0	239,000	9.85	3.413	82,813		299,453	0.73	19,484
53	47	1098.0	239,000	-	1.0	239,000	9.85	3.413	82,813		299,453	0.73	19,449
48	43	902.0	239,000	-	1.0	239,000	9.85	3.413	82,813		299,453	0.73	15,977
43	40	681.0	239,000	-	1.0	239,000	9.85	3.413	82,813		299,453	0.73	12,062
38	36	397.0	239,000	-	1.0	239,000	9.85	3.413	82,813		299,453	0.73	7,032
33	32	159.0	239,000	-	1.0	239,000	9.85	3.413	82,813		299,453	0.73	2,816
28	27	32.0	239,000	-	1.0	239,000	9.85	3.413	82,813		299,453	0.73	567

			Application
kWh=	158,403	=	156,540
kWh=	24.26	=	24.3

Condenser Capacity	1,150,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	3	circuits	34,848
LT#1 Condensing Circuits	7	circuits	81,313
LT#2 Condensing Circuits	5	circuits	58,081
MT#1 Condensing Circuits	23	circuits	267,172
MT#2 Condensing Circuits	26	circuits	302,020
AC Condensing Circuits	35	circuits	406,566
Total Circuits	99		1,150,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	AC Load (tons)	AC Load (Btuh)	Equivalent Btuh rejected for AC (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	1.0	30.00	360,000	360,000	17.69	3.413	69,456		429,456	1.00	20
108	72	8.0	30.00	360,000	360,000	17.69	3.413	69,456		429,456	1.00	163
103	70	53.0	30.47	365,640	365,640	17.69	3.413	70,544		436,184	1.00	1,095
98	68	159.0	25.78	309,360	309,360	17.69	3.413	59,686		369,046	1.00	2,781
93	66	287.0	21.09	253,080	253,080	17.69	3.413	48,828		301,908	1.00	4,106
88	66	364.0	16.41	196,920	196,920	17.69	3.413	37,993		234,913	1.00	4,052
83	63	457.0	11.72	140,640	140,640	17.69	3.413	27,134		167,774	1.00	3,633
78	61	581.0	7.03	84,360	84,360	17.69	3.413	16,276		100,636	1.00	2,771
73	59	707.0	2.34	28,080	28,080	17.69	3.413	5,418		33,498	1.00	1,122
68	56	804.0										
63	53	965.0										
58	50	1100.0										
53	47	1098.0										
48	43	902.0										
43	40	681.0										
38	36	397.0										
33	32	159.0										
28	27	32.0										

			Application
kWh=	19,743	=	19,748
kWh=	20.35	=	21

Notes

The application assumes a lower AC load in the post-measure #2 retrofit condition.

Condenser, Measure #1

Condenser Capacity	1,150,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	3	circuits	34,848
LT#1 Condensing Circuits	7	circuits	81,313
LT#2 Condensing Circuits	5	circuits	58,081
MT#1 Condensing Circuits	23	circuits	267,172
MT#2 Condensing Circuits	26	circuits	302,020
AC Condensing Circuits	35	circuits	406,566
Total Circuits	99		1,150,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	AC Heat Rejection (Btuh)	Refrigeration Heat Rejection (Btuh)	Condenser Load Factor (unitless)	Calculated Condenser Load Factor, Check (unitless)	Total Heat Rejection (Btuh)	Total Heat Rejection from the Application (MBtuh)	Total Heat Rejection from the Application (Btuh)	
113	74	1.0	429,456	836,942	-	0.9	1,266,398	1,330	1,330,000	
108	72	8.0	429,456	836,942	-	0.9	1,266,398	1,412	1,412,000	
103	70	53.0	436,184	836,942	-	0.9	1,273,126	1,419	1,419,000	
98	68	159.0	369,046	836,942	-	1.0	1,205,988	1,352	1,352,000	
93	66	287.0	301,908	808,290	-	1.0	1,110,198	1,285	1,285,000	
88	66	364.0	234,913	764,617	-	1.2	999,530	1,218	1,218,000	
83	63	457.0	167,774	764,617	-	1.2	932,391	1,151	1,151,000	
78	61	581.0	100,636	764,617	-	1.3	865,253	1,083	1,083,000	
73	59	707.0	33,498	764,617	-	1.4	798,115	1,016	1,016,000	
68	56	804.0	0	764,617	-	1.5	764,617	983	983,000	
63	53	965.0	0	764,617	-	1.5	764,617	983	983,000	
58	50	1100.0	0	764,617	-	1.5	764,617	983	983,000	
53	47	1098.0	0	764,617	-	1.5	764,617	983	983,000	
48	43	902.0	0	764,617	-	1.5	764,617	983	983,000	
43	40	681.0	0	764,617	-	1.5	764,617	983	983,000	
38	36	397.0	0	764,617	-	1.5	764,617	983	983,000	
33	32	159.0	0	764,617	-	1.5	764,617	983	983,000	
28	27	32.0	0	764,617	-	1.5	764,617	983	983,000	
						Total Rejected	16,598,949	20,113	20,113,000	Heat rejection differences are significant

Measure #2 Summary of Findings

Evaluation Compressor Savings	Pre-Retrofit Demand	Post-Retrofit Demand	Measure # Demand Savings		Pre-Retrofit Energy	Post-Retrofit Energy	Measure # Energy Savings	
Ice Cream Condensing Circuits	8.89	8.89	0.00		57,357	57,357	0	
LT#1 Condensing Circuits	19.98	19.98	0.00		123,772	123,772	0	
LT#2 Condensing Circuits	17.42	17.42	0.00		113,723	113,723	0	
MT#1 Condensing Circuits	23.13	22.63	0.50		150,996	127,651	23,344	
MT#2 Condensing Circuits	24.26	24.00	0.27		158,403	128,985	29,417	
AC Condensing Circuits	20.35	19.64	0.71		19,743	12,125	7,618	
Total			1.48	kW			60,379	kWh
Total Refer w/ Compressor		102.09				613,255		

Application Compressor Savings	Pre-Retrofit Demand	Post-Retrofit Demand	Measure # Demand Savings		Pre-Retrofit Energy	Post-Retrofit Energy	Measure # Energy Savings	
Ice Cream Condensing Circuits	8.90	8.90	0.00		57,364	57,364	0	
LT#1 Condensing Circuits	19.90	19.90	0.00		128,387	128,288	99	
LT#2 Condensing Circuits	17.40	17.40	0.00		113,282	113,282	0	
MT#1 Condensing Circuits	23.10	22.60	0.50		149,258	127,637	21,621	
MT#2 Condensing Circuits	24.30	24.00	0.30		156,540	128,992	27,548	
AC Condensing Circuits	21.00	20.00	1.00		19,748	8,754	10,994	
Total			1.80	kW			60,262	kWh

Dark Green font is an estimate because this level of detail was missing from the application.

Applicaton Condenser Analysis	Pre-Retrofit Demand	Post-Retrofit Demand	Measure # Demand Savings	Pre-Retrofit Energy	Post-Retrofit Energy	Measure # Energy Savings (kWh)	Pre-Condenser Rejection (Btuh)	Post-Condenser Rejection (Btuh)	Difference in Condenser Heat Rejection (Btuh)	Measure Energy Savings per Condenser Heat Rejection (kWh/Btuh)
Condenser Fan Use	11.00	11.00	0.00	28,049	74,038	-45,989	20,113,000	19,365,000	748,000	-0.06
							0.00382329	5.6804E-07		

Evaluation Condenser Analysis	Pre-Condenser Rejection (Btuh)	Post-Condenser Rejection (Btuh)	Difference in Condenser Heat Rejection (Btuh)	Measure Energy Savings per Condenser Heat Rejection (kWh/Btuh)	Post-Energy	Post Demand
Condenser Fan Use	16,598,949	16,155,348	443,602	-27.274	61,767	9.17680473

Final Results for Measure #2

Source	Demand Impact	Energy Impact
Evaluation	1.48	33,106
Application	1.80	14,273

Condenser Capacity	1,500,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	2	circuits	61,224
LT#1 Condensing Circuits	3	circuits	91,837
LT#2 Condensing Circuits	4	circuits	122,449
MT#1 Condensing Circuits	10	circuits	306,122
MT#2 Condensing Circuits	12	circuits	367,347
AC Condensing Circuits	18	circuits	551,020
Total Circuits	49		1,500,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	Refrigeration Case Load (Btuh)	Application Factor (unitless)	Calculated Application Factor, Check (unitless)	Equivalent Btuh rejected for case Load (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	1.0	24,800	1.4	1.5	24,800	5.08	3.413	16,662	[redacted]	41,462	1.00	5
108	72	8.0	24,800	1.5	1.5	24,800	5.11	3.413	16,564	[redacted]	41,364	1.00	39
103	70	53.0	24,800	1.5	1.5	24,800	5.13	3.413	16,499	[redacted]	41,299	1.00	256
98	68	159.0	24,800	1.5	1.5	24,800	5.15	3.413	16,435	[redacted]	41,235	1.00	766
93	66	287.0	24,800	1.5	1.7	24,800	5.36	3.413	15,791	[redacted]	35,064	0.65	863
88	66	364.0	24,800	1.5	1.8	24,800	5.47	3.413	15,474	[redacted]	34,858	0.65	1,073
83	63	457.0	24,800	1.5	1.8	24,800	5.68	3.413	14,902	[redacted]	34,486	0.65	1,297
78	61	581.0	24,800	1.5	1.8	24,800	5.78	3.413	14,644	[redacted]	34,319	0.65	1,620
73	59	707.0	24,800	1.5	1.8	24,800	6.00	3.413	14,107	[redacted]	33,970	0.65	1,899
68	56	804.0	24,800	1.6	1.8	24,800	6.28	3.413	13,478	[redacted]	33,561	0.65	2,064
63	53	965.0	24,800	1.6	1.8	24,800	6.35	3.413	13,330	[redacted]	33,464	0.65	2,450
58	50	1100.0	24,800	1.6	1.9	24,800	6.50	3.413	13,022	[redacted]	33,264	0.65	2,728
53	47	1098.0	24,800	1.6	1.9	24,800	6.72	3.413	12,596	[redacted]	32,987	0.65	2,634
48	43	902.0	24,800	1.6	1.9	24,800	6.94	3.413	12,196	[redacted]	32,728	0.65	2,095
43	40	681.0	24,800	1.6	1.9	24,800	6.94	3.413	12,196	[redacted]	32,728	0.65	1,582
38	36	397.0	24,800	1.6	1.9	24,800	6.94	3.413	12,196	[redacted]	32,728	0.65	922
33	32	159.0	24,800	1.6	1.9	24,800	6.94	3.413	12,196	[redacted]	32,728	0.65	369
28	27	32.0	24,800	1.6	1.9	24,800	6.94	3.413	12,196	[redacted]	32,728	0.65	74

			Application
kWh=	22,736	=	22,736
kWh=	4.88	=	4.9

Condenser Capacity	1,500,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	2	circuits	61,224
LT#1 Condensing Circuits	3	circuits	91,837
LT#2 Condensing Circuits	4	circuits	122,449
MT#1 Condensing Circuits	10	circuits	306,122
MT#2 Condensing Circuits	12	circuits	367,347
AC Condensing Circuits	18	circuits	551,020
Total Circuits	49		1,500,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	Refrigeration Case Load (Btuh)	Application Factor (unitless)	Calculated Application Factor, Check (unitless)	Equivalent Btuh rejected for case Load (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	1.0	50,850	1.1	1.1	50,850	5.70	3.413	30,448	[redacted]	81,298	1.00	9
108	72	8.0	50,850	1.1	1.1	50,850	5.90	3.413	29,415	[redacted]	80,265	1.00	69
103	70	53.0	50,850	1.1	1.1	50,850	5.90	3.413	29,415	[redacted]	80,265	1.00	457
98	68	159.0	50,850	1.1	1.1	50,850	5.90	3.413	29,415	[redacted]	80,265	1.00	1,370
93	66	287.0	50,850	1.1	1.3	50,850	6.10	3.413	28,451	[redacted]	70,766	0.70	1,675
88	66	364.0	50,850	1.1	1.3	50,850	6.10	3.413	28,451	[redacted]	70,766	0.70	2,124
83	63	457.0	50,850	1.1	1.3	50,850	6.30	3.413	27,548	[redacted]	70,133	0.70	2,582
78	61	581.0	50,850	1.2	1.3	50,850	6.30	3.413	27,548	[redacted]	70,133	0.70	3,283
73	59	707.0	50,850	1.2	1.3	50,850	6.40	3.413	27,117	[redacted]	69,832	0.70	3,932
68	56	804.0	50,850	1.2	1.3	50,850	6.60	3.413	26,296	[redacted]	69,257	0.70	4,336
63	53	965.0	50,850	1.2	1.3	50,850	6.70	3.413	25,903	[redacted]	68,982	0.70	5,127
58	50	1100.0	50,850	1.2	1.3	50,850	6.90	3.413	25,152	[redacted]	68,457	0.70	5,675
53	47	1098.0	50,850	1.2	1.4	50,850	7.10	3.413	24,444	[redacted]	67,961	0.70	5,505
48	43	902.0	50,850	1.2	1.4	50,850	7.50	3.413	23,140	[redacted]	67,048	0.70	4,281
43	40	681.0	50,850	1.2	1.4	50,850	8.00	3.413	21,694	[redacted]	66,036	0.70	3,030
38	36	397.0	50,850	1.2	1.4	50,850	8.00	3.413	21,694	[redacted]	66,036	0.70	1,766
33	32	159.0	50,850	1.2	1.4	50,850	8.00	3.413	21,694	[redacted]	66,036	0.70	707
28	27	32.0	50,850	1.2	1.4	50,850	8.00	3.413	21,694	[redacted]	66,036	0.70	142

			Application
kWh=	46,070	>	42,933
kWh=	8.92	=	8.9

Condenser Capacity	1,500,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	2	circuits	61,224
LT#1 Condensing Circuits	3	circuits	91,837
LT#2 Condensing Circuits	4	circuits	122,449
MT#1 Condensing Circuits	10	circuits	306,122
MT#2 Condensing Circuits	12	circuits	367,347
AC Condensing Circuits	18	circuits	551,020
Total Circuits	49		1,500,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	Refrigeration Case Load (Btuh)	Application Factor (unitless)	Calculated Application Factor, Check (unitless)	Equivalent Btuh rejected for case Load (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	1.0	82,750	0.9	0.9	82,750	5.30	3.413	53,288		136,038	1.00	16
108	72	8.0	82,750	0.9	0.9	82,750	5.50	3.413	51,350		134,100	1.00	120
103	70	53.0	82,750	0.9	0.9	82,750	5.50	3.413	51,350		134,100	1.00	797
98	68	159.0	82,750	0.9	0.9	82,750	5.50	3.413	51,350		134,100	1.00	2,392
93	66	287.0	82,750	0.9	1.1	82,750	5.60	3.413	50,433		115,532	0.65	2,757
88	66	364.0	82,750	0.9	1.1	82,750	5.70	3.413	49,548		114,956	0.65	3,435
83	63	457.0	82,750	0.9	1.1	82,750	5.80	3.413	48,694		114,401	0.65	4,238
78	61	581.0	82,750	0.9	1.1	82,750	5.90	3.413	47,869		113,865	0.65	5,297
73	59	707.0	82,750	0.9	1.1	82,750	6.00	3.413	47,071		113,346	0.65	6,338
68	56	804.0	82,750	0.9	1.1	82,750	6.10	3.413	46,299		112,845	0.65	7,089
63	53	965.0	82,750	0.9	1.1	82,750	6.20	3.413	45,553		112,359	0.65	8,372
58	50	1100.0	82,750	0.9	1.1	82,750	6.30	3.413	44,829		111,869	0.65	9,391
53	47	1098.0	82,750	1.0	1.1	82,750	6.50	3.413	43,450		110,993	0.65	9,086
48	43	902.0	82,750	1.0	1.1	82,750	6.80	3.413	41,533		109,747	0.65	7,135
43	40	681.0	82,750	1.0	1.1	82,750	7.30	3.413	38,688		107,897	0.65	5,018
38	36	397.0	82,750	1.0	1.1	82,750	7.30	3.413	38,688		107,897	0.65	2,925
33	32	159.0	82,750	1.0	1.1	82,750	7.30	3.413	38,688		107,897	0.65	1,172
28	27	32.0	82,750	1.0	1.1	82,750	7.30	3.413	38,688		107,897	0.65	236

			Application
kWh=	75,813	<	77,227
kWh=	15.61	=	15.5

Condenser Capacity	1,500,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	2	circuits	61,224
LT#1 Condensing Circuits	3	circuits	91,837
LT#2 Condensing Circuits	4	circuits	122,449
MT#1 Condensing Circuits	10	circuits	306,122
MT#2 Condensing Circuits	12	circuits	367,347
AC Condensing Circuits	18	circuits	551,020
Total Circuits	49		1,500,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	Refrigeration Case Load (Btuh)	Application Factor (unitless)	Calculated Application Factor, Check (unitless)	Equivalent Btuh rejected for case Load (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	1.0	247,645	0.9	0.9	247,645	8.48	3.413	99,671		347,316	1.00	29
108	72	8.0	247,645	0.9	0.9	247,645	8.67	3.413	97,487		345,132	1.00	229
103	70	53.0	247,645	0.9	0.9	247,645	8.77	3.413	96,375		344,020	1.00	1,497
98	68	159.0	247,645	0.9	0.9	247,645	8.86	3.413	95,396		343,041	1.00	4,444
93	66	287.0	247,645	0.9	1.0	247,645	8.96	3.413	94,332		308,961	0.65	5,156
88	66	364.0	247,645	0.9	1.0	247,645	9.05	3.413	93,394		308,351	0.65	6,474
83	63	457.0	247,645	0.9	1.0	247,645	9.10	3.413	92,880		308,017	0.65	8,084
78	61	581.0	247,645	0.9	1.0	247,645	9.20	3.413	91,871		307,361	0.65	10,166
73	59	707.0	247,645	0.9	1.0	247,645	9.25	3.413	91,374		307,038	0.65	12,303
68	56	804.0	247,645	0.9	1.0	247,645	9.34	3.413	90,494		306,466	0.65	13,856
63	53	965.0	247,645	0.9	1.0	247,645	9.39	3.413	90,012		306,153	0.65	16,543
58	50	1100.0	247,645	0.9	1.0	247,645	9.44	3.413	89,535		305,843	0.65	18,757
53	47	1098.0	247,645	0.9	1.0	247,645	9.49	3.413	89,063		305,536	0.65	18,624
48	43	902.0	247,645	0.9	1.0	247,645	10.30	3.413	82,059		300,984	0.65	14,097
43	40	681.0	247,645	0.9	1.0	247,645	11.45	3.413	73,818		295,626	0.65	9,574
38	36	397.0	247,645	0.9	1.0	247,645	11.45	3.413	73,818		295,626	0.65	5,581
33	32	159.0	247,645	0.9	1.0	247,645	11.45	3.413	73,818		295,626	0.65	2,235
28	27	32.0	247,645	0.9	1.0	247,645	11.45	3.413	73,818		295,626	0.65	450

			Application
kWh=	148,099	=	148,073
kWh=	29.20	=	29.2

Condenser Capacity	1,500,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	2	circuits	61,224
LT#1 Condensing Circuits	3	circuits	91,837
LT#2 Condensing Circuits	4	circuits	122,449
MT#1 Condensing Circuits	10	circuits	306,122
MT#2 Condensing Circuits	12	circuits	367,347
AC Condensing Circuits	18	circuits	551,020
Total Circuits	49		1,500,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	Refrigeration Case Load (Btuh)	Application Factor (unitless)	Calculated Application Factor, Check (unitless)	Equivalent Btuh rejected for case Load (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	1.0	290,600	0.9	0.9	290,600	9.96	3.413	99,580	[redacted]	390,180	1.00	29
108	72	8.0	290,600	0.9	0.9	290,600	10.20	3.413	97,237	[redacted]	387,837	1.00	228
103	70	53.0	290,600	0.9	0.9	290,600	10.31	3.413	96,200	[redacted]	386,800	1.00	1,494
98	68	159.0	290,600	0.9	0.9	290,600	10.31	3.413	96,200	[redacted]	386,800	1.00	4,482
93	66	287.0	290,600	0.9	1.0	290,600	10.57	3.413	93,833	[redacted]	351,592	0.65	5,129
88	66	364.0	290,600	0.9	1.0	290,600	10.70	3.413	92,693	[redacted]	350,851	0.65	6,426
83	63	457.0	290,600	0.9	1.0	290,600	10.84	3.413	91,496	[redacted]	350,072	0.65	7,963
78	61	581.0	290,600	0.9	1.1	290,600	11.12	3.413	89,192	[redacted]	348,575	0.65	9,869
73	59	707.0	290,600	1.0	1.1	290,600	11.26	3.413	88,083	[redacted]	347,854	0.65	11,860
68	56	804.0	290,600	1.0	1.1	290,600	11.53	3.413	86,021	[redacted]	346,513	0.65	13,172
63	53	965.0	290,600	1.0	1.1	290,600	11.67	3.413	84,989	[redacted]	345,843	0.65	15,619
58	50	1100.0	290,600	1.0	1.1	290,600	11.97	3.413	82,859	[redacted]	344,458	0.65	17,358
53	47	1098.0	290,600	1.0	1.1	290,600	12.30	3.413	80,636	[redacted]	343,013	0.65	16,862
48	43	902.0	290,600	1.0	1.1	290,600	12.96	3.413	76,529	[redacted]	340,344	0.65	13,147
43	40	681.0	290,600	1.0	1.1	290,600	13.87	3.413	71,508	[redacted]	337,080	0.65	9,274
38	36	397.0	290,600	1.0	1.1	290,600	13.87	3.413	71,508	[redacted]	337,080	0.65	5,407
33	32	159.0	290,600	1.0	1.1	290,600	13.87	3.413	71,508	[redacted]	337,080	0.65	2,165
28	27	32.0	290,600	1.0	1.1	290,600	13.87	3.413	71,508	[redacted]	337,080	0.65	436

			Application
kWh=	140,919	=	140,914
kWh=	29.18	=	29.2

Condenser Capacity	1,500,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	2	circuits	61,224
LT#1 Condensing Circuits	3	circuits	91,837
LT#2 Condensing Circuits	4	circuits	122,449
MT#1 Condensing Circuits	10	circuits	306,122
MT#2 Condensing Circuits	12	circuits	367,347
AC Condensing Circuits	18	circuits	551,020
Total Circuits	49		1,500,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	AC Load (tons)	AC Load (Btuh)	Equivalent Btuh rejected for AC (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	1.0	40.00	480,000	480,000	16.37	3.413	100,076	[redacted]	580,076	1.00	29
108	72	8.0	40.00	480,000	480,000	17.20	3.413	95,247	[redacted]	575,247	1.00	223
103	70	53.0	40.63	487,560	487,560	18.20	3.413	91,431	[redacted]	578,991	1.00	1,420
98	68	159.0	34.38	412,560	412,560	20.02	3.413	70,333	[redacted]	482,893	1.00	3,277
93	66	287.0	28.13	337,560	337,560	23.15	3.413	49,766	[redacted]	387,326	1.00	4,185
88	66	364.0	21.88	262,560	262,560	27.19	3.413	32,958	[redacted]	295,518	1.00	3,515
83	63	457.0	15.63	187,560	187,560	33.00	3.413	19,398	[redacted]	206,958	1.00	2,597
78	61	581.0	9.38	112,560	112,560	35.91	3.413	10,698	[redacted]	123,258	1.00	1,821
73	59	707.0	3.13	37,560	37,560	35.91	3.413	3,570	[redacted]	44,700	2.00	1,479
68	56	804.0							[redacted]			
63	53	965.0							[redacted]			
58	50	1100.0							[redacted]			
53	47	1098.0							[redacted]			
48	43	902.0							[redacted]			
43	40	681.0							[redacted]			
38	36	397.0							[redacted]			
33	32	159.0							[redacted]			
28	27	32.0							[redacted]			

			Application
kWh=	18,546	>	13,472
kWh=	29.32	=	29

Condenser Capacity	1,500,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	2	circuits	61,224
LT#1 Condensing Circuits	3	circuits	91,837
LT#2 Condensing Circuits	4	circuits	122,449
MT#1 Condensing Circuits	10	circuits	306,122
MT#2 Condensing Circuits	12	circuits	367,347
AC Condensing Circuits	18	circuits	551,020
Total Circuits	49		1,500,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	AC Heat Rejection (Btuh)	Refrigeration Heat Rejection (Btuh)	Condenser Load Factor (unitless)	Calculated Condenser Load Factor, Check (unitless)	Total Heat Rejection (Btuh)	Total Heat Rejection from the Application (MBtuh)	Total Heat Rejection from the Application (Btuh)	
113	74	1.0	580,076	860,256	1.0	1.0	1,440,332	1,575	1,575,000	
108	72	8.0	575,247	854,599	1.0	1.0	1,429,845	1,565	1,565,000	
103	70	53.0	578,991	852,385	1.0	1.0	1,431,376	1,501	1,501,000	
98	68	159.0	482,893	851,342	1.1	1.1	1,334,235	1,405	1,405,000	
93	66	287.0	387,326	766,382	1.1	1.3	1,153,709	1,305	1,305,000	
88	66	364.0	295,518	764,825	1.2	1.4	1,060,343	1,210	1,210,000	
83	63	457.0	206,958	762,709	1.3	1.5	969,668	1,120	1,120,000	
78	61	581.0	123,258	760,388	1.5	1.7	883,646	1,031	1,031,000	
73	59	707.0	44,700	758,694	1.6	1.9	803,394	964	964,000	
68	56	804.0	0	755,797	1.6	2.0	755,797	959	959,000	
63	53	965.0	0	754,442	1.6	2.0	754,442	956	956,000	
58	50	1100.0	0	752,022	1.6	2.0	752,022	951	951,000	
53	47	1098.0	0	749,497	1.6	2.0	749,497	946	946,000	
48	43	902.0	0	741,103	1.6	2.0	741,103	932	932,000	
43	40	681.0	0	731,470	1.6	2.1	731,470	915	915,000	
38	36	397.0	0	731,470	1.6	2.1	731,470	915	915,000	
33	32	159.0	0	731,470	1.6	2.1	731,470	915	915,000	
28	27	32.0	0	731,470	1.6	2.1	731,470	915	915,000	
						Total Rejected	17,185,288	20,080	20,080,000	Heat rejection differences are significant

Condenser Capacity	1,500,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	2	circuits	61,224
LT#1 Condensing Circuits	3	circuits	91,837
LT#2 Condensing Circuits	4	circuits	122,449
MT#1 Condensing Circuits	10	circuits	306,122
MT#2 Condensing Circuits	12	circuits	367,347
AC Condensing Circuits	18	circuits	551,020
Total Circuits	49		1,500,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	Refrigeration Case Load (Btuh)	Application Factor (unitless)	Calculated Application Factor, Check (unitless)	Equivalent Btuh rejected for case Load (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	1.0	24,800	1.4	1.5	24,800	5.04	3.413	16,794	[redacted]	41,594	1.00	5
108	72	8.0	24,800	1.4	1.5	24,800	5.06	3.413	16,728	[redacted]	41,528	1.00	39
103	70	53.0	24,800	1.4	1.5	24,800	5.06	3.413	16,728	[redacted]	41,528	1.00	260
98	68	159.0	24,800	1.4	1.5	24,800	5.06	3.413	16,728	[redacted]	41,528	1.00	779
93	66	287.0	24,800	1.4	1.5	24,800	5.06	3.413	16,728	[redacted]	41,528	1.00	1,407
88	66	364.0	24,800	1.4	1.7	24,800	5.06	3.413	16,728	[redacted]	35,673	0.65	1,160
83	63	457.0	24,800	1.4	1.7	24,800	5.06	3.413	16,728	[redacted]	35,673	0.65	1,456
78	61	581.0	24,800	1.4	1.7	24,800	5.06	3.413	16,728	[redacted]	35,673	0.65	1,851
73	59	707.0	24,800	1.4	1.7	24,800	5.06	3.413	16,728	[redacted]	35,673	0.65	2,252
68	56	804.0	24,800	1.4	1.7	24,800	5.06	3.413	16,728	[redacted]	35,673	0.65	2,561
63	53	965.0	24,800	1.4	1.7	24,800	5.06	3.413	16,728	[redacted]	35,673	0.65	3,074
58	50	1100.0	24,800	1.4	1.7	24,800	5.06	3.413	16,728	[redacted]	35,673	0.65	3,504
53	47	1098.0	24,800	1.4	1.7	24,800	5.06	3.413	16,728	[redacted]	35,673	0.65	3,498
48	43	902.0	24,800	1.4	1.7	24,800	5.06	3.413	16,728	[redacted]	35,673	0.65	2,874
43	40	681.0	24,800	1.4	1.7	24,800	5.06	3.413	16,728	[redacted]	35,673	0.65	2,170
38	36	397.0	24,800	1.4	1.7	24,800	5.06	3.413	16,728	[redacted]	35,673	0.65	1,265
33	32	159.0	24,800	1.4	1.7	24,800	5.06	3.413	16,728	[redacted]	35,673	0.65	507
28	27	32.0	24,800	1.4	1.7	24,800	5.06	3.413	16,728	[redacted]	35,673	0.65	102

			Application
kWh=	28,763	=	28,272
kWh=	4.92	=	4.9

Condenser Capacity	1,500,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	2	circuits	61,224
LT#1 Condensing Circuits	3	circuits	91,837
LT#2 Condensing Circuits	4	circuits	122,449
MT#1 Condensing Circuits	10	circuits	306,122
MT#2 Condensing Circuits	12	circuits	367,347
AC Condensing Circuits	18	circuits	551,020
Total Circuits	49		1,500,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	Refrigeration Case Load (Btuh)	Application Factor (unitless)	Calculated Application Factor, Check (unitless)	Equivalent Btuh rejected for case Load (Btuh)	Estimated Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	1.0	50,850	1.1	1.1	50,850	5.70	3.413	30,448		81,298	1.00	9
108	72	8.0	50,850	1.1	1.1	50,850	5.90	3.413	29,415		80,265	1.00	69
103	70	53.0	50,850	1.1	1.1	50,850	5.90	3.413	29,415		80,265	1.00	457
98	68	159.0	50,850	1.1	1.1	50,850	5.90	3.413	29,415		80,265	1.00	1,370
93	66	287.0	50,850	1.1	1.2	50,850	6.00	3.413	28,925		79,775	1.00	2,432
88	66	364.0	50,850	1.1	1.3	50,850	6.00	3.413	28,925		69,651	0.65	2,005
83	63	457.0	50,850	1.1	1.3	50,850	6.00	3.413	28,925		69,651	0.65	2,517
78	61	581.0	50,850	1.1	1.3	50,850	6.00	3.413	28,925		69,651	0.65	3,201
73	59	707.0	50,850	1.1	1.3	50,850	6.00	3.413	28,925		69,651	0.65	3,895
68	56	804.0	50,850	1.1	1.3	50,850	6.00	3.413	28,925		69,651	0.65	4,429
63	53	965.0	50,850	1.1	1.3	50,850	6.00	3.413	28,925		69,651	0.65	5,316
58	50	1100.0	50,850	1.1	1.3	50,850	6.00	3.413	28,925		69,651	0.65	6,060
53	47	1098.0	50,850	1.1	1.3	50,850	6.00	3.413	28,925		69,651	0.65	6,049
48	43	902.0	50,850	1.1	1.3	50,850	6.00	3.413	28,925		69,651	0.65	4,969
43	40	681.0	50,850	1.1	1.3	50,850	6.00	3.413	28,925		69,651	0.65	3,751
38	36	397.0	50,850	1.1	1.3	50,850	6.00	3.413	28,925		69,651	0.65	2,187
33	32	159.0	50,850	1.1	1.3	50,850	6.00	3.413	28,925		69,651	0.65	876
28	27	32.0	50,850	1.1	1.3	50,850	6.00	3.413	28,925		69,651	0.65	176

			Application
kWh=	49,768	=	49,002
kWh=	8.92	=	8.9

Condenser Capacity	1,500,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	2	circuits	61,224
LT#1 Condensing Circuits	3	circuits	91,837
LT#2 Condensing Circuits	4	circuits	122,449
MT#1 Condensing Circuits	10	circuits	306,122
MT#2 Condensing Circuits	12	circuits	367,347
AC Condensing Circuits	18	circuits	551,020
Total Circuits	49		1,500,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	Refrigeration Case Load (Btuh)	Application Factor (unitless)	Calculated Application Factor, Check (unitless)	Equivalent Btuh rejected for case Load (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	1.0	82,750	0.9	0.9	82,750	5.30	3.413	53,288		136,038	1.00	16
108	72	8.0	82,750	0.9	0.9	82,750	5.50	3.413	51,350		134,100	1.00	120
103	70	53.0	82,750	0.9	0.9	82,750	5.50	3.413	51,350		134,100	1.00	797
98	68	159.0	82,750	0.9	0.9	82,750	5.50	3.413	51,350		134,100	1.00	2,392
93	66	287.0	82,750	0.9	0.9	82,750	5.60	3.413	50,433		133,183	1.00	4,241
88	66	364.0	82,750	0.9	1.1	82,750	5.70	3.413	49,548		114,956	0.65	3,435
83	63	457.0	82,750	0.9	1.1	82,750	5.80	3.413	48,694		114,401	0.65	4,238
78	61	581.0	82,750	0.9	1.1	82,750	5.90	3.413	47,869		113,865	0.65	5,297
73	59	707.0	82,750	0.9	1.1	82,750	6.00	3.413	47,071		113,346	0.65	6,338
68	56	804.0	82,750	0.9	1.1	82,750	6.00	3.413	47,071		113,346	0.65	7,208
63	53	965.0	82,750	0.9	1.1	82,750	6.00	3.413	47,071		113,346	0.65	8,651
58	50	1100.0	82,750	0.9	1.1	82,750	6.00	3.413	47,071		113,346	0.65	9,861
53	47	1098.0	82,750	0.9	1.1	82,750	6.00	3.413	47,071		113,346	0.65	9,843
48	43	902.0	82,750	0.9	1.1	82,750	6.00	3.413	47,071		113,346	0.65	8,086
43	40	681.0	82,750	0.9	1.1	82,750	6.00	3.413	47,071		113,346	0.65	6,105
38	36	397.0	82,750	0.9	1.1	82,750	6.00	3.413	47,071		113,346	0.65	3,559
33	32	159.0	82,750	0.9	1.1	82,750	6.00	3.413	47,071		113,346	0.65	1,425
28	27	32.0	82,750	0.9	1.1	82,750	6.00	3.413	47,071		113,346	0.65	287

			Application
kWh=	81,899	>	81,950
kWh=	15.61	>	15.5

Condenser Capacity	1,500,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	2	circuits	61,224
LT#1 Condensing Circuits	3	circuits	91,837
LT#2 Condensing Circuits	4	circuits	122,449
MT#1 Condensing Circuits	10	circuits	306,122
MT#2 Condensing Circuits	12	circuits	367,347
AC Condensing Circuits	18	circuits	551,020
Total Circuits	49		1,500,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	Refrigeration Case Load (Btuh)	Application Factor (unitless)	Calculated Application Factor, Check (unitless)	Equivalent Btuh rejected for case Load (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	1.0	247,645	0.9	0.9	247,645	8.48	3.413	99,671		347,316	1.00	29
108	72	8.0	247,645	0.9	0.9	247,645	8.67	3.413	97,487		345,132	1.00	229
103	70	53.0	247,645	0.9	0.9	247,645	8.77	3.413	96,375		344,020	1.00	1,497
98	68	159.0	247,645	0.9	0.9	247,645	8.86	3.413	95,396		343,041	1.00	4,444
93	66	287.0	247,645	0.9	1.0	247,645	8.96	3.413	94,332		308,961	0.65	5,156
88	66	364.0	247,645	0.9	1.0	247,645	9.05	3.413	93,394		308,351	0.65	6,474
83	63	457.0	247,645	0.9	1.0	247,645	9.10	3.413	92,880		308,017	0.65	8,084
78	61	581.0	247,645	0.9	1.0	247,645	9.20	3.413	91,871		307,361	0.65	10,166
73	59	707.0	247,645	0.9	1.0	247,645	9.25	3.413	91,374		307,038	0.65	12,303
68	56	804.0	247,645	0.9	1.0	247,645	9.34	3.413	90,494		306,466	0.65	13,856
63	53	965.0	247,645	0.9	1.0	247,645	9.39	3.413	90,012		306,153	0.65	16,543
58	50	1100.0	247,645	0.9	1.0	247,645	9.44	3.413	89,535		305,843	0.65	18,757
53	47	1098.0	247,645	0.9	1.0	247,645	9.49	3.413	89,063		305,536	0.65	18,624
48	43	902.0	247,645	0.9	1.0	247,645	9.54	3.413	88,597		305,233	0.65	15,220
43	40	681.0	247,645	0.9	1.0	247,645	9.54	3.413	88,597		305,233	0.65	11,491
38	36	397.0	247,645	0.9	1.0	247,645	9.54	3.413	88,597		305,233	0.65	6,699
33	32	159.0	247,645	0.9	1.0	247,645	9.54	3.413	88,597		305,233	0.65	2,663
28	27	32.0	247,645	0.9	1.0	247,645	9.54	3.413	88,597		305,233	0.65	540

			Application
kWh=	152,793	>	152,780
kWh=	29.20	=	29.2

Condenser Capacity	1,500,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	2	circuits	61,224
LT#1 Condensing Circuits	3	circuits	91,837
LT#2 Condensing Circuits	4	circuits	122,449
MT#1 Condensing Circuits	10	circuits	306,122
MT#2 Condensing Circuits	12	circuits	367,347
AC Condensing Circuits	18	circuits	551,020
Total Circuits	49		1,500,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	Refrigeration Case Load (Btuh)	Application Factor (unitless)	Calculated Application Factor, Check (unitless)	Equivalent Btuh rejected for case Load (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	1.0	290,600	0.9	0.9	290,600	9.96	3.413	99,580		390,180	1.00	29
108	72	8.0	290,600	0.9	0.9	290,600	10.20	3.413	97,237		387,837	1.00	228
103	70	53.0	290,600	0.9	0.9	290,600	10.31	3.413	96,200		386,800	1.00	1,494
98	68	159.0	290,600	0.9	0.9	290,600	10.31	3.413	96,200		386,800	1.00	4,482
93	66	287.0	290,600	0.9	1.0	290,600	10.57	3.413	93,833		351,592	0.65	5.129
88	66	364.0	290,600	0.9	1.0	290,600	10.70	3.413	92,693		350,851	0.65	6,426
83	63	457.0	290,600	0.9	1.0	290,600	10.84	3.413	91,496		350,072	0.65	7,963
78	61	581.0	290,600	0.9	1.1	290,600	11.12	3.413	89,192		348,575	0.65	9,869
73	59	707.0	290,600	1.0	1.1	290,600	11.26	3.413	88,083		347,854	0.65	11,860
68	56	804.0	290,300	1.0	1.1	290,600	11.53	3.413	86,021		346,513	0.65	13,172
63	53	965.0	290,600	1.0	1.1	290,600	11.67	3.413	84,989		345,843	0.65	15,619
58	50	1100.0	290,600	1.0	1.1	290,600	11.81	3.413	83,981		345,188	0.65	17,593
53	47	1098.0	290,600	1.0	1.1	290,600	11.81	3.413	83,981		345,188	0.65	17,561
48	43	902.0	290,600	1.0	1.1	290,600	11.81	3.413	83,981		345,188	0.65	14,427
43	40	681.0	290,600	1.0	1.1	290,600	11.81	3.413	83,981		345,188	0.65	10,892
38	36	397.0	290,600	1.0	1.1	290,600	11.81	3.413	83,981		345,188	0.65	6,350
33	32	159.0	290,600	1.0	1.1	290,600	11.81	3.413	83,981		345,188	0.65	2,543
28	27	32.0	290,600	1.0	1.1	290,600	11.81	3.413	83,981		345,188	0.65	512

			Application
kWh=	146.149	=	146,177
kWh=	29.18	=	29.2

Condenser Capacity	1,500,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	2	circuits	61,224
LT#1 Condensing Circuits	3	circuits	91,837
LT#2 Condensing Circuits	4	circuits	122,449
MT#1 Condensing Circuits	10	circuits	306,122
MT#2 Condensing Circuits	12	circuits	367,347
AC Condensing Circuits	18	circuits	551,020
Total Circuits	49		1,500,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	AC Load (tons)	AC Load (Btuh)	Equivalent Btuh rejected for AC (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	1.0	40.00	480,000	480,000	16.37	3.413	100,076		580,076	1.00	29
108	72	8.0	40.00	480,000	480,000	16.92	3.413	96,823		576,823	1.00	227
103	70	53.0	40.63	487,560	487,560	17.20	3.413	96,747		584,307	1.00	1,502
98	68	159.0	34.38	412,560	412,560	18.93	3.413	74,383		486,943	1.00	3,465
93	66	287.0	28.13	337,560	337,560	19.29	3.413	59,725		397,285	1.00	5,022
88	66	364.0	21.88	262,560	262,560	19.29	3.413	46,455		309,015	1.00	4,954
83	63	457.0	15.63	187,560	187,560	19.29	3.413	33,185		220,745	1.00	4,443
78	61	581.0	9.38	112,560	112,560	19.29	3.413	19,915		132,475	1.00	3,390
73	59	707.0	3.13	37,560	37,560	19.29	3.413	6,646		50,851	2.00	2,753
68	56	804.0										
63	53	965.0										
58	50	1100.0										
53	47	1098.0										
48	43	902.0										
43	40	681.0										
38	36	397.0										
33	32	159.0										
28	27	32.0										

			Application
kWh=	25,788	<	24,413
kWh=	29.32	<	29

Notes

The application assumes a lower AC load in the post-measure #2 retrofit condition.

Condenser, Measure #1

Condenser Capacity	1,500,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	2	circuits	61,224
LT#1 Condensing Circuits	3	circuits	91,837
LT#2 Condensing Circuits	4	circuits	122,449
MT#1 Condensing Circuits	10	circuits	306,122
MT#2 Condensing Circuits	12	circuits	367,347
AC Condensing Circuits	18	circuits	551,020
Total Circuits	49		1,500,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	AC Heat Rejection (Btuh)	Refrigeration Heat Rejection (Btuh)	Condenser Load Factor (unitless)	Calculated Condenser Load Factor, Check (unitless)	Total Heat Rejection (Btuh)	Total Heat Rejection from the Application (MBtuh)	Total Heat Rejection from the Application (Btuh)
113	74	1.0	580,076	860,388	1.0	1.0	1,440,464	1,575	1,575,000
108	72	8.0	576,823	854,762	1.0	1.0	1,431,585	1,566	1,566,000
103	70	53.0	584,307	852,613	1.0	1.0	1,436,920	1,571	1,571,000
98	68	159.0	486,943	851,634	1.0	1.1	1,338,577	1,472	1,472,000
93	66	287.0	397,285	781,855	1.1	1.3	1,179,140	1,378	1,378,000
88	66	364.0	309,015	764,526	1.2	1.4	1,073,541	1,287	1,287,000
83	63	457.0	220,745	763,414	1.3	1.5	984,159	1,196	1,196,000
78	61	581.0	132,475	761,260	1.4	1.7	893,736	1,103	1,103,000
73	59	707.0	50,851	760,217	1.5	1.8	811,068	1,013	1,013,000
68	56	804.0	0	758,304	1.6	2.0	758,304	966	966,000
63	53	965.0	0	757,320	1.6	2.0	757,320	964	964,000
58	50	1100.0	0	756,355	1.6	2.0	756,355	963	963,000
53	47	1098.0	0	756,048	1.6	2.0	756,048	962	962,000
48	43	902.0	0	755,745	1.6	2.0	755,745	962	962,000
43	40	681.0	0	755,745	1.6	2.0	755,745	962	962,000
38	36	397.0	0	755,745	1.6	2.0	755,745	962	962,000
33	32	159.0	0	755,745	1.6	2.0	755,745	962	962,000
28	27	32.0	0	755,745	1.6	2.0	755,745	962	962,000
						Total Rejected	17,395,942	20,826	20,826,000

Heat rejection differences are significant

Condenser Capacity	2,425,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	8	circuits	195,960
LT#1 Condensing Circuits	14	circuits	342,929
LT#2 Condensing Circuits	0	circuits	0
MT#1 Condensing Circuits	35	circuits	857,323
MT#2 Condensing Circuits	24	circuits	587,879
AC Condensing Circuits	18	circuits	440,909
Total Circuits	99		2,425,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	Refrigeration Case Load (Btuh)	Application Factor (unitless)	Calculated Application Factor, Check (unitless)	Equivalent Btuh rejected for case Load (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	2.0	103,700	1.1	1.1	103,700	5.08	3.413	69,671		173,371	1.00	41
108	72	28.0	103,700	1.1	1.1	103,700	5.08	3.413	69,671		173,371	1.00	572
103	70	139.0	103,700	1.2	1.1	103,700	5.10	3.413	69,398		173,098	1.00	2,826
98	68	247.0	103,700	1.2	1.1	103,700	5.25	3.413	67,415		171,115	1.00	4,879
93	66	322.0	103,700	1.2	1.3	103,700	5.25	3.413	67,415		152,913	0.73	4,643
88	66	381.0	103,700	1.2	1.3	103,700	5.25	3.413	67,415		152,913	0.73	5,494
83	63	526.0	103,700	1.2	1.3	103,700	5.78	3.413	61,233		148,400	0.73	6,889
78	61	531.0	103,700	1.2	1.3	103,700	5.78	3.413	61,233		148,400	0.73	6,955
73	59	671.0	103,700	1.2	1.3	103,700	5.78	3.413	61,233		148,400	0.73	8,788
68	56	684.0	103,700	1.2	1.3	103,700	5.89	3.413	60,090		147,565	0.73	8,791
63	53	852.0	103,700	1.2	1.4	103,700	6.28	3.413	56,358		144,841	0.73	10,270
58	50	871.0	103,700	1.2	1.4	103,700	6.28	3.413	56,358		144,841	0.73	10,499
53	47	1042.0	103,700	1.3	1.4	103,700	6.50	3.413	54,450		143,449	0.73	12,135
48	43	854.0	103,700	1.3	1.4	103,700	7.40	3.413	47,828		138,615	0.73	8,736
43	40	754.0	103,700	1.3	1.4	103,700	7.21	3.413	49,089		139,535	0.73	7,917
38	36	489.0	103,700	1.3	1.4	103,700	7.21	3.413	49,089		139,535	0.73	5,134
33	32	259.0	103,700	1.3	1.4	103,700	7.21	3.413	49,089		139,535	0.73	2,719
28	27	87.0	103,700	1.3	1.4	103,700	7.21	3.413	49,089		139,535	0.73	913

			Application
kWh=	108,202	=	108,153
kWh=	20.41	=	20.4

Measure #2 Summary of Findings

Evaluation Compressor Savings	Pre-Retrofit Demand	Post-Retrofit Demand	Measure # Demand Savings		Pre-Retrofit Energy	Post-Retrofit Energy	Measure # Energy Savings	
Ice Cream Condensing Circuits	4.92	4.88	0.04		28,763	22,736	6,026	
LT#1 Condensing Circuits	8.92	8.92	0.00		49,768	46,070	3,698	
LT#2 Condensing Circuits	15.61	15.61	0.00		81,899	75,813	6,085	
MT#1 Condensing Circuits	29.20	29.20	0.00		152,793	148,099	4,695	
MT#2 Condensing Circuits	29.18	29.18	0.00		146,149	140,919	5,229	
AC Condensing Circuits	29.32	29.32	0.00		25,788	18,546	7,241	
Total			0.04	kW			32,975	kWh
Total Refer w/ Compressor		101.49				548,749		

Application Compressor Savings	Pre-Retrofit Demand	Post-Retrofit Demand	Measure # Demand Savings		Pre-Retrofit Energy	Post-Retrofit Energy	Measure # Energy Savings	
Ice Cream Condensing Circuits	4.90	4.90	0.00		28,272	22,736	5,536	
LT#1 Condensing Circuits	8.90	8.90	0.00		49,002	42,933	6,069	
LT#2 Condensing Circuits	15.50	15.50	0.00		81,950	77,227	4,723	
MT#1 Condensing Circuits	29.20	29.20	0.00		152,780	148,073	4,707	
MT#2 Condensing Circuits	29.20	29.20	0.00		146,177	140,914	5,263	
AC Condensing Circuits	29.00	29.00	0.00		24,413	13,472	10,941	
Total			0.00	kW			37,239	kWh

Dark Green font is an estimate because this level of detail was missing from the application.

Applicaton Condenser Analysis	Pre-Retrofit Demand	Post-Retrofit Demand	Measure # Demand Savings	Pre-Retrofit Energy	Post-Retrofit Energy	Measure # Energy Savings (kWh)	Pre-Condenser Rejection (Btuh)	Post-Condenser Rejection (Btuh)	Difference in Condenser Heat Rejection (Btuh)	Measure Energy Savings per Condenser Heat Rejection (kWh/Btuh)
Condenser Fan Use	16.00	16.00	0.00	127,026	134,501	-7,475	20,826,000	20,080,000	746,000	-0.01
							0.00669826	7.9681E-07		

Evaluation Condenser Analysis	Pre-Condenser Rejection (Btuh)	Post-Condenser Rejection (Btuh)	Difference in Condenser Heat Rejection (Btuh)	Measure Energy Savings per Condenser Heat Rejection (kWh/Btuh)	Post-Energy	Post Demand
Condenser Fan Use	17,395,942	17,185,288	210,653	-2,111	115,111	13.6934568

Final Results for Measure #2		
Source	Demand Impact	Energy Impact
Evaluation	0.04	30,865
Application	0.00	29,764

Condenser Capacity	1,764,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	5	circuits	110,250
LT#1 Condensing Circuits	7	circuits	154,350
LT#2 Condensing Circuits	2	circuits	44,100
MT#1 Condensing Circuits	4	circuits	88,200
MT#2 Condensing Circuits	30	circuits	661,500
AC Condensing Circuits	32	circuits	705,600
Total Circuits	80		1,764,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	Refrigeration Case Load (Btuh)	Application Factor (unitless)	Calculated Application Factor, Check (unitless)	Equivalent Btuh rejected for case Load (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	1.0	63,400	1.2	6.2	63,400	5.08	3.413	42,595		105,995	1.00	12
108	72	8.0	63,400	1.2	6.3	63,400	5.13	3.413	42,180		105,580	1.00	99
103	70	53.0	63,400	1.2	6.3	63,400	5.25	3.413	41,216		104,616	1.00	640
98	68	159.0	63,400	1.2	6.4	63,400	5.36	3.413	40,370		103,770	1.00	1,881
93	66	287.0	63,400	1.2	7.3	63,400	5.68	3.413	38,096		91,210	0.73	2,339
88	66	364.0	63,400	1.2	7.3	63,400	5.78	3.413	37,437		90,729	0.73	2,915
83	63	457.0	63,400	1.2	7.4	63,400	6.21	3.413	34,844		88,836	0.73	3,406
78	61	581.0	63,400	1.2	7.5	63,400	6.50	3.413	33,290		87,702	0.73	4,137
73	59	707.0	63,400	1.2	7.5	63,400	6.50	3.413	33,290		87,702	0.73	5,034
68	56	804.0	63,400	1.2	7.7	63,400	6.87	3.413	31,497		86,393	0.73	5,416
63	53	965.0	63,400	1.2	7.7	63,400	6.94	3.413	31,179		86,161	0.73	6,435
58	50	1100.0	63,400	1.2	7.7	63,400	6.94	3.413	31,179		86,161	0.73	7,336
53	47	1098.0	63,400	1.2	7.7	63,400	6.94	3.413	31,179		86,161	0.73	7,322
48	43	902.0	63,400	1.2	7.7	63,400	6.94	3.413	31,179		86,161	0.73	6,015
43	40	681.0	63,400	1.2	7.7	63,400	6.94	3.413	31,179		86,161	0.73	4,542
38	36	397.0	63,400	1.2	7.7	63,400	6.94	3.413	31,179		86,161	0.73	2,648
33	32	159.0	63,400	1.2	7.7	63,400	6.94	3.413	31,179		86,161	0.73	1,060
28	27	32.0	63,400	1.2	7.7	63,400	6.94	3.413	31,179		86,161	0.73	213

			Application
kWh=	61,450	=	61,447
kWh=	12.48	=	12.5

Condenser Capacity	1,764,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	5	circuits	110,250
LT#1 Condensing Circuits	7	circuits	154,350
LT#2 Condensing Circuits	2	circuits	44,100
MT#1 Condensing Circuits	4	circuits	88,200
MT#2 Condensing Circuits	30	circuits	661,500
AC Condensing Circuits	32	circuits	705,600
Total Circuits	80		1,764,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	Refrigeration Case Load (Btuh)	Application Factor (unitless)	Calculated Application Factor, Check (unitless)	Equivalent Btuh rejected for case Load (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	1.0	86,900	1.2	1.2	86,900	6.70	3.413	44,267	[redacted]	131,167	1.00	13
108	72	8.0	86,900	1.2	1.2	86,900	6.90	3.413	42,984	[redacted]	129,884	1.00	101
103	70	53.0	86,900	1.2	1.2	86,900	7.20	3.413	41,193	[redacted]	128,093	1.00	640
98	68	159.0	86,900	1.2	1.2	86,900	7.30	3.413	40,629	[redacted]	127,529	1.00	1,893
93	66	287.0	86,900	1.2	1.4	86,900	7.60	3.413	39,025	[redacted]	114,217	0.70	2,297
88	66	364.0	86,900	1.2	1.4	86,900	7.70	3.413	38,518	[redacted]	113,863	0.70	2,876
83	63	457.0	86,900	1.2	1.4	86,900	8.00	3.413	37,074	[redacted]	112,852	0.70	3,475
78	61	581.0	86,900	1.2	1.4	86,900	8.50	3.413	34,893	[redacted]	111,325	0.70	4,156
73	59	707.0	86,900	1.2	1.4	86,900	8.40	3.413	35,308	[redacted]	111,616	0.70	5,120
68	56	804.0	86,900	1.2	1.4	86,900	8.70	3.413	34,091	[redacted]	110,764	0.70	5,622
63	53	965.0	86,900	1.2	1.4	86,900	8.70	3.413	34,091	[redacted]	110,764	0.70	6,747
58	50	1100.0	86,900	1.2	1.4	86,900	8.70	3.413	34,091	[redacted]	110,764	0.70	7,691
53	47	1098.0	86,900	1.2	1.4	86,900	8.70	3.413	34,091	[redacted]	110,764	0.70	7,677
48	43	902.0	86,900	1.2	1.4	86,900	8.70	3.413	34,091	[redacted]	110,764	0.70	6,307
43	40	681.0	86,900	1.2	1.4	86,900	8.70	3.413	34,091	[redacted]	110,764	0.70	4,762
38	36	397.0	86,900	1.2	1.4	86,900	8.70	3.413	34,091	[redacted]	110,764	0.70	2,776
33	32	159.0	86,900	1.2	1.4	86,900	8.70	3.413	34,091	[redacted]	110,764	0.70	1,112
28	27	32.0	86,900	1.2	1.4	86,900	8.70	3.413	34,091	[redacted]	110,764	0.70	224

			Application
kWh=	63,488	>	66,143
kWh=	12.97	=	13

Condenser Capacity	1,764,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	5	circuits	110,250
LT#1 Condensing Circuits	7	circuits	154,350
LT#2 Condensing Circuits	2	circuits	44,100
MT#1 Condensing Circuits	4	circuits	88,200
MT#2 Condensing Circuits	30	circuits	661,500
AC Condensing Circuits	32	circuits	705,600
Total Circuits	80		1,764,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	Refrigeration Case Load (Btuh)	Application Factor (unitless)	Calculated Application Factor, Check (unitless)	Equivalent Btuh rejected for case Load (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	1.0	27,300	1.0	1.0	27,300	5.90	3.413	15,792	[redacted]	43,092	1.00	5
108	72	8.0	27,300	1.0	1.0	27,300	6.20	3.413	15,028	[redacted]	42,328	1.00	35
103	70	53.0	27,300	1.0	1.0	27,300	6.20	3.413	15,028	[redacted]	42,328	1.00	233
98	68	159.0	27,300	1.0	1.0	27,300	6.20	3.413	15,028	[redacted]	42,328	1.00	700
93	66	287.0	27,300	1.0	1.2	27,300	6.30	3.413	14,790	[redacted]	38,096	0.73	908
88	66	364.0	27,300	1.0	1.2	27,300	6.50	3.413	14,335	[redacted]	37,764	0.73	1,116
83	63	457.0	27,300	1.0	1.2	27,300	6.50	3.413	14,335	[redacted]	37,764	0.73	1,401
78	61	581.0	27,300	1.0	1.2	27,300	6.60	3.413	14,117	[redacted]	37,606	0.73	1,754
73	59	707.0	27,300	1.0	1.2	27,300	6.80	3.413	13,702	[redacted]	37,303	0.73	2,072
68	56	804.0	27,300	1.1	1.2	27,300	6.90	3.413	13,504	[redacted]	37,158	0.73	2,322
63	53	965.0	27,300	1.1	1.2	27,300	7.00	3.413	13,311	[redacted]	37,017	0.73	2,747
58	50	1100.0	27,300	1.1	1.2	27,300	7.20	3.413	12,941	[redacted]	36,747	0.73	3,045
53	47	1098.0	27,300	1.1	1.2	27,300	7.50	3.413	12,423	[redacted]	36,369	0.73	2,918
48	43	902.0	27,300	1.1	1.2	27,300	7.80	3.413	11,946	[redacted]	36,020	0.73	2,305
43	40	681.0	27,300	1.1	1.2	27,300	8.40	3.413	11,092	[redacted]	35,397	0.73	1,616
38	36	397.0	27,300	1.1	1.2	27,300	8.40	3.413	11,092	[redacted]	35,397	0.73	942
33	32	159.0	27,300	1.1	1.2	27,300	8.40	3.413	11,092	[redacted]	35,397	0.73	377
28	27	32.0	27,300	1.1	1.2	27,300	8.40	3.413	11,092	[redacted]	35,397	0.73	76

			Application
kWh=	24,572	<	24,563
kWh=	4.63	=	4.6

Condenser Capacity	1,764,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	5	circuits	110,250
LT#1 Condensing Circuits	7	circuits	154,350
LT#2 Condensing Circuits	2	circuits	44,100
MT#1 Condensing Circuits	4	circuits	88,200
MT#2 Condensing Circuits	30	circuits	661,500
AC Condensing Circuits	32	circuits	705,600
Total Circuits	80		1,764,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	Refrigeration Case Load (Btuh)	Application Factor (unitless)	Calculated Application Factor, Check (unitless)	Equivalent Btuh rejected for case Load (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	1.0	97,600	1.2	0.7	97,600	9.39	3.413	35,475		133,075	1.00	10
108	72	8.0	97,600	1.2	0.7	97,600	9.54	3.413	34,917		132,517	1.00	82
103	70	53.0	97,600	1.2	0.7	97,600	9.92	3.413	33,580		131,180	1.00	521
98	68	159.0	97,600	1.2	0.7	97,600	10.11	3.413	32,948		130,548	1.00	1,535
93	66	287.0	97,600	1.2	0.7	97,600	10.88	3.413	30,617		119,950	0.73	1,879
88	66	364.0	97,600	1.2	0.7	97,600	11.07	3.413	30,091		119,567	0.73	2,343
83	63	457.0	97,600	1.2	0.7	97,600	11.76	3.413	28,326		118,278	0.73	2,769
78	61	581.0	97,600	1.2	0.8	97,600	12.38	3.413	26,907		117,242	0.73	3,344
73	59	707.0	97,600	1.2	0.8	97,600	12.23	3.413	27,237		117,483	0.73	4,119
68	56	804.0	97,600	1.2	0.8	97,600	13.00	3.413	25,624		116,305	0.73	4,406
63	53	965.0	97,600	1.2	0.8	97,600	13.00	3.413	25,624		116,305	0.73	5,289
58	50	1100.0	97,600	1.2	0.8	97,600	13.00	3.413	25,624		116,305	0.73	6,029
53	47	1098.0	97,600	1.2	0.8	97,600	13.00	3.413	25,624		116,305	0.73	6,018
48	43	902.0	97,600	1.2	0.8	97,600	13.00	3.413	25,624		116,305	0.73	4,944
43	40	681.0	97,600	1.2	0.8	97,600	13.00	3.413	25,624		116,305	0.73	3,732
38	36	397.0	97,600	1.2	0.8	97,600	13.00	3.413	25,624		116,305	0.73	2,176
33	32	159.0	97,600	1.2	0.8	97,600	13.00	3.413	25,624		116,305	0.73	871
28	27	32.0	97,600	1.2	0.8	97,600	13.00	3.413	25,624		116,305	0.73	175

			Application
kWh=	50,242	>	26,984
kWh=	10.39	>	5.6

Condenser Capacity	1,764,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	5	circuits	110,250
LT#1 Condensing Circuits	7	circuits	154,350
LT#2 Condensing Circuits	2	circuits	44,100
MT#1 Condensing Circuits	4	circuits	88,200
MT#2 Condensing Circuits	30	circuits	661,500
AC Condensing Circuits	32	circuits	705,600
Total Circuits	80		1,764,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	Refrigeration Case Load (Btuh)	Application Factor (unitless)	Calculated Application Factor, Check (unitless)	Equivalent Btuh rejected for case Load (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	1.0	454,700	1.3	1.1	454,700	10.89	3.413	142,506		597,206	1.00	42
108	72	8.0	454,700	1.3	1.1	454,700	11.33	3.413	136,972		591,672	1.00	321
103	70	53.0	454,700	1.3	1.1	454,700	11.62	3.413	133,553		588,253	1.00	2,074
98	68	159.0	454,700	1.3	1.1	454,700	11.91	3.413	130,302		585,002	1.00	6,070
93	66	287.0	454,700	1.3	1.2	454,700	12.34	3.413	125,761		546,506	0.73	7,720
88	66	364.0	454,700	1.3	1.2	454,700	12.52	3.413	123,953		545,186	0.73	9,650
83	63	457.0	454,700	1.3	1.2	454,700	13.22	3.413	117,390		540,394	0.73	11,474
78	61	581.0	454,700	1.3	1.2	454,700	14.09	3.413	110,141		535,103	0.73	13,667
73	59	707.0	454,700	1.3	1.2	454,700	14.09	3.413	110,141		535,103	0.73	16,655
68	56	804.0	454,700	1.3	1.2	454,700	14.09	3.413	110,141		535,103	0.73	18,941
63	53	965.0	454,700	1.3	1.2	454,700	14.09	3.413	110,141		535,103	0.73	22,733
58	50	1100.0	454,700	1.3	1.2	454,700	14.09	3.413	110,141		535,103	0.73	25,914
53	47	1098.0	454,700	1.3	1.2	454,700	14.09	3.413	110,141		535,103	0.73	25,867
48	43	902.0	454,700	1.3	1.2	454,700	14.09	3.413	110,141		535,103	0.73	21,249
43	40	681.0	454,700	1.3	1.2	454,700	14.09	3.413	110,141		535,103	0.73	16,043
38	36	397.0	454,700	1.3	1.2	454,700	14.09	3.413	110,141		535,103	0.73	9,352
33	32	159.0	454,700	1.3	1.2	454,700	14.09	3.413	110,141		535,103	0.73	3,746
28	27	32.0	454,700	1.3	1.2	454,700	14.09	3.413	110,141		535,103	0.73	754

			Application
kWh=	212,293	=	212,476
kWh=	41.75	=	41.8

Condenser Capacity	1,764,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	5	circuits	110,250
LT#1 Condensing Circuits	7	circuits	154,350
LT#2 Condensing Circuits	2	circuits	44,100
MT#1 Condensing Circuits	4	circuits	88,200
MT#2 Condensing Circuits	30	circuits	661,500
AC Condensing Circuits	32	circuits	705,600
Total Circuits	80		1,764,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	AC Load (tons)	AC Load (Btuh)	Equivalent Btuh rejected for AC (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	1.0	40.00	480,000	480,000	18.33	3.413	89,375		569,375	1.00	26
108	72	8.0	40.00	480,000	480,000	19.27	3.413	85,015		565,015	1.00	199
103	70	53.0	40.63	487,560	487,560	21.03	3.413	79,127		566,687	1.00	1,229
98	68	159.0	34.38	412,560	412,560	23.66	3.413	59,513		472,073	1.00	2,772
93	66	287.0	23.13	277,560	277,560	27.46	3.413	34,498		312,058	1.00	2,901
88	66	364.0	21.88	262,560	262,560	35.06	3.413	25,560		288,120	1.00	2,726
83	63	457.0	15.63	187,560	187,560	40.12	3.413	15,956		203,516	1.00	2,136
78	61	581.0	9.38	112,560	112,560	40.12	3.413	9,575		122,135	1.00	1,630
73	59	707.0	3.13	37,560	37,560	23.66	3.413	5,418		42,978	1.00	1,122
68	56	804.0										
63	53	965.0										
58	50	1100.0										
53	47	1098.0										
48	43	902.0										
43	40	681.0										
38	36	397.0										
33	32	159.0										
28	27	32.0										

			Application
kWh=	14,742	=	13,055
kWh=	26.19	=	25

Condenser, Measure #2

Condenser Capacity	1,764,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	5	circuits	110,250
LT#1 Condensing Circuits	7	circuits	154,350
LT#2 Condensing Circuits	2	circuits	44,100
MT#1 Condensing Circuits	4	circuits	88,200
MT#2 Condensing Circuits	30	circuits	661,500
AC Condensing Circuits	32	circuits	705,600
Total Circuits	80		1,764,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	AC Heat Rejection (Btuh)	Refrigeration Heat Rejection (Btuh)	Condenser Load Factor (unitless)	Calculated Condenser Load Factor, Check (unitless)	Total Heat Rejection (Btuh)	Total Heat Rejection from the Application (MBtuh)	Total Heat Rejection from the Application (Btuh)
113	74	1.0	569,375	967,443	1.1	1.1	1,536,818	1,574	1,574,000
108	72	8.0	565,015	959,653	1.1	1.2	1,524,668	1,565	1,565,000
103	70	53.0	566,687	952,142	1.2	1.2	1,518,829	1,484	1,484,000
98	68	159.0	472,073	946,849	1.3	1.2	1,418,921	1,404	1,404,000
93	66	287.0	312,058	871,883	1.3	1.5	1,183,941	1,325	1,325,000
88	66	364.0	288,120	869,344	1.4	1.5	1,157,463	1,247	1,247,000
83	63	457.0	203,516	860,360	1.5	1.7	1,063,876	1,175	1,175,000
78	61	581.0	122,135	851,372	1.6	1.8	973,507	1,106	1,106,000
73	59	707.0	42,978	851,904	1.7	2.0	894,882	1,039	1,039,000
68	56	804.0	0	848,565	1.8	2.1	848,565	1,002	1,002,000
63	53	965.0	0	848,333	1.8	2.1	848,333	1,002	1,002,000
58	50	1100.0	0	848,333	1.8	2.1	848,333	1,001	1,001,000
53	47	1098.0	0	848,333	1.8	2.1	848,333	1,000	1,000,000
48	43	902.0	0	848,333	1.8	2.1	848,333	1,000	1,000,000
43	40	681.0	0	848,333	1.8	2.1	848,333	1,000	1,000,000
38	36	397.0	0	848,333	1.8	2.1	848,333	1,000	1,000,000
33	32	159.0	0	848,333	1.8	2.1	848,333	1,000	1,000,000
28	27	32.0	0	848,333	1.8	2.1	848,333	1,000	1,000,000
						Total Rejected	18,908,134	20,924	20,924,000

Condenser Capacity	1,764,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	5	circuits	110,250
LT#1 Condensing Circuits	7	circuits	154,350
LT#2 Condensing Circuits	2	circuits	44,100
MT#1 Condensing Circuits	4	circuits	88,200
MT#2 Condensing Circuits	30	circuits	661,500
AC Condensing Circuits	32	circuits	705,600
Total Circuits	80		1,764,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	Refrigeration Case Load (Btuh)	Application Factor (unitless)	Calculated Application Factor, Check (unitless)	Equivalent Btuh rejected for case Load (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	1.0	63,400	1.0	1.0	63,400	4.70	3.413	46,039	[redacted]	109,439	1.00	13
108	72	8.0	63,400	1.0	1.0	63,400	4.70	3.413	46,039	[redacted]	109,439	1.00	108
103	70	53.0	63,400	1.0	1.0	63,400	4.70	3.413	46,039	[redacted]	109,439	1.00	715
98	68	159.0	63,400	1.0	1.0	63,400	4.70	3.413	46,039	[redacted]	109,439	1.00	2,145
93	66	287.0	63,400	1.0	1.1	63,400	4.70	3.413	46,039	[redacted]	97,009	0.73	2,826
88	66	364.0	63,400	1.0	1.1	63,400	4.70	3.413	46,039	[redacted]	97,009	0.73	3,584
83	63	457.0	63,400	1.0	1.1	63,400	4.70	3.413	46,039	[redacted]	97,009	0.73	4,500
78	61	581.0	63,400	1.0	1.1	63,400	4.70	3.413	46,039	[redacted]	97,009	0.73	5,721
73	59	707.0	63,400	1.0	1.1	63,400	4.70	3.413	46,039	[redacted]	97,009	0.73	6,962
68	56	804.0	63,400	1.0	1.1	63,400	4.70	3.413	46,039	[redacted]	97,009	0.73	7,917
63	53	965.0	63,400	1.0	1.1	63,400	4.70	3.413	46,039	[redacted]	97,009	0.73	9,503
58	50	1100.0	63,400	1.0	1.1	63,400	4.70	3.413	46,039	[redacted]	97,009	0.73	10,832
53	47	1098.0	63,400	1.0	1.1	63,400	4.70	3.413	46,039	[redacted]	97,009	0.73	10,812
48	43	902.0	63,400	1.0	1.1	63,400	4.70	3.413	46,039	[redacted]	97,009	0.73	8,882
43	40	681.0	63,400	1.0	1.1	63,400	4.70	3.413	46,039	[redacted]	97,009	0.73	6,706
38	36	397.0	63,400	1.0	1.1	63,400	4.70	3.413	46,039	[redacted]	97,009	0.73	3,909
33	32	159.0	63,400	1.0	1.1	63,400	4.70	3.413	46,039	[redacted]	97,009	0.73	1,566
28	27	32.0	63,400	1.0	1.1	63,400	4.70	3.413	46,039	[redacted]	97,009	0.73	315

			Application
kWh=	87,017	≈	87,103
kWh=	13.49	≈	13.5

Condenser Capacity	1,764,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	5	circuits	110,250
LT#1 Condensing Circuits	7	circuits	154,350
LT#2 Condensing Circuits	2	circuits	44,100
MT#1 Condensing Circuits	4	circuits	88,200
MT#2 Condensing Circuits	30	circuits	661,500
AC Condensing Circuits	32	circuits	705,600
Total Circuits	80		1,764,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	Refrigeration Case Load (Btuh)	Application Factor (unitless)	Calculated Application Factor, Check (unitless)	Equivalent Btuh rejected for case Load (Btuh)	Estimated Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	1.0	86,900	1.1	1.1	86,900	5.70	3.413	52,033		138,933	1.00	15
108	72	8.0	86,900	1.1	1.1	86,900	5.70	3.413	52,033		138,933	1.00	122
103	70	53.0	86,900	1.1	1.1	86,900	5.70	3.413	52,033		138,933	1.00	808
98	68	159.0	86,900	1.1	1.1	86,900	5.70	3.413	52,033		138,933	1.00	2,424
93	66	287.0	86,900	1.1	1.3	86,900	5.70	3.413	52,033		123,323	0.70	3,063
88	66	364.0	86,900	1.1	1.3	86,900	5.70	3.413	52,033		123,323	0.70	3,885
83	63	457.0	86,900	1.1	1.3	86,900	5.70	3.413	52,033		123,323	0.70	4,877
78	61	581.0	86,900	1.1	1.3	86,900	5.70	3.413	52,033		123,323	0.70	6,200
73	59	707.0	86,900	1.1	1.3	86,900	5.70	3.413	52,033		123,323	0.70	7,545
68	56	804.0	86,900	1.1	1.3	86,900	5.70	3.413	52,033		123,323	0.70	8,580
63	53	965.0	86,900	1.1	1.3	86,900	5.70	3.413	52,033		123,323	0.70	10,298
58	50	1100.0	86,900	1.1	1.3	86,900	5.70	3.413	52,033		123,323	0.70	11,739
53	47	1098.0	86,900	1.1	1.3	86,900	5.70	3.413	52,033		123,323	0.70	11,718
48	43	902.0	86,900	1.1	1.3	86,900	5.70	3.413	52,033		123,323	0.70	9,626
43	40	681.0	86,900	1.1	1.3	86,900	5.70	3.413	52,033		123,323	0.70	7,268
38	36	397.0	86,900	1.1	1.3	86,900	5.70	3.413	52,033		123,323	0.70	4,237
33	32	159.0	86,900	1.1	1.3	86,900	5.70	3.413	52,033		123,323	0.70	1,697
28	27	32.0	86,900	1.1	1.3	86,900	5.70	3.413	52,033		123,323	0.70	342

			Application
kWh=	94,444	<	97,665
kWh=	15.25	=	15.1

Condenser Capacity	1,764,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	5	circuits	110,250
LT#1 Condensing Circuits	7	circuits	154,350
LT#2 Condensing Circuits	2	circuits	44,100
MT#1 Condensing Circuits	4	circuits	88,200
MT#2 Condensing Circuits	30	circuits	661,500
AC Condensing Circuits	32	circuits	705,600
Total Circuits	80		1,764,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	Refrigeration Case Load (Btuh)	Application Factor (unitless)	Calculated Application Factor, Check (unitless)	Equivalent Btuh rejected for case Load (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	1.0	27,300	1.0	1.0	27,300	5.90	3.413	15,792		43,092	1.00	5
108	72	8.0	27,300	1.0	1.0	27,300	6.10	3.413	15,275		42,575	1.00	36
103	70	53.0	27,300	1.0	1.0	27,300	6.20	3.413	15,028		42,328	1.00	233
98	68	159.0	27,300	1.0	1.0	27,300	6.20	3.413	15,028		42,328	1.00	700
93	66	287.0	27,300	1.0	1.2	27,300	6.30	3.413	14,790		38,096	0.73	908
88	66	364.0	27,300	1.0	1.2	27,300	6.50	3.413	14,335		37,764	0.73	1,116
83	63	457.0	27,300	1.0	1.2	27,300	6.50	3.413	14,335		37,764	0.73	1,401
78	61	581.0	27,300	1.0	1.2	27,300	6.50	3.413	14,335		37,764	0.73	1,781
73	59	707.0	27,300	1.0	1.2	27,300	6.50	3.413	14,335		37,764	0.73	2,168
68	56	804.0	27,300	1.0	1.2	27,300	6.50	3.413	14,335		37,764	0.73	2,465
63	53	965.0	27,300	1.0	1.2	27,300	6.50	3.413	14,335		37,764	0.73	2,959
58	50	1100.0	27,300	1.0	1.2	27,300	6.50	3.413	14,335		37,764	0.73	3,373
53	47	1098.0	27,300	1.0	1.2	27,300	6.50	3.413	14,335		37,764	0.73	3,366
48	43	902.0	27,300	1.0	1.2	27,300	6.50	3.413	14,335		37,764	0.73	2,766
43	40	681.0	27,300	1.0	1.2	27,300	6.50	3.413	14,335		37,764	0.73	2,088
38	36	397.0	27,300	1.0	1.2	27,300	6.50	3.413	14,335		37,764	0.73	1,217
33	32	159.0	27,300	1.0	1.2	27,300	6.50	3.413	14,335		37,764	0.73	487
28	27	32.0	27,300	1.0	1.2	27,300	6.50	3.413	14,335		37,764	0.73	98

			Application
kWh=	27,167	=	27,296
kWh=	4.63	=	4.6

Condenser Capacity	1,764,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	5	circuits	110,250
LT#1 Condensing Circuits	7	circuits	154,350
LT#2 Condensing Circuits	2	circuits	44,100
MT#1 Condensing Circuits	4	circuits	88,200
MT#2 Condensing Circuits	30	circuits	661,500
AC Condensing Circuits	32	circuits	705,600
Total Circuits	80		1,764,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	Refrigeration Case Load (Btuh)	Application Factor (unitless)	Calculated Application Factor, Check (unitless)	Equivalent Btuh rejected for case Load (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	1.0	97,600	1.0	0.6	97,600	8.58	3.413	38,824		136,424	1.00	11
108	72	8.0	97,600	1.0	0.6	97,600	8.58	3.413	38,824		136,424	1.00	91
103	70	53.0	97,600	1.0	0.6	97,600	8.58	3.413	38,824		136,424	1.00	603
98	68	159.0	97,600	1.0	0.6	97,600	8.58	3.413	38,824		136,424	1.00	1,809
93	66	287.0	97,600	1.0	0.7	97,600	8.58	3.413	38,824		125,941	0.73	2.383
88	66	364.0	97,600	1.0	0.7	97,600	8.58	3.413	38,824		125,941	0.73	3,023
83	63	457.0	97,600	1.0	0.7	97,600	8.58	3.413	38,824		125,941	0.73	3,795
78	61	581.0	97,600	1.0	0.7	97,600	8.58	3.413	38,824		125,941	0.73	4,825
73	59	707.0	97,600	1.0	0.7	97,600	8.58	3.413	38,824		125,941	0.73	5,871
68	56	804.0	97,600	1.0	0.7	97,600	8.58	3.413	38,824		125,941	0.73	6.676
63	53	965.0	97,600	1.0	0.7	97,600	8.58	3.413	38,824		125,941	0.73	8,013
58	50	1100.0	97,600	1.0	0.7	97,600	8.58	3.413	38,824		125,941	0.73	9,134
53	47	1098.0	97,600	1.0	0.7	97,600	8.58	3.413	38,824		125,941	0.73	9,118
48	43	902.0	97,600	1.0	0.7	97,600	8.58	3.413	38,824		125,941	0.73	7,490
43	40	681.0	97,600	1.0	0.7	97,600	8.58	3.413	38,824		125,941	0.73	5.655
38	36	397.0	97,600	1.0	0.7	97,600	8.58	3.413	38,824		125,941	0.73	3,297
33	32	159.0	97,600	1.0	0.7	97,600	8.58	3.413	38,824		125,941	0.73	1,320
28	27	32.0	97,600	1.0	0.7	97,600	8.58	3.413	38,824		125,941	0.73	266

			Application
kWh=	73,380	>	39,422
kWh=	11.38	>	6.1

Condenser Capacity	1,764,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	5	circuits	110,250
LT#1 Condensing Circuits	7	circuits	154,350
LT#2 Condensing Circuits	2	circuits	44,100
MT#1 Condensing Circuits	4	circuits	88,200
MT#2 Condensing Circuits	30	circuits	661,500
AC Condensing Circuits	32	circuits	705,600
Total Circuits	80		1,764,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	Refrigeration Case Load (Btuh)	Application Factor (unitless)	Calculated Application Factor, Check (unitless)	Equivalent Btuh rejected for case Load (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	1.0	454,700	1.0	1.1	454,700	9.15	3.413	169,606	[redacted]	624,306	1.00	50
108	72	8.0	454,700	1.0	1.1	454,700	9.15	3.413	169,606	[redacted]	624,306	1.00	398
103	70	53.0	454,700	1.0	1.1	454,700	9.15	3.413	169,606	[redacted]	624,306	1.00	2,634
98	68	159.0	454,700	1.0	1.1	454,700	9.15	3.413	169,606	[redacted]	624,306	1.00	7,901
93	66	287.0	454,700	1.0	1.1	454,700	9.15	3.413	169,606	[redacted]	578,512	0.73	10,411
88	66	364.0	454,700	1.0	1.1	454,700	9.15	3.413	169,606	[redacted]	578,512	0.73	13,205
83	63	457.0	454,700	1.0	1.1	454,700	9.15	3.413	169,606	[redacted]	578,512	0.73	16,578
78	61	581.0	454,700	1.0	1.1	454,700	9.15	3.413	169,606	[redacted]	578,512	0.73	21,077
73	59	707.0	454,700	1.0	1.1	454,700	9.15	3.413	169,606	[redacted]	578,512	0.73	25,648
68	56	804.0	454,700	1.0	1.1	454,700	9.15	3.413	169,606	[redacted]	578,512	0.73	29,166
63	53	965.0	454,700	1.0	1.1	454,700	9.15	3.413	169,606	[redacted]	578,512	0.73	35,007
58	50	1100.0	454,700	1.0	1.1	454,700	9.15	3.413	169,606	[redacted]	578,512	0.73	39,904
53	47	1098.0	454,700	1.0	1.1	454,700	9.15	3.413	169,606	[redacted]	578,512	0.73	39,832
48	43	902.0	454,700	1.0	1.1	454,700	9.15	3.413	169,606	[redacted]	578,512	0.73	32,722
43	40	681.0	454,700	1.0	1.1	454,700	9.15	3.413	169,606	[redacted]	578,512	0.73	24,704
38	36	397.0	454,700	1.0	1.1	454,700	9.15	3.413	169,606	[redacted]	578,512	0.73	14,402
33	32	159.0	454,700	1.0	1.1	454,700	9.15	3.413	169,606	[redacted]	578,512	0.73	5,768
28	27	32.0	454,700	1.0	1.1	454,700	9.15	3.413	169,606	[redacted]	578,512	0.73	1,161

				Application
kWh=	320,567	=		320,451
kWh=	49.69	=		49.7

AC, Measure #1

Condenser Capacity	1,764,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	5	circuits	110,250
LT#1 Condensing Circuits	7	circuits	154,350
LT#2 Condensing Circuits	2	circuits	44,100
MT#1 Condensing Circuits	4	circuits	88,200
MT#2 Condensing Circuits	30	circuits	661,500
AC Condensing Circuits	32	circuits	705,600
Total Circuits	80		1,764,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	AC Load (tons)	AC Load (Btuh)	Equivalent Btuh rejected for AC (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	1.0	40.00	480,000	480,000	21.47	3.413	76,304		556,304	1.00	22
108	72	8.0	40.00	480,000	480,000	21.47	3.413	76,304		556,304	1.00	179
103	70	53.0	40.63	487,560	487,560	21.47	3.413	77,505		565,065	1.00	1,204
98	68	159.0	34.38	412,560	412,560	21.47	3.413	65,583		478,143	1.00	3,055
93	66	287.0	23.13	277,560	277,560	21.47	3.413	44,123		321,683	1.00	3,710
88	66	364.0	21.88	262,560	262,560	21.47	3.413	41,738		304,298	1.00	4,451
83	63	457.0	15.63	187,560	187,560	21.47	3.413	29,816		217,376	1.00	3,992
78	61	581.0	9.38	112,560	112,560	21.47	3.413	17,893		130,453	1.00	3,046
73	59	707.0	3.13	37,560	37,560	21.47	3.413	5,971		43,531	1.00	1,237
68	56	804.0										
63	53	965.0										
58	50	1100.0										
53	47	1098.0										
48	43	902.0										
43	40	681.0										
38	36	397.0										
33	32	159.0										
28	27	32.0										

			Application
kWh=	20,897	<	21,697
kWh=	22.36	<	23

Notes

The application assumes a lower AC load in the post-measure #2 retrofit condition.

Condenser, Measure #1

Condenser Capacity	1,764,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	5	circuits	110,250
LT#1 Condensing Circuits	7	circuits	154,350
LT#2 Condensing Circuits	2	circuits	44,100
MT#1 Condensing Circuits	4	circuits	88,200
MT#2 Condensing Circuits	30	circuits	661,500
AC Condensing Circuits	32	circuits	705,600
Total Circuits	80		1,764,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	AC Heat Rejection (Btuh)	Refrigeration Heat Rejection (Btuh)	Condenser Load Factor (unitless)	Calculated Condenser Load Factor, Check (unitless)	Total Heat Rejection (Btuh)	Total Heat Rejection from the Application (MBtuh)	Total Heat Rejection from the Application (Btuh)	
113	74	1.0	556,304	1,009,102	1.1	1.1	1,565,406	1,561	1,561,000	
108	72	8.0	556,304	1,009,102	1.1	1.1	1,565,406	1,560	1,560,000	
103	70	53.0	565,065	1,009,102	1.1	1.1	1,574,167	1,569	1,569,000	
98	68	159.0	478,143	1,009,102	1.2	1.2	1,487,245	1,482	1,482,000	
93	66	287.0	321,683	924,785	1.3	1.4	1,246,468	1,395	1,395,000	
88	66	364.0	304,298	924,785	1.4	1.4	1,229,084	1,307	1,307,000	
83	63	457.0	217,376	924,785	1.6	1.5	1,142,161	1,220	1,220,000	
78	61	581.0	130,453	924,785	1.7	1.7	1,055,239	1,133	1,133,000	
73	59	707.0	43,531	924,785	1.8	1.8	968,316	1,046	1,046,000	
68	56	804.0	0	924,785	1.8	1.9	924,785	1,003	1,003,000	
63	53	965.0	0	924,785	1.8	1.9	924,785	1,003	1,003,000	
58	50	1100.0	0	924,785	1.8	1.9	924,785	1,003	1,003,000	
53	47	1098.0	0	924,785	1.8	1.9	924,785	1,003	1,003,000	
48	43	902.0	0	924,785	1.8	1.9	924,785	1,003	1,003,000	
43	40	681.0	0	924,785	1.8	1.9	924,785	1,003	1,003,000	
38	36	397.0	0	924,785	1.8	1.9	924,785	1,003	1,003,000	
33	32	159.0	0	924,785	1.8	1.9	924,785	1,003	1,003,000	
28	27	32.0	0	924,785	1.8	1.9	924,785	1,003	1,003,000	
						Total Rejected	20,156,560	21,300	21,300,000	Heat rejection differences are significant

Measure #2 Summary of Findings

Evaluation Compressor Savings	Pre-Retrofit Demand	Post-Retrofit Demand	Measure # Demand Savings	Pre-Retrofit Energy	Post-Retrofit Energy	Measure # Energy Savings	
Ice Cream Condensing Circuits	13.49	12.48	1.01	87,017	61,450	25,567	
LT#1 Condensing Circuits	15.25	12.97	2.28	94,444	63,488	30,955	
LT#2 Condensing Circuits	4.63	4.63	0.00	27,167	24,572	2,595	
MT#1 Condensing Circuits	11.38	10.39	0.98	73,380	50,242	23,138	
MT#2 Condensing Circuits	49.69	41.75	7.94	320,567	212,293	108,274	
AC Condensing Circuits	22.36	26.19	-3.83	20,897	14,742	6,154	
Total			8.38	kW		196,684	kWh
Total Refer w/ Compressor		89.45			466,761		

Application Compressor Savings	Pre-Retrofit Demand	Post-Retrofit Demand	Measure # Demand Savings	Pre-Retrofit Energy	Post-Retrofit Energy	Measure # Energy Savings	
Ice Cream Condensing Circuits	13.50	12.50	1.00	87,103	61,447	25,656	
LT#1 Condensing Circuits	15.10	13.00	2.10	97,665	66,143	31,522	
LT#2 Condensing Circuits	4.60	4.60	0.00	27,296	24,563	2,733	
MT#1 Condensing Circuits	6.10	5.60	0.50	39,422	26,984	12,438	
MT#2 Condensing Circuits	49.70	41.80	7.90	320,451	212,476	107,975	
AC Condensing Circuits	23.00	25.00	-2.00	21,697	13,055	8,642	
Total			9.50	kW		188,966	kWh

Dark Green font is an estimate because this level of detail was missing from the application.

Applicaton Condenser Analysis	Pre-Retrofit Demand	Post-Retrofit Demand	Measure # Demand Savings	Pre-Retrofit Energy	Post-Retrofit Energy	Measure # Energy Savings (kWh)	Pre-Condenser Rejection (Btuh)	Post-Condenser Rejection (Btuh)	Difference in Condenser Heat Rejection (Btuh)	Measure Energy Savings per Condenser Heat Rejection (kWh/Btuh)
Condenser Fan Use	8.00	8.00	0.00	19,099	60,549	-41,450	21,300,000	20,924,000	376,000	-0.11
							0.00289376	3.8234E-07		

Evaluation Condenser Analysis	Pre-Condenser Rejection (Btuh)	Post-Condenser Rejection (Btuh)	Difference in Condenser Heat Rejection (Btuh)	Measure Energy Savings per Condenser Heat Rejection (kWh/Btuh)	Post-Energy	Post Demand
Condenser Fan Use	20,156,560	18,908,134	1,248,425	-137,626	54,716	7.22926175

Final Results for Measure #2

Source	Demand Impact	Energy Impact
Evaluation	8.38	59,058
Application	9.50	147,516

Condenser Capacity	2,552,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	3	circuits	147,231
LT#1 Condensing Circuits	5	circuits	245,385
LT#2 Condensing Circuits	6	circuits	294,462
MT#1 Condensing Circuits	16	circuits	785,231
MT#2 Condensing Circuits	15	circuits	736,154
AC Condensing Circuits	7	circuits	343,538
Total Circuits	52		2,552,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	Refrigeration Case Load (Btuh)	Application Factor (unitless)	Calculated Application Factor, Check (unitless)	Equivalent Btuh rejected for case Load (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	0.0	0	-	0.0	0	0.00	3.413	0		0	0.00	0
108	72	5.0	23,704	-	3.4	23,704	4.10	3.413	19,732		43,436	1.00	29
103	70	16.0	23,704	-	3.5	23,704	4.40	3.413	18,387		42,091	1.00	86
98	68	60.0	23,704	-	3.6	23,704	4.70	3.413	17,213		40,917	1.00	303
93	66	126.0	23,704	-	4.1	23,704	5.00	3.413	16,180		35,516	0.73	436
88	66	197.0	23,704	-	4.2	23,704	5.10	3.413	15,863		35,284	0.73	668
83	63	295.0	23,704	-	4.2	23,704	5.10	3.413	15,863		35,284	0.73	1,001
78	61	430.0	23,704	-	4.3	23,704	5.70	3.413	14,193		34,065	0.73	1,305
73	59	563.0	23,704	-	4.5	23,704	6.30	3.413	12,842		33,078	0.73	1,546
68	56	773.0	23,704	-	4.5	23,704	6.60	3.413	12,268		32,652	0.73	2,027
63	53	1177.0	23,704	-	4.6	23,704	6.90	3.413	11,725		32,263	0.73	2,952
58	50	1593.0	23,704	-	4.6	23,704	6.90	3.413	11,725		32,263	0.73	3,995
53	47	1407.0	23,704	-	4.6	23,704	6.90	3.413	11,725		32,263	0.73	3,528
48	43	987.0	23,704	-	4.6	23,704	6.90	3.413	11,725		32,263	0.73	2,475
43	40	676.0	23,704	-	4.6	23,704	6.90	3.413	11,725		32,263	0.73	1,695
38	36	313.0	23,704	-	4.6	23,704	6.90	3.413	11,725		32,263	0.73	785
33	32	108.0	23,704	-	4.6	23,704	6.90	3.413	11,725		32,263	0.73	271
28	27	23.0	23,704	-	4.6	23,704	6.90	3.413	11,725		32,263	0.73	58

			Application
kWh=	23,161	≈	23,063
kWh=	5.78	≈	6

Condenser Capacity	2,552,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	3	circuits	147,231
LT#1 Condensing Circuits	5	circuits	245,385
LT#2 Condensing Circuits	6	circuits	294,462
MT#1 Condensing Circuits	16	circuits	785,231
MT#2 Condensing Circuits	15	circuits	736,154
AC Condensing Circuits	7	circuits	343,538
Total Circuits	52		2,552,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	Refrigeration Case Load (Btuh)	Application Factor (unitless)	Calculated Application Factor, Check (unitless)	Equivalent Btuh rejected for case Load (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	0.0	0	-	0.0	0	0.00	0	0	[redacted]	0	0.00	0
108	72	5.0	43,850	-	3.3	43,850	4.76	3.413	31,441	[redacted]	75,291	1.00	46
103	70	16.0	43,850	-	3.3	43,850	5.05	3.413	29,636	[redacted]	73,486	1.00	139
98	68	60.0	43,850	-	3.4	43,850	5.35	3.413	27,974	[redacted]	71.824	1.00	492
93	66	126.0	43,850	-	3.9	43,850	5.64	3.413	26.535	[redacted]	63,221	0.73	715
88	66	197.0	43,850	-	4.0	43,850	6.06	3.413	24,696	[redacted]	61,878	0.73	1,041
83	63	295.0	43,850	-	4.0	43,850	6.42	3.413	23,312	[redacted]	60,867	0.73	1,471
78	61	430.0	43,850	-	4.1	43,850	6.82	3.413	21,844	[redacted]	59,869	0.73	2,018
73	59	563.0	43,850	-	4.2	43.850	7.22	3.413	20,729	[redacted]	58,982	0.73	2.496
68	56	773.0	43,850	-	4.2	43,850	7.67	3.413	19,512	[redacted]	58,094	0.73	3,226
63	53	1177.0	43,850	-	4.3	43,850	8.12	3.413	18,431	[redacted]	57,305	0.73	4,640
58	50	1593.0	43,850	-	4.3	43,850	8.12	3.413	18,431	[redacted]	57,305	0.73	6,280
53	47	1407.0	43,850	-	4.3	43,850	8.12	3.413	18.431	[redacted]	57,305	0.73	5,547
48	43	987.0	43,850	-	4.3	43,850	8.12	3.413	18,431	[redacted]	57,305	0.73	3,891
43	40	676.0	43,850	-	4.3	43,850	8.12	3.413	18,431	[redacted]	57,305	0.73	2,665
38	36	313.0	43,850	-	4.3	43,850	8.12	3.413	18,431	[redacted]	57,305	0.73	1,234
33	32	108.0	43,850	-	4.3	43,850	8.12	3.413	18,431	[redacted]	57,305	0.73	426
28	27	23.0	43,850	-	4.3	43,850	8.12	3.413	18,431	[redacted]	57.305	0.73	91

			Application
kWh=	36,417	=	36,676
kWh=	9.21	=	9

Condenser Capacity	2,552,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	3	circuits	147,231
LT#1 Condensing Circuits	5	circuits	245,385
LT#2 Condensing Circuits	6	circuits	294,462
MT#1 Condensing Circuits	16	circuits	785,231
MT#2 Condensing Circuits	15	circuits	736,154
AC Condensing Circuits	7	circuits	343,538
Total Circuits	52		2,552,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	Refrigeration Case Load (Btuh)	Application Factor (unitless)	Calculated Application Factor, Check (unitless)	Equivalent Btuh rejected for case Load (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	0.0	0	-	0.0	0	0.00	0	0		0	0.00	0
108	72	5.0	91,200	-	2.0	91,200	5.88	3.413	52,936		144,136	1.00	78
103	70	16.0	91,200	-	2.1	91,200	6.29	3.413	49,486		140,686	1.00	232
98	68	60.0	91,200	-	2.1	91,200	6.70	3.413	46,458		137,658	1.00	817
93	66	126.0	91,200	-	2.5	91,200	7.14	3.413	43,595		119,537	0.65	1,046
88	66	197.0	91,200	-	2.5	91,200	7.61	3.413	40,902		117,786	0.65	1,535
83	63	295.0	91,200	-	2.5	91,200	8.21	3.413	37,913		115,843	0.65	2,130
78	61	430.0	91,200	-	2.6	91,200	8.75	3.413	35,573		114,323	0.65	2,913
73	59	563.0	91,200	-	2.6	91,200	9.34	3.413	33,326		112,862	0.65	3.573
68	56	773.0	91,200	-	2.6	91,200	9.98	3.413	31,189		111,473	0.65	4,592
63	53	1177.0	91,200	-	2.7	91,200	10.23	3.413	30,427		110,977	0.65	6,820
58	50	1593.0	91,200	-	2.7	91,200	10.23	3.413	30,427		110,977	0.65	9,231
53	47	1407.0	91,200	-	2.7	91,200	10.23	3.413	30,427		110,977	0.65	8,153
48	43	987.0	91,200	-	2.7	91,200	10.23	3.413	30,427		110,977	0.65	5.719
43	40	676.0	91,200	-	2.7	91,200	10.23	3.413	30,427		110,977	0.65	3,917
38	36	313.0	91,200	-	2.7	91,200	10.23	3.413	30,427		110,977	0.65	1,814
33	32	108.0	91,200	-	2.7	91,200	10.23	3.413	30,427		110,977	0.65	626
28	27	23.0	91,200	-	2.7	91,200	10.23	3.413	30.427		110,977	0.65	133

			Application
kWh=	53.329	<	60,185
kWh=	15.51	=	15.6

Condenser Capacity	2,552,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	3	circuits	147,231
LT#1 Condensing Circuits	5	circuits	245,385
LT#2 Condensing Circuits	6	circuits	294,462
MT#1 Condensing Circuits	16	circuits	785,231
MT#2 Condensing Circuits	15	circuits	736,154
AC Condensing Circuits	7	circuits	343,538
Total Circuits	52		2,552,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	Refrigeration Case Load (Btuh)	Application Factor (unitless)	Calculated Application Factor, Check (unitless)	Equivalent Btuh rejected for case Load (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	0.0	0	-	0.0	0	0.00	0	0		0	0.00	0
108	72	5.0	227,100	-	2.3	227,100	7.15	3.413	108,405		335,505	1.00	159
103	70	16.0	247,645	-	2.2	247,645	7.62	3.413	110,920		358,565	1.00	520
98	68	60.0	247,645	-	2.2	247,645	8.20	3.413	103,075		350,720	1.00	1,812
93	66	126.0	247,645	-	2.5	247,645	8.67	3.413	97,487		318,811	0.73	2,627
88	66	197.0	247,645	-	2.5	247,645	9.10	3.413	92,880		315,448	0.73	3,914
83	63	295.0	247,645	-	2.5	247,645	9.34	3.413	90,494		313,705	0.73	5,710
78	61	430.0	247,645	-	2.5	247,645	9.73	3.413	86,867		311,058	0.73	7,989
73	59	563.0	247,645	-	2.8	247,645	10.88	3.413	77,685		304,355	0.73	9,355
68	56	773.0	247,645	-	2.6	247,645	11.76	3.413	71,872		300,111	0.73	11,883
63	53	1177.0	247,645	-	2.6	247,645	12.53	3.413	67,455		296,887	0.73	16,982
58	50	1593.0	247,645	-	2.7	247,645	13.00	3.413	65,016		295,107	0.73	22,153
53	47	1407.0	247,645	-	2.7	247,645	13.00	3.413	65,016		295,107	0.73	19,566
48	43	987.0	247,645	-	2.7	247,645	13.00	3.413	65,016		295,107	0.73	13,725
43	40	676.0	247,645	-	2.7	247,645	13.00	3.413	65,016		295,107	0.73	9,401
38	36	313.0	247,645	-	2.7	247,645	13.00	3.413	65,016		295,107	0.73	4,353
33	32	108.0	247,645	-	2.7	247,645	13.00	3.413	65,016		295,107	0.73	1,502
28	27	23.0	247,645	-	2.7	247,645	13.00	3.413	65,016		295,107	0.73	320

			Application
kWh=	131,969	>	121,921
kWh=	31.76	=	32

Condenser Capacity	2,552,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	3	circuits	147,231
LT#1 Condensing Circuits	5	circuits	245,385
LT#2 Condensing Circuits	6	circuits	294,462
MT#1 Condensing Circuits	16	circuits	785,231
MT#2 Condensing Circuits	15	circuits	738,154
AC Condensing Circuits	7	circuits	343,538
Total Circuits	52		2,552,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	Refrigeration Case Load (Btuh)	Application Factor (unitless)	Calculated Application Factor, Check (unitless)	Equivalent Btuh rejected for case Load (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	0.0	0	-	0.0	0	0.00	0	0		0	0.00	0
108	72	5.0	219,825	-	2.4	219,825	8.11	3.413	92,511		312,336	1.00	136
103	70	16.0	219,825	-	2.4	219,825	8.80	3.413	85,257		305,082	1.00	400
98	68	60.0	219,825	-	2.5	219,825	9.38	3.413	79,985		299,810	1.00	1,406
93	66	126.0	219,825	-	2.7	219,825	9.96	3.413	75,328		274,814	0.73	2,030
88	66	197.0	219,825	-	2.7	219,825	10.57	3.413	70,980		271,641	0.73	2,991
83	63	295.0	219,825	-	2.7	219,825	11.26	3.413	66,631		268,465	0.73	4,204
78	61	430.0	219,825	-	2.8	219,825	12.14	3.413	61,801		264,940	0.73	5,884
73	59	563.0	219,825	-	2.8	219,825	12.96	3.413	57,891		262,085	0.73	6,971
68	56	773.0	219,825	-	2.8	219,825	13.87	3.413	54,092		259,313	0.73	8,943
63	53	1177.0	219,825	-	2.9	219,825	14.90	3.413	50,353		256,583	0.73	12,876
58	50	1593.0	219,825	-	2.9	219,825	15.51	3.413	48,373		255,137	0.73	16,482
53	47	1407.0	219,825	-	2.9	219,825	15.51	3.413	48,373		255,137	0.73	14,557
48	43	987.0	219,825	-	2.9	219,825	15.51	3.413	48,373		255,137	0.73	10,212
43	40	676.0	219,825	-	2.9	219,825	15.51	3.413	48,373		255,137	0.73	6,994
38	36	313.0	219,825	-	2.9	219,825	15.51	3.413	48,373		255,137	0.73	3,238
33	32	108.0	219,825	-	2.9	219,825	15.51	3.413	48,373		255,137	0.73	1,117
28	27	23.0	219,825	-	2.9	219,825	15.51	3.413	48,373		255,137	0.73	238

			Application
kWh=	98,280	=	99,024
kWh=	27.11	=	27

Condenser Capacity	2,552,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	3	circuits	147,231
LT#1 Condensing Circuits	5	circuits	245,385
LT#2 Condensing Circuits	6	circuits	294,462
MT#1 Condensing Circuits	16	circuits	785,231
MT#2 Condensing Circuits	15	circuits	736,154
AC Condensing Circuits	7	circuits	343,538
Total Circuits	52		2,552,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	AC Load (tons)	AC Load (Btuh)	Equivalent Btuh rejected for AC (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	0.0	0.00	0	0	0.00	0	0		0	-	0
108	72	5.0	20.00	240,000	240,000	12.64	3.413	64,804		304,804	1.00	95
103	70	16.0	18.57	222,840	222,840	14.85	3.413	51,216		274,056	1.00	240
98	68	60.0	15.71	188,520	188,520	17.06	3.413	37,715		226,235	1.00	663
93	66	126.0	12.86	154,320	154,320	18.71	3.413	28,150		182,470	1.00	1,039
88	66	197.0	10.00	120,000	120,000	22.78	3.413	17,979		137,979	1.00	1,038
83	63	295.0	7.14	85,680	85,680	27.46	3.413	10,649		96,329	1.00	920
78	61	430.0	4.29	51,480	51,480	33.04	3.413	5,318		56,798	1.00	670
73	59	563.0	1.43	17,160	17,160	37.08	3.413	1,579		18,739	1.00	261
68	56	773.0										
63	53	1177.0										
58	50	1593.0										
53	47	1407.0										
48	43	987.0										
43	40	676.0										
38	36	313.0										
33	32	108.0										
28	27	23.0										

			Application
kWh=	4,926	=	2,726
kWh=	18.99	=	15.1

Condenser, Measure #2

Condenser Capacity	2,552,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	3	circuits	147,231
LT#1 Condensing Circuits	5	circuits	245,385
LT#2 Condensing Circuits	6	circuits	294,462
MT#1 Condensing Circuits	16	circuits	785,231
MT#2 Condensing Circuits	15	circuits	736,154
AC Condensing Circuits	7	circuits	343,538
Total Circuits	52		2,552,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	AC Heat Rejection (Btuh)	Refrigeration Heat Rejection (Btuh)	Condenser Load Factor (unitless)	Calculated Condenser Load Factor, Check (unitless)	Total Heat Rejection (Btuh)	Total Heat Rejection from the Application (MBtuh)	Total Heat Rejection from the Application (Btuh)	
113	74	0.0	0	0	-	0.0	0	0	0	
108	72	5.0	304,804	766,568	-	2.4	1,071,371	1,163	1,163,000	
103	70	16.0	274,056	779,224	-	2.4	1,053,279	1,114	1,114,000	
98	68	60.0	226,235	763,271	-	2.6	989,506	1,049	1,049,000	
93	66	126.0	182,470	692,361	-	2.9	874,832	990	990,000	
88	66	197.0	137,979	684,251	-	3.1	822,230	934	934,000	
83	63	295.0	96,329	678,322	-	3.3	774,652	882	882,000	
78	61	430.0	56,798	669,932	-	3.5	726,730	830	830,000	
73	59	563.0	18,739	658,500	-	3.8	677,240	829	829,000	
68	56	773.0	0	650,170	-	3.9	650,170	797	797,000	
63	53	1177.0	0	643,038	-	4.0	643,038	786	786,000	
58	50	1593.0	0	639,812	-	4.0	639,812	782	782,000	
53	47	1407.0	0	639,812	-	4.0	639,812	782	782,000	
48	43	987.0	0	639,812	-	4.0	639,812	782	782,000	
43	40	676.0	0	639,812	-	4.0	639,812	782	782,000	
38	36	313.0	0	639,812	-	4.0	639,812	800	800,000	
33	32	108.0	0	639,812	-	4.0	639,812	700	700,000	
28	27	23.0	0	639,812	-	4.0	639,812	600	600,000	
						Total Rejected	12,761,731	14,602	14,602,000	Heat rejection differences are significant

Condenser Capacity	2,552,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	3	circuits	147,231
LT#1 Condensing Circuits	5	circuits	245,385
LT#2 Condensing Circuits	6	circuits	294,462
MT#1 Condensing Circuits	16	circuits	785,231
MT#2 Condensing Circuits	15	circuits	736,154
AC Condensing Circuits	7	circuits	343,538
Total Circuits	52		2,552,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	Refrigeration Case Load (Btuh)	Application Factor (unitless)	Calculated Application Factor, Check (unitless)	Equivalent Btuh rejected for case Load (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	0.0	0	-	0.0	0	0.00	0	0		0	0.00	0
108	72	5.0	23,704	-	3.4	23,704	4.10	3.413	19,732		43,436	1.00	29
103	70	16.0	23,704	-	3.5	23,704	4.40	3.413	18,387		42,091	1.00	86
98	68	60.0	23,704	-	3.6	23,704	4.70	3.413	17,213		40,917	1.00	303
93	66	126.0	23,704	-	4.1	23,704	4.70	3.413	17,213		36,270	0.73	464
88	65	197.0	23,704	-	4.1	23,704	4.70	3.413	17,213		36,270	0.73	725
83	63	295.0	23,704	-	4.1	23,704	4.70	3.413	17,213		36,270	0.73	1,086
78	61	430.0	23,704	-	4.1	23,704	4.70	3.413	17,213		36,270	0.73	1,583
73	59	563.0	23,704	-	4.1	23,704	4.70	3.413	17,213		36,270	0.73	2,073
68	56	773.0	23,704	-	4.1	23,704	4.70	3.413	17,213		36,270	0.73	2,846
63	53	1177.0	23,704	-	4.1	23,704	4.70	3.413	17,213		36,270	0.73	4,333
58	50	1593.0	23,704	-	4.1	23,704	4.70	3.413	17,213		36,270	0.73	5,865
53	47	1407.0	23,704	-	4.1	23,704	4.70	3.413	17,213		36,270	0.73	5,180
48	43	987.0	23,704	-	4.1	23,704	4.70	3.413	17,213		36,270	0.73	3,634
43	40	676.0	23,704	-	4.1	23,704	4.70	3.413	17,213		36,270	0.73	2,489
38	36	313.0	23,704	-	4.1	23,704	4.70	3.413	17,213		36,270	0.73	1,152
33	32	108.0	23,704	-	4.1	23,704	4.70	3.413	17,213		36,270	0.73	398
28	27	23.0	23,704	-	4.1	23,704	4.70	3.413	17,213		36,270	0.73	85

			Application
kWh=	32,331	=	32,363
kWh=	5.78	=	6

Condenser Capacity	2,552,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	3	circuits	147,231
LT#1 Condensing Circuits	5	circuits	245,385
LT#2 Condensing Circuits	6	circuits	294,462
MT#1 Condensing Circuits	16	circuits	785,231
MT#2 Condensing Circuits	15	circuits	738,154
AC Condensing Circuits	7	circuits	343,538
Total Circuits	52		2,552,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	Refrigeration Case Load (Btuh)	Application Factor (unitless)	Calculated Application Factor, Check (unitless)	Equivalent Btuh rejected for case Load (Btuh)	Estimated Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	0.0	0	-	0.0	0	0.00	0	0		0	0.00	0
108	72	5.0	43,850	-	3.3	43,850	4.76	3.413	31,441		75,291	1.00	46
103	70	16.0	43,850	-	3.3	43,850	5.05	3.413	29,636		73,486	1.00	139
98	68	60.0	43,850	-	3.4	43,850	5.35	3.413	27,974		71,824	1.00	492
93	66	126.0	43,850	-	3.4	43,850	5.40	3.413	27,715		71,565	1.00	1,023
88	66	197.0	43,850	-	3.8	43,850	5.40	3.413	27,715		64,082	0.73	1,168
83	63	295.0	43,850	-	3.8	43,850	5.40	3.413	27,715		64,082	0.73	1,749
78	61	430.0	43,850	-	3.8	43,850	5.40	3.413	27,715		64,082	0.73	2,549
73	59	563.0	43,850	-	3.8	43,850	5.40	3.413	27,715		64,082	0.73	3,337
68	56	773.0	43,850	-	3.8	43,850	5.40	3.413	27,715		64,082	0.73	4,582
63	53	1177.0	43,850	-	3.8	43,850	5.40	3.413	27,715		64,082	0.73	6,977
58	50	1593.0	43,850	-	3.8	43,850	5.40	3.413	27,715		64,082	0.73	9,443
53	47	1407.0	43,850	-	3.8	43,850	5.40	3.413	27,715		64,082	0.73	8,341
48	43	987.0	43,850	-	3.8	43,850	5.40	3.413	27,715		64,082	0.73	5,851
43	40	676.0	43,850	-	3.8	43,850	5.40	3.413	27,715		64,082	0.73	4,007
38	36	313.0	43,850	-	3.8	43,850	5.40	3.413	27,715		64,082	0.73	1,855
33	32	108.0	43,850	-	3.8	43,850	5.40	3.413	27,715		64,082	0.73	640
28	27	23.0	43,850	-	3.8	43,850	5.40	3.413	27,715		64,082	0.73	136

			Application
kWh=	52,336	=	52,289
kWh=	9.21	=	9

Condenser Capacity	2,552,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	3	circuits	147,231
LT#1 Condensing Circuits	5	circuits	245,385
LT#2 Condensing Circuits	6	circuits	294,462
MT#1 Condensing Circuits	16	circuits	785,231
MT#2 Condensing Circuits	15	circuits	736,154
AC Condensing Circuits	7	circuits	343,538
Total Circuits	52		2,552,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	Refrigeration Case Load (Btuh)	Application Factor (unitless)	Calculated Application Factor, Check (unitless)	Equivalent Btuh rejected for case Load (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	0.0	0	-	0.0	0	0.00	0	0		0	0.00	0
108	72	5.0	91,200	-	2.0	91,200	5.88	3.413	52,936		144,136	1.00	78
103	70	16.0	91,200	-	2.1	91,200	6.29	3.413	49,486		140,686	1.00	232
98	68	60.0	91,200	-	2.1	91,200	6.54	3.413	47,594		138,794	1.00	837
93	66	126.0	91,200	-	2.1	91,200	6.54	3.413	47,594		138,794	1.00	1,757
88	66	197.0	91,200	-	2.3	91,200	6.54	3.413	47,594		125,944	0.73	2,005
83	63	295.0	91,200	-	2.3	91,200	6.54	3.413	47,594		125,944	0.73	3,003
78	61	430.0	91,200	-	2.3	91,200	6.54	3.413	47,594		125,944	0.73	4,377
73	59	563.0	91,200	-	2.3	91,200	6.54	3.413	47,594		125,944	0.73	5,731
68	56	773.0	91,200	-	2.3	91,200	6.54	3.413	47,594		125,944	0.73	7,869
63	53	1177.0	91,200	-	2.3	91,200	6.54	3.413	47,594		125,944	0.73	11,982
58	50	1593.0	91,200	-	2.3	91,200	6.54	3.413	47,594		125,944	0.73	16,216
53	47	1407.0	91,200	-	2.3	91,200	6.54	3.413	47,594		125,944	0.73	14,323
48	43	987.0	91,200	-	2.3	91,200	6.54	3.413	47,594		125,944	0.73	10,047
43	40	676.0	91,200	-	2.3	91,200	6.54	3.413	47,594		125,944	0.73	6,882
38	36	313.0	91,200	-	2.3	91,200	6.54	3.413	47,594		125,944	0.73	3,186
33	32	108.0	91,200	-	2.3	91,200	6.54	3.413	47,594		125,944	0.73	1,099
28	27	23.0	91,200	-	2.3	91,200	6.54	3.413	47,594		125,944	0.73	234

			Application
kWh=	89,859	=	89,869
kWh=	15.51	=	15.6

Condenser Capacity	2,552,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	3	circuits	147,231
LT#1 Condensing Circuits	5	circuits	245,385
LT#2 Condensing Circuits	6	circuits	294,462
MT#1 Condensing Circuits	16	circuits	785,231
MT#2 Condensing Circuits	15	circuits	736,154
AC Condensing Circuits	7	circuits	343,538
Total Circuits	52		2,552,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	Refrigeration Case Load (Btuh)	Application Factor (unitless)	Calculated Application Factor, Check (unitless)	Equivalent Btuh rejected for case Load (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	0.0	0	-	0.0	0	0.00	0	0		0	0.00	0
108	72	5.0	227,100	-	2.3	227,100	6.86	3.413	112,987		340,087	1.00	166
103	70	16.0	227,100	-	2.4	227,100	7.34	3.413	105,598		332,698	1.00	495
98	68	60.0	227,100	-	2.4	227,100	7.91	3.413	97,989		325,089	1.00	1,723
93	66	126.0	227,100	-	2.5	227,100	8.39	3.413	92,383		319,483	1.00	3,411
88	66	197.0	227,100	-	2.7	227,100	8.58	3.413	90,337		293,046	0.73	3,806
83	63	295.0	227,100	-	2.7	227,100	8.58	3.413	90,337		293,046	0.73	5,700
78	61	430.0	227,100	-	2.7	227,100	8.58	3.413	90,337		293,046	0.73	8,308
73	59	563.0	227,100	-	2.7	227,100	8.58	3.413	90,337		293,046	0.73	10,878
68	56	773.0	227,100	-	2.7	227,100	8.58	3.413	90,337		293,046	0.73	14,936
63	53	1177.0	227,100	-	2.7	227,100	8.58	3.413	90,337		293,046	0.73	22,742
58	50	1593.0	227,100	-	2.7	227,100	8.58	3.413	90,337		293,046	0.73	30,780
53	47	1407.0	227,100	-	2.7	227,100	8.58	3.413	90,337		293,046	0.73	27,186
48	43	987.0	227,100	-	2.7	227,100	8.58	3.413	90,337		293,046	0.73	19,071
43	40	676.0	227,100	-	2.7	227,100	8.58	3.413	90,337		293,046	0.73	13,062
38	36	313.0	227,100	-	2.7	227,100	8.58	3.413	90,337		293,046	0.73	6,048
33	32	108.0	227,100	-	2.7	227,100	8.58	3.413	90,337		293,046	0.73	2,087
28	27	23.0	227,100	-	2.7	227,100	8.58	3.413	90,337		293,046	0.73	444

			Application
kWh=	170,843	=	170,905
kWh=	33.10	=	33

Condenser Capacity	2,552,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	3	circuits	147,231
LT#1 Condensing Circuits	5	circuits	245,385
LT#2 Condensing Circuits	6	circuits	294,462
MT#1 Condensing Circuits	16	circuits	785,231
MT#2 Condensing Circuits	15	circuits	736,154
AC Condensing Circuits	7	circuits	343,538
Total Circuits	52		2,552,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	Refrigeration Case Load (Btuh)	Application Factor (unitless)	Calculated Application Factor, Check (unitless)	Equivalent Btuh rejected for case Load (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	0.0	0	-	0.0	0	0.00	0	0	[redacted]	0	0.00	0
108	72	5.0	219,825	-	2.3	219,825	7.88	3.413	95,211	[redacted]	315,036	1.00	139
103	70	16.0	219,825	-	2.4	219,825	8.57	3.413	87,545	[redacted]	307,370	1.00	410
98	68	60.0	219,825	-	2.4	219,825	9.15	3.413	81,996	[redacted]	301,821	1.00	1,441
93	66	126.0	219,825	-	2.7	219,825	9.73	3.413	77,108	[redacted]	276,114	0.73	2,078
88	66	197.0	219,825	-	2.7	219,825	9.85	3.413	76,169	[redacted]	275,428	0.73	3,209
83	63	295.0	219,825	-	2.7	219,825	9.85	3.413	76,169	[redacted]	275,428	0.73	4,806
78	61	430.0	219,825	-	2.7	219,825	9.85	3.413	76,169	[redacted]	275,428	0.73	7,005
73	59	563.0	219,825	-	2.7	219,825	9.85	3.413	76,169	[redacted]	275,428	0.73	9,172
68	56	773.0	219,825	-	2.7	219,825	9.85	3.413	76,169	[redacted]	275,428	0.73	12,593
63	53	1177.0	219,825	-	2.7	219,825	9.85	3.413	76,169	[redacted]	275,428	0.73	19,175
58	50	1593.0	219,825	-	2.7	219,825	9.85	3.413	76,169	[redacted]	275,428	0.73	25,953
53	47	1407.0	219,825	-	2.7	219,825	9.85	3.413	76,169	[redacted]	275,428	0.73	22,922
48	43	987.0	219,825	-	2.7	219,825	9.85	3.413	76,169	[redacted]	275,428	0.73	16,080
43	40	676.0	219,825	-	2.7	219,825	9.85	3.413	76,169	[redacted]	275,428	0.73	11,013
38	36	313.0	219,825	-	2.7	219,825	9.85	3.413	76,169	[redacted]	275,428	0.73	5,099
33	32	108.0	219,825	-	2.7	219,825	9.85	3.413	76,169	[redacted]	275,428	0.73	1,759
28	27	23.0	219,825	-	2.7	219,825	9.85	3.413	76,169	[redacted]	275,428	0.73	375

			Application
kWh=	143.232	=	144,016
kWh=	27.90	=	28

Condenser Capacity	2,552,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	3	circuits	147,231
LT#1 Condensing Circuits	5	circuits	245,385
LT#2 Condensing Circuits	6	circuits	294,462
MT#1 Condensing Circuits	16	circuits	785,231
MT#2 Condensing Circuits	15	circuits	736,154
AC Condensing Circuits	7	circuits	343,538
Total Circuits	52		2,552,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	AC Load (tons)	AC Load (Btuh)	Equivalent Btuh rejected for AC (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	0.0	0.00	0	0	0.00	0	0		0	0.00	0
108	72	5.0	20.00	240,000	240,000	12.64	3.413	64,804		304,804	1.00	95
103	70	16.0	18.57	222,840	222,840	14.85	3.413	51,216		274,056	1.00	240
98	68	60.0	15.71	188,520	188,520	17.06	3.413	37,715		226,235	1.00	663
93	66	126.0	12.86	154,320	154,320	17.69	3.413	29,774		184,094	1.00	1,099
88	66	197.0	10.00	120,000	120,000	17.69	3.413	23,152		143,152	1.00	1,336
83	63	295.0	7.14	85,680	85,680	17.69	3.413	16,531		102,211	1.00	1,429
78	61	430.0	4.29	51,480	51,480	17.69	3.413	9,932		61,412	1.00	1,251
73	59	563.0	1.43	17,160	17,160	17.69	3.413	3,311		20,471	1.00	546
68	56	773.0										
63	53	1177.0										
58	50	1593.0										
53	47	1407.0										
48	43	987.0										
43	40	676.0										
38	36	313.0										
33	32	108.0										
28	27	23.0										

			Application
kWh=	6,660	=	6,665
kWh=	18.99	=	19

Notes

The application assumes a lower AC load in the post-measure #2 retrofit condition.

Condenser Capacity	2,552,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	3	circuits	147,231
LT#1 Condensing Circuits	5	circuits	245,385
LT#2 Condensing Circuits	6	circuits	294,462
MT#1 Condensing Circuits	16	circuits	785,231
MT#2 Condensing Circuits	15	circuits	736,154
AC Condensing Circuits	7	circuits	343,538
Total Circuits	52		2,552,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	AC Heat Rejection (Btuh)	Refrigeration Heat Rejection (Btuh)	Condenser Load Factor (unitless)	Calculated Condenser Load Factor, Check (unitless)	Total Heat Rejection (Btuh)	Total Heat Rejection from the Application (MBtuh)	Total Heat Rejection from the Application (Btuh)	
113	74	0.0	0	0	-	0.0	0	0	0	
108	72	5.0	304,804	773,851	-	2.4	1,078,654	1,233	1,233,000	
103	70	16.0	274,056	755,645	-	2.5	1,029,701	1,181	1,181,000	
98	68	60.0	226,235	739,651	-	2.6	965,886	1,115	1,115,000	
93	66	126.0	184,094	703,431	-	2.9	887,525	1,062	1,062,000	
88	66	197.0	143,152	668,826	-	3.1	811,978	1,018	1,018,000	
83	63	295.0	102,211	668,826	-	3.3	771,036	977	977,000	
78	61	430.0	61,412	668,826	-	3.5	730,238	936	936,000	
73	59	563.0	20,471	668,826	-	3.7	689,296	895	895,000	
68	56	773.0	0	668,826	-	3.8	668,826	875	875,000	
63	53	1177.0	0	668,826	-	3.8	668,826	875	875,000	
58	50	1593.0	0	668,826	-	3.8	668,826	875	875,000	
53	47	1407.0	0	668,826	-	3.8	668,826	875	875,000	
48	43	987.0	0	668,826	-	3.8	668,826	875	875,000	
43	40	676.0	0	668,826	-	3.8	668,826	875	875,000	
38	36	313.0	0	668,826	-	3.8	668,826	800	800,000	
33	32	108.0	0	668,826	-	3.8	668,826	700	700,000	
28	27	23.0	0	668,826	-	3.8	668,826	600	600,000	
						Total Rejected	12,983,746	15,767	15,767,000	Heat rejection differences are significant

Measure #2 Summary of Findings

Evaluation Compressor Savings	Pre-Retrofit Demand	Post-Retrofit Demand	Measure # Demand Savings		Pre-Retrofit Energy	Post-Retrofit Energy	Measure # Energy Savings	
Ice Cream Condensing Circuits	5.78	5.78	0.00		32,331	23,161	9,170	
LT#1 Condensing Circuits	9.21	9.21	0.00		52,336	36,417	15,919	
LT#2 Condensing Circuits	15.51	15.51	0.00		89,859	53,329	36,530	
MT#1 Condensing Circuits	33.10	31.76	1.34		170,843	131,969	38,873	
MT#2 Condensing Circuits	27.90	27.11	0.79		143,232	98,280	44,952	
AC Condensing Circuits	18.99	18.99	0.00		6,660	4,926	1,734	
Total			2.13	kW			147,179	kWh
Total Refer w/ Compressor		103.36				460,705		

Application Compressor Savings	Pre-Retrofit Demand	Post-Retrofit Demand	Measure # Demand Savings		Pre-Retrofit Energy	Post-Retrofit Energy	Measure # Energy Savings	
Ice Cream Condensing Circuits	6.00	6.00	0.00		32,363	23,063	9,300	
LT#1 Condensing Circuits	9.00	9.00	0.00		52,289	36,676	15,613	
LT#2 Condensing Circuits	15.60	15.60	0.00		89,869	60,185	29,684	
MT#1 Condensing Circuits	33.00	32.00	1.00		170,905	121,921	48,984	
MT#2 Condensing Circuits	28.00	27.00	1.00		144,016	99,024	44,992	
AC Condensing Circuits	19.00	15.10	3.90		6,665	2,726	3,939	
Total			5.90	kW			152,512	kWh

Dark Green font is an estimate because this level of detail was missing from the application.

Applicaton Condenser Analysis	Pre-Retrofit Demand	Post-Retrofit Demand	Measure # Demand Savings	Pre-Retrofit Energy	Post-Retrofit Energy	Measure # Energy Savings (kWh)	Pre-Condenser Rejection (Btuh)	Post-Condenser Rejection (Btuh)	Difference in Condenser Heat Rejection (Btuh)	Measure Energy Savings per Condenser Heat Rejection (kWh/Btuh)
Condenser Fan Use	16.00	16.00	0.00	127,026	134,501	-7,475	15,767,000	14,602,000	1,165,000	-0.01
							0.00921114	1.0957E-06		

Evaluation Condenser Analysis	Pre-Condenser Rejection (Btuh)	Post-Condenser Rejection (Btuh)	Difference in Condenser Heat Rejection (Btuh)	Measure Energy Savings per Condenser Heat Rejection (kWh/Btuh)	Post-Energy	Post Demand
Condenser Fan Use	12,983,746	12,761,731	222,015	-1,425	117,550	13.9835431

Final Results for Measure #2		
Source	Demand Impact	Energy Impact
Evaluation	2.13	145,754
Application	5.90	145,037

Condenser Capacity	2,552,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	3	circuits	147,231
LT#1 Condensing Circuits	12	circuits	588,923
LT#2 Condensing Circuits	0	circuits	0
MT#1 Condensing Circuits	7	circuits	343,538
MT#2 Condensing Circuits	21	circuits	1,030,615
AC Condensing Circuits	9	circuits	441,692
Total Circuits	52		2,552,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	Refrigeration Case Load (Btuh)	Application Factor (unitless)	Calculated Application Factor, Check (unitless)	Equivalent Btuh rejected for case Load (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	0.0	0	-	0.0	0	3.90	0	0		0	0.00	0
108	72	8.0	31,833	-	2.6	31,833	4.20	3.413	25,868		57,701	1.00	61
103	70	53.0	31,833	-	2.6	31,833	4.50	3.413	24,144		55,977	1.00	375
98	68	159.0	31,833	-	2.7	31,833	4.80	3.413	22,635		54,468	1.00	1,054
93	66	287.0	31,833	-	3.1	31,833	5.00	3.413	21,729		47,695	0.73	1,334
88	66	364.0	31,833	-	3.1	31,833	5.10	3.413	21,303		47,384	0.73	1,659
83	63	457.0	31,833	-	3.2	31,833	5.40	3.413	20,120		46,520	0.73	1,967
78	61	581.0	31,833	-	3.3	31,833	6.00	3.413	18,108		45,052	0.73	2,250
73	59	707.0	31,833	-	3.3	31,833	6.40	3.413	16,976		44,225	0.73	2,567
68	56	804.0	31,833	-	3.4	31,833	6.80	3.413	15,977		43,496	0.73	2,748
63	53	965.0	31,833	-	3.4	31,833	6.90	3.413	15,746		43,327	0.73	3,250
58	50	1100.0	31,833	-	3.4	31,833	6.90	3.413	15.746		43,327	0.73	3,705
53	47	1098.0	31,833	-	3.4	31,833	6.90	3.413	15,746		43,327	0.73	3.698
48	43	902.0	31,833	-	3.4	31,833	6.90	3.413	15,746		43,327	0.73	3,038
43	40	681.0	31,833	-	3.4	31,833	6.90	3.413	15,746		43,327	0.73	2,293
38	36	397.0	31,833	-	3.4	31,833	6.90	3.413	15,746		43,327	0.73	1,337
33	32	159.0	31,833	-	3.4	31,833	6.90	3.413	15,746		43,327	0.73	535
28	27	32.0	31,833	-	3.4	31,833	6.90	3.413	15,746		43,327	0.73	108

			Application
kWh=	31,978	=	32,840
kWh=	7.58	=	8

Condenser Capacity	2,552,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	3	circuits	147,231
LT#1 Condensing Circuits	12	circuits	588,923
LT#2 Condensing Circuits	0	circuits	0
MT#1 Condensing Circuits	7	circuits	343,538
MT#2 Condensing Circuits	21	circuits	1,030,615
AC Condensing Circuits	9	circuits	441,692
Total Circuits	52		2,552,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	Refrigeration Case Load (Btuh)	Application Factor (unitless)	Calculated Application Factor, Check (unitless)	Equivalent Btuh rejected for case Load (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	0.0	0	-	0.0	0	0.00	0	0		0	0.00	0
108	72	8.0	107,318	-	3.2	107,318	4.76	3.413	76,949		184,267	1.00	180
103	70	53.0	107,318	-	3.3	107,318	5.05	3.413	72,530		179,848	1.00	1,126
98	68	159.0	107,318	-	3.4	107,318	5.35	3.413	68,463		175,781	1.00	3,189
93	66	287.0	107,318	-	3.4	107,318	5.64	3.413	64,943		172,261	1.00	5,461
88	66	364.0	107,318	-	3.9	107,318	5.99	3.413	61,148		151,956	0.73	4,761
83	63	457.0	107,318	-	4.0	107,318	6.42	3.413	57,052		148,966	0.73	5,577
78	61	581.0	107,318	-	4.0	107,318	6.82	3.413	53,706		146,524	0.73	6,674
73	59	707.0	107,318	-	4.1	107,318	7.22	3.413	50,731		144,351	0.73	7,671
68	56	804.0	107,318	-	4.1	107,318	7.67	3.413	47,754		142,179	0.73	8,212
63	53	965.0	107,318	-	4.2	107,318	8.12	3.413	45,108		140,247	0.73	9,310
58	50	1100.0	107,318	-	4.2	107,318	8.12	3.413	45,108		140,247	0.73	10,613
53	47	1098.0	107,318	-	4.2	107,318	8.12	3.413	45,108		140,247	0.73	10,594
48	43	902.0	107,318	-	4.2	107,318	8.12	3.413	45,108		140,247	0.73	8,703
43	40	681.0	107,318	-	4.2	107,318	8.12	3.413	45,108		140,247	0.73	6,570
38	36	397.0	107,318	-	4.2	107,318	8.12	3.413	45,108		140,247	0.73	3,830
33	32	159.0	107,318	-	4.2	107,318	8.12	3.413	45,108		140,247	0.73	1,534
28	27	32.0	107,318	-	4.2	107.318	8.12	3.413	45.108		140.247	0.73	309

			Application
kWh=	94.315	=	94,312
kWh=	22.55	=	23

Condenser Capacity	2,552,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	3	circuits	147,231
LT#1 Condensing Circuits	12	circuits	588,923
LT#2 Condensing Circuits	0	circuits	0
MT#1 Condensing Circuits	7	circuits	343,538
MT#2 Condensing Circuits	21	circuits	1,030,615
AC Condensing Circuits	9	circuits	441,692
Total Circuits	52		2,552,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	Refrigeration Case Load (Btuh)	Application Factor (unitless)	Calculated Application Factor, Check (unitless)	Equivalent Btuh rejected for case Load (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	0.0	0	-	0.0	0	0.00	0	0		0	0.00	0
108	72	8.0	115,300	-	3.5	115,300	7.38	3.413	53,322		168,622	1.00	125
103	70	53.0	115,300	-	3.6	115,300	8.01	3.413	49,128		164,428	1.00	763
98	68	159.0	115,300	-	3.6	115,300	8.53	3.413	46,134		161,434	1.00	2,149
93	66	287.0	115,300	-	3.7	115,300	9.05	3.413	43,483		158,783	1.00	3,656
88	66	384.0	115,300	-	4.1	115,300	9.57	3.413	41,120		145,318	0.73	3,201
83	63	457.0	115,300	-	4.1	115,300	10.28	3.413	38,280		143,244	0.73	3,742
78	61	581.0	115,300	-	4.2	115,300	10.89	3.413	36,136		141,679	0.73	4,491
73	59	707.0	115,300	-	4.2	115,300	11.62	3.413	33,866		140,022	0.73	5,121
68	56	804.0	115,300	-	4.2	115,300	12.34	3.413	31,890		138,579	0.73	5.484
63	53	965.0	115,300	-	4.3	115,300	13.22	3.413	29,767		137,030	0.73	6,144
58	50	1100.0	115,300	-	4.3	115,300	14.19	3.413	27,732		135,544	0.73	6,525
53	47	1098.0	115,300	-	4.3	115,300	14.19	3.413	27,732		135,544	0.73	6,513
48	43	902.0	115,300	-	4.3	115,300	14.19	3.413	27,732		135,544	0.73	5,350
43	40	681.0	115,300	-	4.3	115,300	14.19	3.413	27,732		135,544	0.73	4.039
38	36	397.0	115,300	-	4.3	115,300	14.19	3.413	27,732		135,544	0.73	2,355
33	32	159.0	115,300	-	4.3	115,300	14.19	3.413	27,732		135,544	0.73	943
28	27	32.0	115,300	-	4.3	115,300	14.19	3.413	27,732		135,544	0.73	190

			Application
kWh=	60,791	=	60,973
kWh=	15.62	=	16

Condenser Capacity	2,552,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	3	circuits	147,231
LT#1 Condensing Circuits	12	circuits	588,923
LT#2 Condensing Circuits	0	circuits	0
MT#1 Condensing Circuits	7	circuits	343,538
MT#2 Condensing Circuits	21	circuits	1,030,615
AC Condensing Circuits	9	circuits	441,692
Total Circuits	52		2,552,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	Refrigeration Case Load (Btuh)	Application Factor (unitless)	Calculated Application Factor, Check (unitless)	Equivalent Btuh rejected for case Load (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	0.0	0	-	0.0	0	0.00	0	0		0	0.00	0
108	72	8.0	366,750	-	0.7	366,750	7.88	3.413	158,847		525,597	1.00	372
103	70	53.0	366,750	-	0.7	366,750	8.46	3.413	147.957		514,707	1.00	2,298
98	68	159.0	366,750	-	0.7	366,750	9.04	3.413	138,464		505,214	1.00	6,451
93	66	287.0	366,750	-	0.7	366,750	9.73	3.413	128,645		495,395	1.00	10,818
88	66	364.0	366,750	-	0.8	366,750	10.31	3.413	121,408		455,378	0.73	9,452
83	63	457.0	366,750	-	0.8	366,750	10.98	3.413	114,000		449,970	0.73	11,143
78	61	581.0	366,750	-	0.8	366,750	11.67	3.413	107,259		445,049	0.73	13,329
73	59	707.0	366,750	-	0.8	366,750	12.47	3.413	100,378		440,026	0.73	15,179
68	56	804.0	366,750	-	0.8	366,750	13.46	3.413	92,995		434,637	0.73	15,992
63	53	965.0	366,750	-	0.8	366,750	14.49	3.413	86,385		429,811	0.73	17,830
58	50	1100.0	366,750	-	0.8	366,750	15.51	3.413	80,704		425,664	0.73	18,988
53	47	1098.0	366,750	-	0.8	366,750	15.51	3.413	80,704		425,664	0.73	18,953
48	43	902.0	366,750	-	0.8	366,750	15.51	3.413	80,704		425,664	0.73	15,570
43	40	681.0	366,750	-	0.8	366,750	15.51	3.413	80,704		425,664	0.73	11,755
38	36	397.0	366,750	-	0.8	366,750	15.51	3.413	80,704		425,664	0.73	6,853
33	32	159.0	366,750	-	0.8	366,750	15.51	3.413	80,704		425,664	0.73	2,745
28	27	32.0	366,750	-	0.8	366,750	15.51	3.413	80,704		425,664	0.73	552

			Application
kWh=	178.280	=	178,274
kWh=	46.54	=	47

Condenser Capacity	2,552,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	3	circuits	147,231
LT#1 Condensing Circuits	12	circuits	588,923
LT#2 Condensing Circuits	0	circuits	0
MT#1 Condensing Circuits	7	circuits	343,538
MT#2 Condensing Circuits	21	circuits	1,030,615
AC Condensing Circuits	9	circuits	441,692
Total Circuits	52		2,552,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	AC Load (tons)	AC Load (Btuh)	Equivalent Btuh rejected for AC (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	0.0	0.00	0	0	0.00	0	0		0	-	0
108	72	8.0	20.00	240,000	240,000	13.91	3.413	58,887		298,887	1.00	138
103	70	53.0	18.57	222,840	222,840	15.80	3.413	48,136		270,976	1.00	748
98	68	159.0	15.71	188,520	188,520	18.01	3.413	35,726		224,246	1.00	1,664
93	66	287.0	12.86	154,320	154,320	20.59	3.413	25,580		179,900	1.00	2,151
88	66	364.0	10.00	120,000	120,000	23.66	3.413	17,310		137,310	1.00	1,846
83	63	457.0	7.14	85,680	85,680	28.10	3.413	10,407		96,087	1.00	1,393
78	61	581.0	4.29	51,480	51,480	34.05	3.413	5,160		56,640	1.00	878
73	59	707.0	1.43	17,160	17,160	37.08	3.413	1,579		18,739	1.00	327
68	56	804.0										
63	53	965.0										
58	50	1100.0										
53	47	1098.0										
48	43	902.0										
43	40	681.0										
38	36	397.0										
33	32	159.0										
28	27	32.0										

			Application
kWh=	9,146	=	4,058
kWh=	17.25	=	12.4

Condenser, Measure #2

Condenser Capacity	2,552,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	3	circuits	147,231
LT#1 Condensing Circuits	12	circuits	588,923
LT#2 Condensing Circuits	0	circuits	0
MT#1 Condensing Circuits	7	circuits	343,538
MT#2 Condensing Circuits	21	circuits	1,030,615
AC Condensing Circuits	9	circuits	441,692
Total Circuits	52		2,552,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	AC Heat Rejection (Btuh)	Refrigeration Heat Rejection (Btuh)	Condenser Load Factor (unitless)	Calculated Condenser Load Factor, Check (unitless)	Total Heat Rejection (Btuh)	Total Heat Rejection from the Application (MBtuh)	Total Heat Rejection from the Application (Btuh)
113	74	0.0	0	0	-	0.0	0	0	0
108	72	8.0	298,887	936,188	-	2.1	1,235,075	1,153	1,153,000
103	70	53.0	270,976	914,960	-	2.2	1,185,936	1,106	1,106,000
98	68	159.0	224,246	896,896	-	2.3	1,121,142	1,042	1,042,000
93	66	287.0	179,900	874,134	-	2.4	1,054,034	982	982,000
88	66	364.0	137,310	800,036	-	2.7	937,346	927	927,000
83	63	457.0	96,087	788,701	-	2.9	884,787	872	872,000
78	61	581.0	56,640	778,304	-	3.1	834,944	821	821,000
73	59	707.0	18,739	768,625	-	3.2	787,365	843	843,000
68	56	804.0	0	758,891	-	3.4	758,891	811	811,000
63	53	965.0	0	750,415	-	3.4	750,415	798	798,000
58	50	1100.0	0	744,783	-	3.4	744,783	791	791,000
53	47	1098.0	0	744,783	-	3.4	744,783	791	791,000
48	43	902.0	0	744,783	-	3.4	744,783	791	791,000
43	40	681.0	0	744,783	-	3.4	744,783	791	791,000
38	36	397.0	0	744,783	-	3.4	744,783	800	800,000
33	32	159.0	0	744,783	-	3.4	744,783	700	700,000
28	27	32.0	0	744,783	-	3.4	744,783	600	600,000
						Total Rejected	14,763,413	14,619	14,619,000

Condenser Capacity	2,552,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	3	circuits	147,231
LT#1 Condensing Circuits	12	circuits	588,923
LT#2 Condensing Circuits	0	circuits	0
MT#1 Condensing Circuits	7	circuits	343,538
MT#2 Condensing Circuits	21	circuits	1,030,615
AC Condensing Circuits	9	circuits	441,692
Total Circuits	52		2,552,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	Refrigeration Case Load (Btuh)	Application Factor (unitless)	Calculated Application Factor, Check (unitless)	Equivalent Btuh rejected for case Load (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	0.0	0	-	0.0	0	0.00	0	0		0	0.00	0
108	72	8.0	31,833	-	2.5	31,833	3.90	3.413	27,858		59,691	1.00	65
103	70	53.0	31,833	-	2.6	31,833	4.20	3.413	25,868		57,701	1.00	402
98	68	159.0	31,833	-	2.6	31,833	4.50	3.413	24,144		55,977	1.00	1,125
93	66	287.0	31,833	-	3.0	31,833	4.70	3.413	23,116		48,708	0.73	1,419
88	66	364.0	31,833	-	3.0	31,833	4.70	3.413	23,116		48,708	0.73	1,800
83	63	457.0	31,833	-	3.0	31,833	4.70	3.413	23,116		48,708	0.73	2,260
78	61	581.0	31,833	-	3.0	31,833	4.70	3.413	23,116		48,708	0.73	2,873
73	59	707.0	31,833	-	3.0	31,833	4.70	3.413	23,116		48,708	0.73	3,496
68	56	804.0	31,833	-	3.0	31,833	4.70	3.413	23,116		48,708	0.73	3,975
63	53	965.0	31,833	-	3.0	31,833	4.70	3.413	23,116		48,708	0.73	4,771
58	50	1100.0	31,833	-	3.0	31,833	4.70	3.413	23,116		48,708	0.73	5,439
53	47	1098.0	31,833	-	3.0	31,833	4.70	3.413	23,116		48,708	0.73	5,429
48	43	902.0	31,833	-	3.0	31,833	4.70	3.413	23,116		48,708	0.73	4,460
43	40	681.0	31,833	-	3.0	31,833	4.70	3.413	23,116		48,708	0.73	3,367
38	36	397.0	31,833	-	3.0	31,833	4.70	3.413	23,116		48,708	0.73	1,963
33	32	159.0	31,833	-	3.0	31,833	4.70	3.413	23,116		48,708	0.73	786
28	27	32.0	31,833	-	3.0	31,833	4.70	3.413	23,116		48,708	0.73	158

			Application
kWh=	43,786	=	43,820
kWh=	8.16	=	8

Condenser Capacity	2,552,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	3	circuits	147,231
LT#1 Condensing Circuits	12	circuits	588,923
LT#2 Condensing Circuits	0	circuits	0
MT#1 Condensing Circuits	7	circuits	343,538
MT#2 Condensing Circuits	21	circuits	1,030,615
AC Condensing Circuits	9	circuits	441,692
Total Circuits	52		2,552,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	Refrigeration Case Load (Btuh)	Application Factor (unitless)	Calculated Application Factor, Check (unitless)	Equivalent Btuh rejected for case Load (Btuh)	Estimated Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	0.0	0	-	0.0	0	0.00	0	0		0	0.00	0
108	72	8.0	107,318	-	3.2	107,318	4.76	3.413	76,949		184,267	1.00	180
103	70	53.0	107,318	-	3.3	107,318	5.05	3.413	72,530		179,848	1.00	1,128
98	68	159.0	107,318	-	3.4	107,318	5.35	3.413	68,463		175,781	1.00	3,189
93	66	287.0	107,318	-	3.4	107,318	5.40	3.413	67,829		175,147	1.00	5.704
88	66	364.0	107,318	-	3.8	107,318	5.40	3.413	67,829		156,833	0.73	5,281
83	63	457.0	107,318	-	3.8	107,318	5.40	3.413	67,829		156,833	0.73	6,630
78	61	581.0	107,318	-	3.8	107,318	5.40	3.413	67,829		156,833	0.73	8,429
73	59	707.0	107,318	-	3.8	107,318	5.40	3.413	67,829		156,833	0.73	10,257
68	56	804.0	107,318	-	3.8	107,318	5.40	3.413	67,829		156,833	0.73	11,664
63	53	965.0	107,318	-	3.8	107,318	5.40	3.413	67,829		156,833	0.73	14,000
58	50	1100.0	107,318	-	3.8	107,318	5.40	3.413	67,829		156,833	0.73	15,959
53	47	1098.0	107,318	-	3.8	107,318	5.40	3.413	67,829		156,833	0.73	15,930
48	43	902.0	107,318	-	3.8	107,318	5.40	3.413	67,829		156,833	0.73	13,086
43	40	681.0	107,318	-	3.8	107,318	5.40	3.413	67,829		156,833	0.73	9.880
38	36	397.0	107,318	-	3.8	107,318	5.40	3.413	67,829		156,833	0.73	5,760
33	32	159.0	107,318	-	3.8	107,318	5.40	3.413	67,829		156,833	0.73	2,307
28	27	32.0	107,318	-	3.8	107,318	5.40	3.413	67,829		156,833	0.73	464

			Application
kWh=	129.846	=	129,734
kWh=	22.55	=	23

Condenser Capacity	2,552,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	3	circuits	147,231
LT#1 Condensing Circuits	12	circuits	588,923
LT#2 Condensing Circuits	0	circuits	0
MT#1 Condensing Circuits	7	circuits	343,538
MT#2 Condensing Circuits	21	circuits	1,030,615
AC Condensing Circuits	9	circuits	441,692
Total Circuits	52		2,552,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	Refrigeration Case Load (Btuh)	Application Factor (unitless)	Calculated Application Factor, Check (unitless)	Equivalent Btuh rejected for case Load (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	0.0	0	-	0.0	0	0.00	0	0		0	0.00	0
108	72	8.0	115,300	-	0.0	115,300	7.38	3.413	53,322		168,622	1.00	125
103	70	53.0	115,300	-	0.0	115,300	8.01	3.413	49,128		164,428	1.00	763
98	68	159.0	115,300	-	0.0	115,300	8.53	3.413	46,134		161,434	1.00	2,149
93	66	287.0	115,300	-	0.0	115,300	9.05	3.413	43,483		158,783	1.00	3,656
88	66	364.0	115,300	-	0.0	115,300	9.15	3.413	43,008		146,695	0.73	3,348
83	63	457.0	115,300	-	0.0	115,300	9.15	3.413	43,008		146,695	0.73	4,204
78	61	581.0	115,300	-	0.0	115,300	9.15	3.413	43,008		146,695	0.73	5,345
73	59	707.0	115,300	-	0.0	115,300	9.15	3.413	43,008		146,695	0.73	6,504
68	56	804.0	115,300	-	0.0	115,300	9.15	3.413	43,008		146,695	0.73	7,396
63	53	965.0	115,300	-	0.0	115,300	9.15	3.413	43,008		146,695	0.73	8,877
58	50	1100.0	115,300	-	0.0	115,300	9.15	3.413	43,008		146,695	0.73	10,119
53	47	1098.0	115,300	-	0.0	115,300	9.15	3.413	43,008		146,695	0.73	10,100
48	43	902.0	115,300	-	0.0	115,300	9.15	3.413	43,008		146,695	0.73	8,297
43	40	681.0	115,300	-	0.0	115,300	9.15	3.413	43,008		146,695	0.73	6,264
38	36	397.0	115,300	-	0.0	115,300	9.15	3.413	43,008		146,695	0.73	3,652
33	32	159.0	115,300	-	0.0	115,300	9.15	3.413	43,008		146,695	0.73	1,463
28	27	32.0	115,300	-	0.0	115,300	9.15	3.413	43,008		146,695	0.73	294

			Application
kWh=	82,556	=	82,530
kWh=	15.62	=	16

Condenser Capacity	2,552,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	3	circuits	147,231
LT#1 Condensing Circuits	12	circuits	588,923
LT#2 Condensing Circuits	0	circuits	0
MT#1 Condensing Circuits	7	circuits	343,538
MT#2 Condensing Circuits	21	circuits	1,030,615
AC Condensing Circuits	9	circuits	441,692
Total Circuits	52		2,552,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	Refrigeration Case Load (Btuh)	Application Factor (unitless)	Calculated Application Factor, Check (unitless)	Equivalent Btuh rejected for case Load (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	0.0	0	-	0.0	0	0.00	0	0		0	0.00	0
108	72	8.0	366,750	-	2.0	366,750	7.88	3.413	158,847		525,597	1.00	372
103	70	53.0	366,750	-	2.0	366,750	8.46	3.413	147,957		514,707	1.00	2,298
98	68	159.0	366,750	-	2.0	366,750	9.04	3.413	138,464		505,214	1.00	6,451
93	66	287.0	366,750	-	2.1	366,750	9.73	3.413	128,645		495,395	1.00	10,818
88	66	364.0	366,750	-	2.2	366,750	9.85	3.413	127,078		459,517	0.73	9,894
83	63	457.0	366,750	-	2.2	366,750	9.85	3.413	127,078		459,517	0.73	12,421
78	61	581.0	366,750	-	2.2	366,750	9.85	3.413	127,078		459,517	0.73	15,792
73	59	707.0	366,750	-	2.2	366,750	9.85	3.413	127,078		459,517	0.73	19,217
68	56	804.0	366,750	-	2.2	366,750	9.85	3.413	127,078		459,517	0.73	21,853
63	53	965.0	366,750	-	2.2	366,750	9.85	3.413	127,078		459,517	0.73	26,229
58	50	1100.0	366,750	-	2.2	366,750	9.85	3.413	127,078		459,517	0.73	29,899
53	47	1098.0	366,750	-	2.2	366,750	9.85	3.413	127,078		459,517	0.73	29,844
48	43	902.0	366,750	-	2.2	366,750	9.85	3.413	127,078		459,517	0.73	24,517
43	40	681.0	366,750	-	2.2	366,750	9.85	3.413	127,078		459,517	0.73	18,510
38	36	397.0	366,750	-	2.2	366,750	9.85	3.413	127,078		459,517	0.73	10,791
33	32	159.0	366,750	-	2.2	366,750	9.85	3.413	127,078		459,517	0.73	4,322
28	27	32.0	366,750	-	2.2	366,750	9.85	3.413	127,078		459,517	0.73	870

kWh=	244,098	=	Application 244,122
kWh=	46.54	=	47

Condenser Capacity	2,552,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	3	circuits	147,231
LT#1 Condensing Circuits	12	circuits	588,923
LT#2 Condensing Circuits	0	circuits	0
MT#1 Condensing Circuits	7	circuits	343,538
MT#2 Condensing Circuits	21	circuits	1,030,615
AC Condensing Circuits	9	circuits	441,692
Total Circuits	52		2,552,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	AC Load (tons)	AC Load (Btuh)	Equivalent Btuh rejected for AC (Btuh)	Compressor Efficiency, EER (Btu/Watt-hr)	Conversion Constant (Btu/Watt-hr)	Compressor Btuh rejected due to work (Btuh)	[redacted]	Calculated Btuh Rejected, Check (Btuh)	Load Factor (unitless)	Compressor Energy Use (kWh) (kWh)
113	74	0.0	0.00	0	0	0.00	0	0		0	0.00	0
108	72	8.0	20.00	240,000	240,000	11.07	3.413	73,995		313,995	1.00	173
103	70	53.0	18.57	222,840	222,840	12.64	3.413	60,170		283,010	1.00	934
98	68	159.0	15.71	188,520	188,520	14.85	3.413	43,328		231,848	1.00	2,018
93	66	287.0	12.86	154,320	154,320	17.06	3.413	30,873		185,193	1.00	2,596
88	66	364.0	10.00	120,000	120,000	17.69	3.413	23,152		143,152	1.00	2,469
83	63	457.0	7.14	85,680	85,680	17.69	3.413	16,531		102,211	1.00	2,213
78	61	581.0	4.29	51,480	51,480	17.69	3.413	9,932		61,412	1.00	1,691
73	59	707.0	1.43	17,160	17,160	17.69	3.413	3,311		20,471	1.00	686
68	56	804.0										
63	53	965.0										
58	50	1100.0										
53	47	1098.0										
48	43	902.0										
43	40	681.0										
38	36	397.0										
33	32	159.0										
28	27	32.0										

			Application
kWh=	12,782	=	12,292
kWh=	21.68	=	21.7

Notes

The application assumes a lower AC load in the post-measure #2 retrofit condition.

Condenser, Measure #1

Condenser Capacity	2,552,000	Btuh	Btuh Capacity
Ice Cream Condensing Circuits	3	circuits	147,231
LT#1 Condensing Circuits	12	circuits	588,923
LT#2 Condensing Circuits	0	circuits	0
MT#1 Condensing Circuits	7	circuits	343,538
MT#2 Condensing Circuits	21	circuits	1,030,615
AC Condensing Circuits	9	circuits	441,692
Total Circuits	52		2,552,000

Bin Temperature (°F)	Coincident Wet-Bulb (°F)	Hour per bin (hours)	AC Heat Rejection (Btuh)	Refrigeration Heat Rejection (Btuh)	Condenser Load Factor (unitless)	Calculated Condenser Load Factor, Check (unitless)	Total Heat Rejection (Btuh)	Total Heat Rejection from the Application (MBtuh)	Total Heat Rejection from the Application (Btuh)
113	74	0.0	0	0	-	0.0	0	0	0
108	72	8.0	313,995	938,178	-	2.0	1,252,172	1,243	1,243,000
103	70	53.0	283,010	916,685	-	2.1	1,199,695	1,191	1,191,000
98	68	159.0	231,848	898,405	-	2.3	1,130,253	1,125	1,125,000
93	66	287.0	185,193	878,033	-	2.4	1,063,226	1,068	1,068,000
88	66	364.0	143,152	811,753	-	2.7	954,905	1,025	1,025,000
83	63	457.0	102,211	811,753	-	2.8	913,964	984	984,000
78	61	581.0	61,412	811,753	-	2.9	873,166	944	944,000
73	59	707.0	20,471	811,753	-	3.1	832,224	903	903,000
68	56	804.0	0	811,753	-	3.1	811,753	882	882,000
63	53	965.0	0	811,753	-	3.1	811,753	882	882,000
58	50	1100.0	0	811,753	-	3.1	811,753	882	882,000
53	47	1098.0	0	811,753	-	3.1	811,753	882	882,000
48	43	902.0	0	811,753	-	3.1	811,753	882	882,000
43	40	681.0	0	811,753	-	3.1	811,753	882	882,000
38	36	397.0	0	811,753	-	3.1	811,753	800	800,000
33	32	159.0	0	811,753	-	3.1	811,753	700	700,000
28	27	32.0	0	811,753	-	3.1	811,753	600	600,000
						Total Rejected	15,525,385	15,875	15,875,000

Heat rejection differences are significant

Measure #2 Summary of Findings

Evaluation Compressor Savings	Pre-Retrofit Demand	Post-Retrofit Demand	Measure # Demand Savings		Pre-Retrofit Energy	Post-Retrofit Energy	Measure # Energy Savings	
Ice Cream Condensing Circuits	8.16	7.58	0.58		43,786	31,978	11,808	
LT#1 Condensing Circuits	22.55	22.55	0.00		129,846	94,315	35,531	
MT#1 Condensing Circuits	15.62	15.62	0.00		82,556	60,791	21,765	
MT#2 Condensing Circuits	46.54	46.54	0.00		244,096	178,280	65,816	
AC Condensing Circuits	21.68	17.25	4.43		12,782	9,146	3,636	
Total			5.01	kW			138,555	kWh
Total Refer w/ Compressor		113.50				425,451		

Application Compressor Savings	Pre-Retrofit Demand	Post-Retrofit Demand	Measure # Demand Savings		Pre-Retrofit Energy	Post-Retrofit Energy	Measure # Energy Savings	
Ice Cream Condensing Circuits	8.00	8.00	0.00		43,820	32,840	10,980	
LT#1 Condensing Circuits	23.00	23.00	0.00		129,734	94,312	35,422	
MT#1 Condensing Circuits	16.00	16.00	0.00		82,530	60,973	21,557	
MT#2 Condensing Circuits	47.00	47.00	0.00		244,122	178,274	65,848	
AC Condensing Circuits	21.70	12.40	9.30		12,292	4,058	8,234	
Total			9.30	kW			142,041	kWh

Applicaton Condenser Analysis	Pre-Retrofit Demand	Post-Retrofit Demand	Measure # Demand Savings	Pre-Retrofit Energy	Post-Retrofit Energy	Measure # Energy Savings (kWh)	Pre-Condenser Rejection (Btuh)	Post-Condenser Rejection (Btuh)	Difference in Condenser Heat Rejection (Btuh)	Measure Energy Savings per Condenser Heat Rejection (kWh/Btuh)
Condenser Fan Use	21.00	21.00	0.00	65,532	59,499	6,033	15,875,000	14,619,000	1,256,000	0.00
							0.00406998	1.4365E-06		

Evaluation Condenser Analysis	Pre-Condenser Rejection (Btuh)	Post-Condenser Rejection (Btuh)	Difference in Condenser Heat Rejection (Btuh)	Measure Energy Savings per Condenser Heat Rejection (kWh/Btuh)	Post-Energy	Post Demand
Condenser Fan Use	15,525,385	14,763,413	761,972	3,660	60,087	21.2074476

Final Results for Measure #2

Source	Demand Impact	Energy Impact
Evaluation	5.01	142,215
Application	9.30	148,074

Site ID#:	390
Check #	63398
Measure	EMS for store lighting and refrigeration system; new condenser

Measure Description: Action code 453, refrigeration EMS.

Summary of Calculations in the Original Application: Savings are estimated in this application for improved compressor efficiency resulting from a reduced minimum condensing temperature setpoint.

Additionally, the EMS controls refrigerated case anti-sweat heaters.

Also, a new evaporative oversized condenser was installed.

Comments on Calculations: This application is well documented and clearly explains the proposed retrofit at this grocery store and all assumptions regarding the associated savings.

In conjunction with the refrigeration retrofits covered under this application, store lighting systems were also retrofit with high efficiency technologies.

Evaluation Process: An on-site audit of this facility has shown that all equipment specified in the application were installed.

Condensing temperatures measured at the time of this audit indicate that a floating head control strategy is used for the condenser. Condensing temperature leaving the condenser (before liquid subcooling) ranged from 63 °F to 65 °F, while ambient dry bulb conditions were 52 °F. These measurements suggest a minimum condensing setpoint below the assumed 70 °F application value.

The final impact verification consisted of a billing comparison. Billing records clearly show an impact following this retrofit that is at least as large as claimed savings. Impacts in the application were adopted as the evaluation estimate of savings.

Additional Notes: An on-site inspection of this facility was conducted with Pam Funk on October 18, 1996. The did not provide useful site contact information. However, an equipment inventory was conducted, and R-22 refrigerant conditions were measured during this inspection (discharge, suction and condensate temperatures).

Impact Results for Site ID# 390

	kW	kWh	Therm
Application	0.94	188,633	0
MDSS	0.94	188,633	0
Evaluation Estimates	0.94	188,633	0
Engineering Realization Rate	1.00	1.00	NA
Customer Billing Summary	NA	308,747	

Monthly Energy

Site_ID	Year	1	2	3	4	5	6	7	8	9	10	11	12	Calander	Oct-Sept	
390	1992	173,120	191,400	202,733	198,376	223,877	221,650	229,605	230,742	227,357	222,844	198,753	203,101	2,523,559		
390	1993	177,865	191,758	218,912	189,148	208,805	213,289	228,897	225,670	226,462	210,037	204,139	206,396	2,501,376	2,505,503	
390	1994	184,258	180,492	202,176	195,714	207,920	205,926	210,797	194,870	182,689	174,471	168,293	164,550	2,272,155	2,385,412	95%
390	1995	134,160	143,440	155,640	152,417	158,023	160,480	176,855	179,593	169,072	162,465	157,950	160,665	1,910,760	1,936,994	77%
390	1996	157,560	147,397	156,825	151,063	162,155	171,097	199,943	199,730	175,950				1,521,720	2,002,800	80%

Monthly Max Demand

Site_ID	Year	1	2	3	4	5	6	7	8	9	10	11	12	Maximum
390	1992	328	328	330	387	386	392	392	410	392	382	350	326	410
390	1993	325	328	309	333	370	389	395	395	342	368	365	330	395
390	1994	325	338	331	339	346	392	381	355	347	317	309	298	392
390	1995	285	277	275	277	294	334	342	336	331	285	298	288	342
390	1996	285	298	288	280	293	277	299	306	346				346

Energy Comparison of Calendar 1995 and Calendar 1993:

1993-1995=	**590,616**	kWh savings per year
Lighting Retrofit	**281,869**	kWh savings per year from application for lighting retrofit
	308,747	estimated additional savings after lighting retrofit savings are removed

Energy Comparable to, and in fact exceeds the claimed savings of 188,633 kWh/year

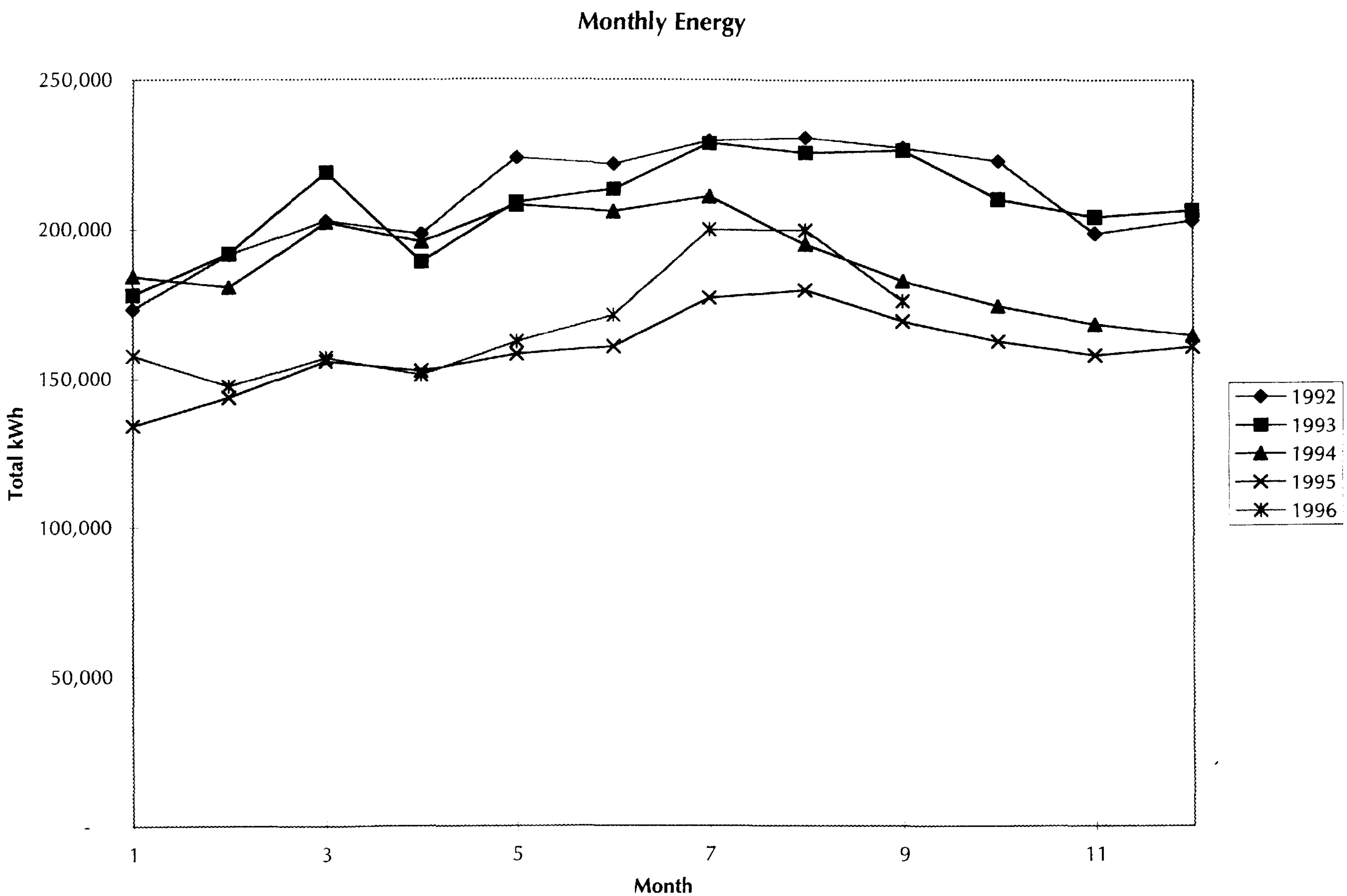
(308,747 kWh) / 2,501,376 kWh

12% Savings to the 1993 bill.

A calendar year 1993 vs 1995 comparison was selected since the project completion date was not until August of 1994.

Note that a 1992 base year yields a similar savings estimate.

Because the demand savings are so small for the refrigeration portion of this retrofit, no demand comparison using billing data was deemed necessary.


Monthly Energy
250,000
200,000
150,000
100,000
50,000
-
Total kWh
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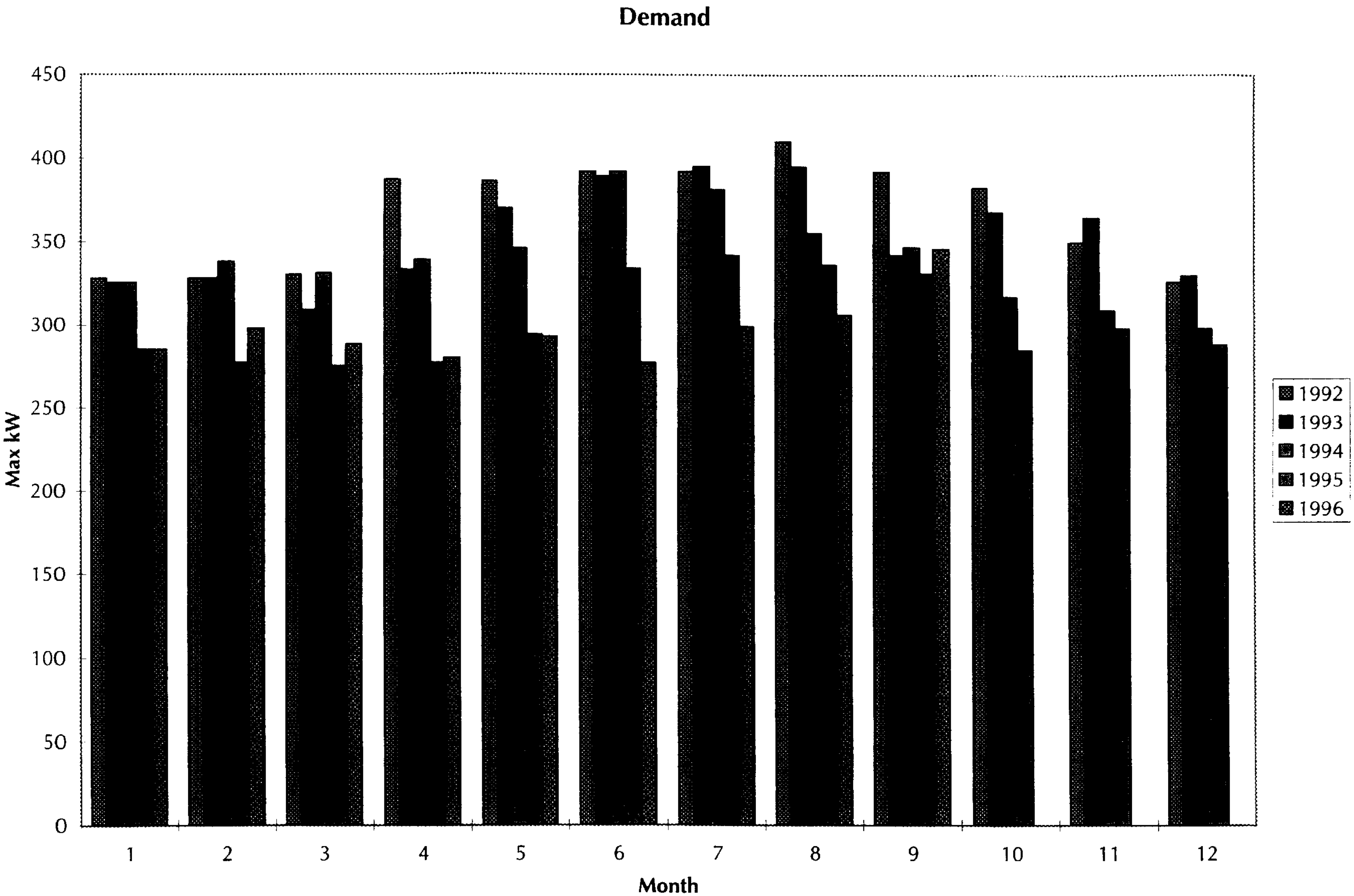
Demand
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Max kW
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Site ID#:	396
Check #	63879
Measure	EMS, new evaporative condenser, floating head pressure controls, anti-sweat heater controls, HID retrofit, and VFD for condenser fans

Measure Description: Action code 478, oversized condensers. Retrofit, however, more extensive than just a condenser measure.

Summary of Calculations in the Original Application: Savings are estimated in this application for improved compressor efficiency resulting from a reduced minimum condensing temperature setpoint (floating head pressure controls).

Additionally, the EMS controls refrigerated case anti-sweat heaters.

Lastly, condensing fans were intended to be retrofit with variable frequency drive (VSD) fan speed controls.

Comments on Calculations: This application is well documented and clearly explains the proposed retrofit at this grocery store and all assumptions regarding the associated savings.

Evaluation Process: An on-site audit of this facility could not identify the location of the VFD serving the condenser. All other equipment were, however, installed according to the application records.

Condensing temperatures measured at the time of this audit indicate that a floating head control strategy is used for the condenser. Condensate temperatures (before liquid subcooling) were measured below 70 °F, while ambient dry bulb conditions were 69 °F. These measurements are consistent with application minimum condensing setpoint assumptions.

The final impact verification consisted of a billing comparison. Billing records clearly show an impact following this retrofit that is at least as large as claimed savings. Impacts in the application were adopted as the evaluation estimate of savings, following a reduction in claimed savings for the VFD measure.

Additional Notes: An on-site inspection of this facility was conducted with Les on October 23, 1996. The inspection included a thorough equipment inventory of the refrigeration systems, and R-22 refrigerant conditions were measured during this inspection (discharge, suction and condensate temperatures).

Impact Results for Site ID# 396

	kW	kWh	Therm
Application	24.7	244,994	0
MDSS	24.7	244,994	0
Evaluation Estimates	24.7	222,466	0
Engineering Realization Rate	1.00	0.91	NA
Customer Billing Summary	16	325,213	

Monthly Energy

Site_ID	Year	1	2	3	4	5	6	7	8	9	10	11	12	Calander	Oct-Sept	
396	1992	207,365	204,352	218,772	202,232	239,796	225,680	233,988	232,252	228,169	228,805	205,382	215,462	2,642,255		
396	1993	198,280	199,920	227,875	218,696	231,469	230,436	241,077	241,419	226,290	227,220	217,963	212,006	2,672,651	2,665,110	
396	1994	186,912	202,423	223,465	215,570	234,201	228,221	236,058	245,630	235,782	235,374	223,698	226,026	2,693,360	2,665,451	100%
396	1995	181,440	170,624	185,330	182,136	191,314	189,961	198,555	194,331	199,539	206,770	210,735	214,175	2,324,910	2,378,328	89%

Monthly Max Demand

Site_ID	Year	1	2	3	4	5	6	7	8	9	10	11	12	Maximum
396	1992	344	363	378	379	376	381	400	387	403	382	373	386	403
396	1993	370	402	403	389	402	397	403	403	403	392	390	390	403
396	1994	346	389	389	386	402	406	406	418	384	413	392	397	418
396	1995	352	307	304	315	331	355	342	342	347	362	387	376	387

Energy Comparison of Calendar 1995 and Calendar 1993:

1993-1995=	**347,741**	kWh savings per year
VSD for Condenser	**22,528**	reduction in kWh savings due to incomplete VSD retrofit (could not find VSD during on-site audit)
	325,213	kWh savings per year after VSD reduction

Energy Comparable to, and in fact exceeds the claimed savings of 244,994 kWh/year

(325,213 kWh) / 2,672,651 kWh

12% Savings to the 1993 bill.

Note that a 1992 or 1994 base year yields a similar savings estimate.

Demand Comparison of Calendar 1995 and Calendar 1993:

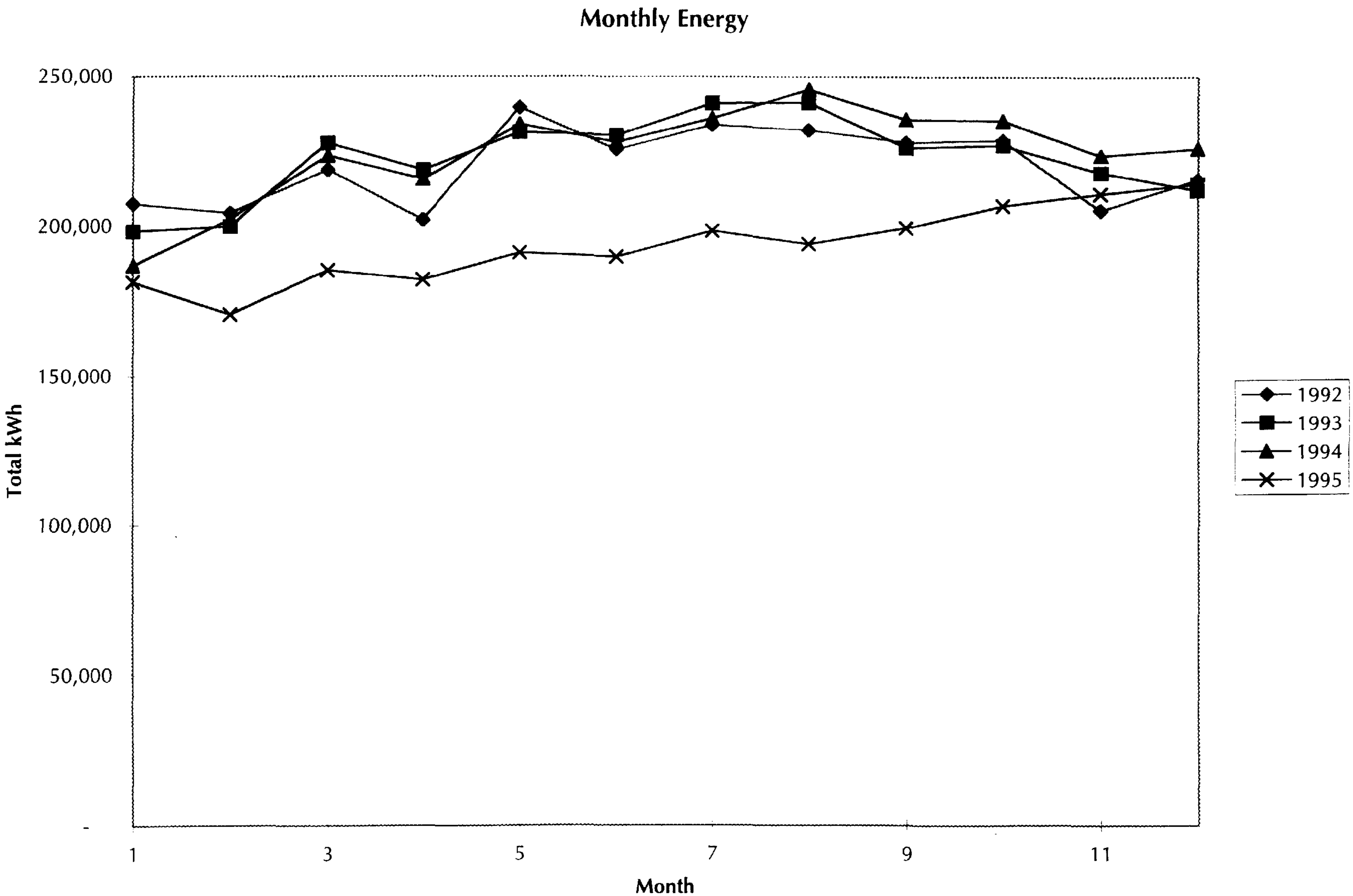
Max 1993-1996= **16** kW

Demand comparable to the claimed savings of 24.7 kW

Note that a 1994 base would yield a closer estimate of 31 kW.

(16 kW) / 403 kW

4% Savings to the 1993 bill.


Monthly Energy
250,000
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Total kWh
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Month
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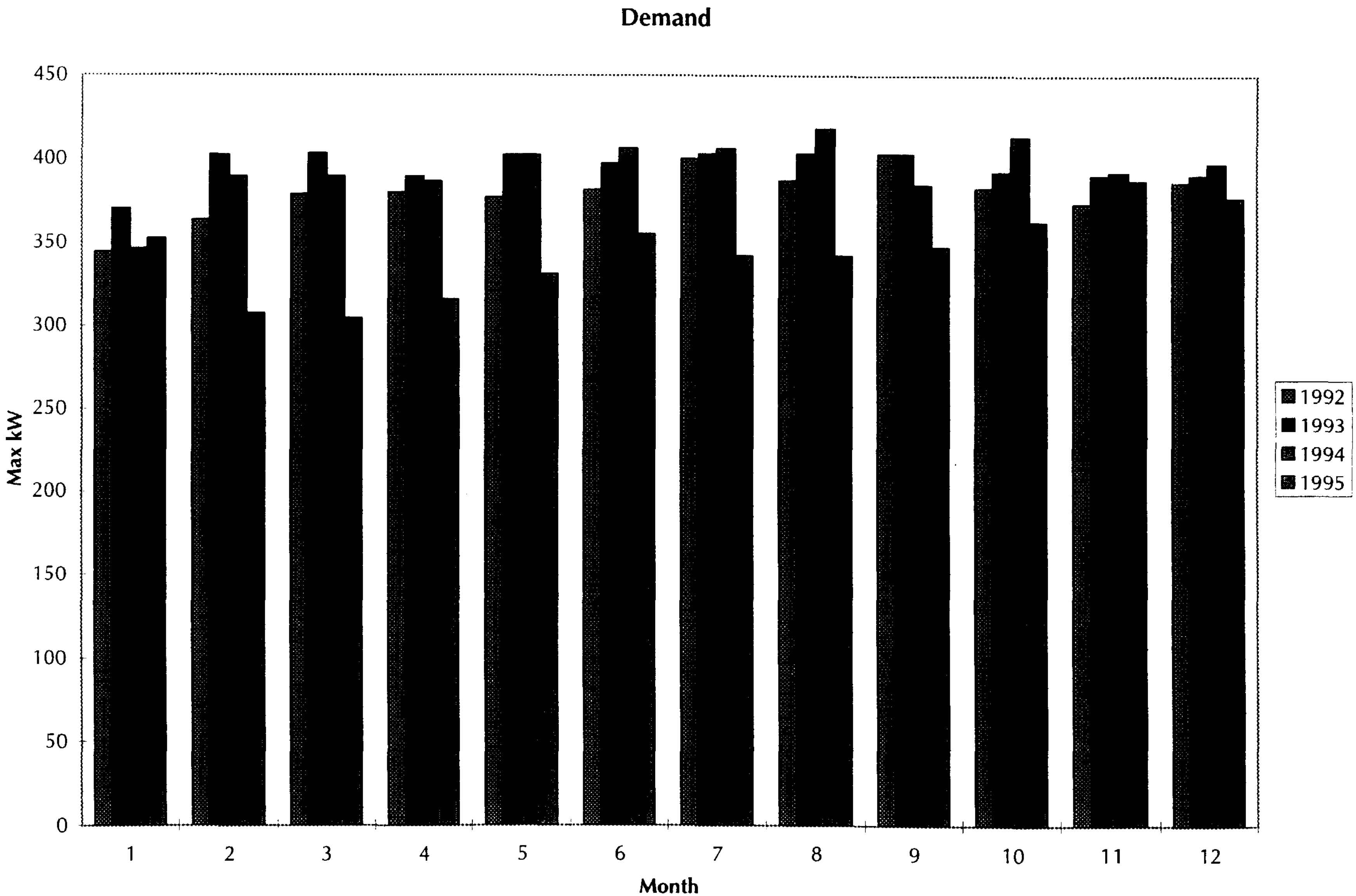
1993
1994
1995


Demand
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1995

Site ID#:	657
Check #	62974
Measure	Energy Management System and Control Optimization

Measure Description:

An Energy Management System (EMS) was installed at a large industrial refrigeration company; action code 453. The EMS serves 117,185 sq ft of refrigerated warehouse, with three engine rooms driving the R-717 ammonia system. This warehouse processes, cools and freezes vegetables, meat, fish and juice concentrates. The application states that the control system saves energy using the following strategies: floating head pressure, floating suction pressure, evaporator coil defrost optimization, and evaporator fan control.

Summary of Calculations in the Original Application:

Bin models were developed to estimate, warehouse loads (surface gains and losses) -- in conjunction with product load estimates, and equipment energy use required to meet those loads -- condenser, compressor and evaporator energy use. Assumptions and model results are well documented.

Comments on Calculations:

The EMS system installed (engine room #1, PLC-5) serves engine rooms #1 and #2 (compressors and condensers) and the refrigerated warehouse space controlled by those systems (including evaporators). However, the original application also indicates that this EMS system serves engine room #3 systems; information provided by the on-site contact has shown that although engine room #3 systems will eventually be controlled by the PLC-5 unit, this portion of the retrofit has not yet been completed (engine room #3 is currently served by a separate control system installed in 1989).

Additionally, the following issues were noted surrounding the application calculations:

Surprisingly, evaporator loads, according to the bin models, are often larger than the compressor loads. Pre-retrofit demand estimates for the evaporator systems are based upon undiversified evaporator fan use in the pre-retrofit condition.

- The modeled compressor and evaporator energy usage shows evaporator loads that are greater than compressor loads. Impacts are based upon the following percentage contributions to the total refrigeration load:

	Pre-Retrofit Usage	Post-Retrofit Usage
Compressors	36%	34%
Evaporators	62%	59%
Condensers	2%	5%

- Compressor loads appear small when compared against the equipment inventory for each engine room. For example, the largest modeled hourly baseline compressor load (excluding boosters) in engine room #1 is 195.9 kW out of 527 available kW, or just 37% of capacity.

- Additionally, engine room #2 compressor loads never exceed 46.7 kW , or just 18% of the 301.7 kW in total capacity.
- Within engine room #1, booster compressors are also modeled with relatively low loads. The maximum observed booster compressor load is 31.6 kW out of a total available equipment connected load of 107 kW, or just 30% of capacity.
- June pre- and post-retrofit engine room #2 energy use is set equal to zero using a monthly use factor that accounts for the portion of each system actually in use.
- It appears that only 15% of the evaporator fan energy use contributes to the warehouse load. All of the evaporator fan energy use should contribute as heat load to the refrigerated space, not just the portion due to "motor inefficiency".

Evaluation Process: The equipment listed on page 7.10 of the application were verified (though one Mycom compressor serving engine room #3 was added in April of 1996)

Product loads were gathered for the one year period following installation of the EMS system (installation completed in September of 1995).

PG&E 15 minute interval load data were acquired for this particular site, providing an additional source for model verification.

According to those site contact records, 87,640,000 pounds of meat, juice concentrate and fruit were processed/stored at this facility during the period October 1995 through September 1996. These loads are significantly lower than application records assumed to estimate impacts -- 109,856,000 lb of product. It is assumed that the product loads gathered on-site indicate a period of relatively low to average historic processing.

No attempt was made to revise the application calculation records due to many of the issues noted above. For this reason, the evaluation process consisted of the following:

- Analysis of refrigerant operating setpoints during the year. A nine month sample of EMS data were provided by the site contact for selected weekdays (one per month) and for a smaller sample of Saturday and Sunday observations. These hourly EMS records provide ammonia refrigerant suction and discharge pressures, a binary evaporator defrost history, and warehouse room and outside air temperatures. These data have been used to verify both the application records and on-site records of refrigeration system operating setpoints. Additionally, condensing temperatures and outdoor temperatures were recorded during the on-site audit in order to verify the use floating head control strategies. Exhibits 657-1 and 657-2 provide a summary of measured high-stage discharge pressures which indicate that summer discharge pressures that are roughly 10-25 psi higher than the winter values recorded. This suggests that floating head pressure controls are used. Exhibits

657-3 and 657-4, however, show that suction pressures are not significantly variable during the year (and therefore with change in ambient temperature conditions). This suggests that application reports of floating suction control may not be used.

- Because the energy impacts for this retrofit were cited in the application as a 20% reduction in annual usage, and because application end-use models exhibit characteristics that may not accurately predict refrigeration equipment usage, evaluation analyses rely instead upon a billing analysis -- that is, a comparison of pre-retrofit and post-retrofit energy use.

Additional Notes: An on-site inspection of this facility was conducted on October 8, 1996 with Tom Casey and Dave Apling, along with Clay Shmidt, a PG&E representative.

During an interview with the facility engineer he stated that the discharge and suction settings for the refrigeration system have not changed since the installation of the EMS. The static discharge temperature (pre- vs post-retrofit) in turn suggests that the condensing temperature has not changed since the installation of the EMS system. The condensed ammonia at a given saturation pressure will have a fixed condensing temperature (due to the properties of pure ammonia at saturation temperature and pressure). Regardless of whether or not floating head pressure control strategies are used at this site, the fact that the discharge pressure has not been modified following the installation of EMS controls suggests that the condensing temperature also has not changed.

In addition, automated evaporator defrost control strategies have been decommissioned since the installation of the EMS, in favor of manual defrost control.

Impact Results for Site ID# 657

	kW	kWh	Therm
Application	24	900,322	0
MDSS	24	900,322	0
Evaluation Estimates	0	0	0
Engineering Realization Rate	0	0	NA
Customer Billing Summary			

Exhibit 657-1

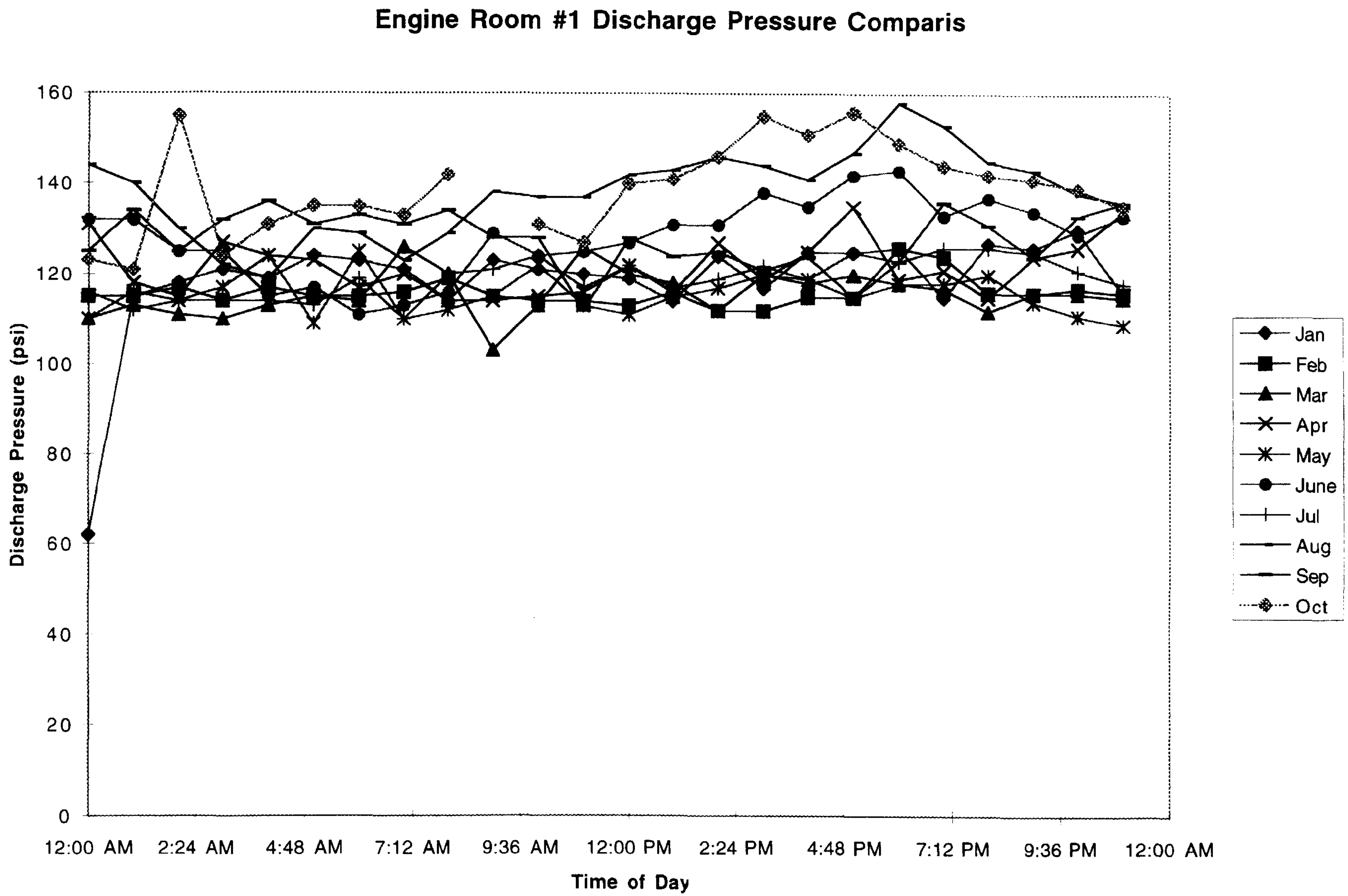


Exhibit 657-2

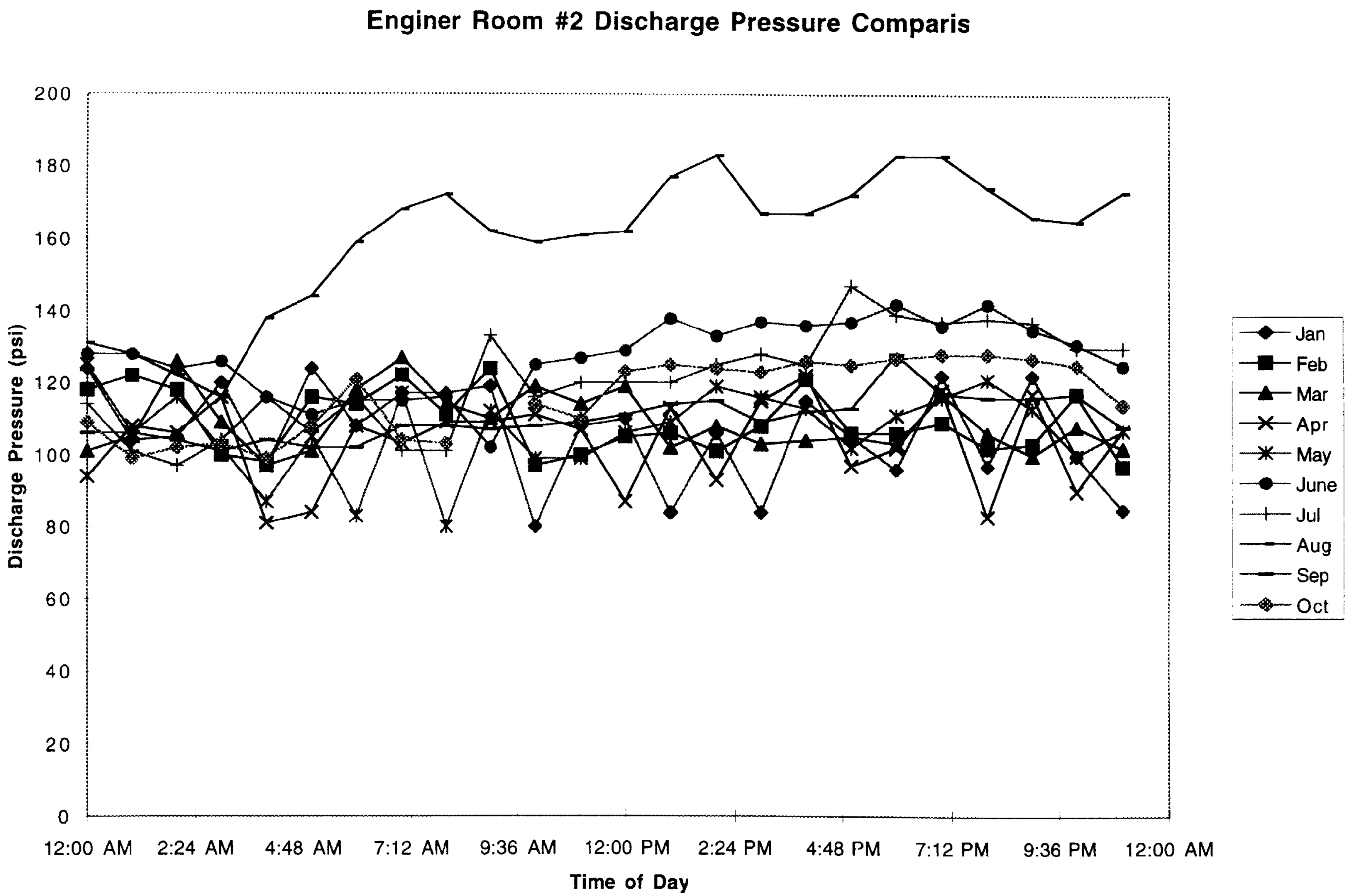


Exhibit 657-3

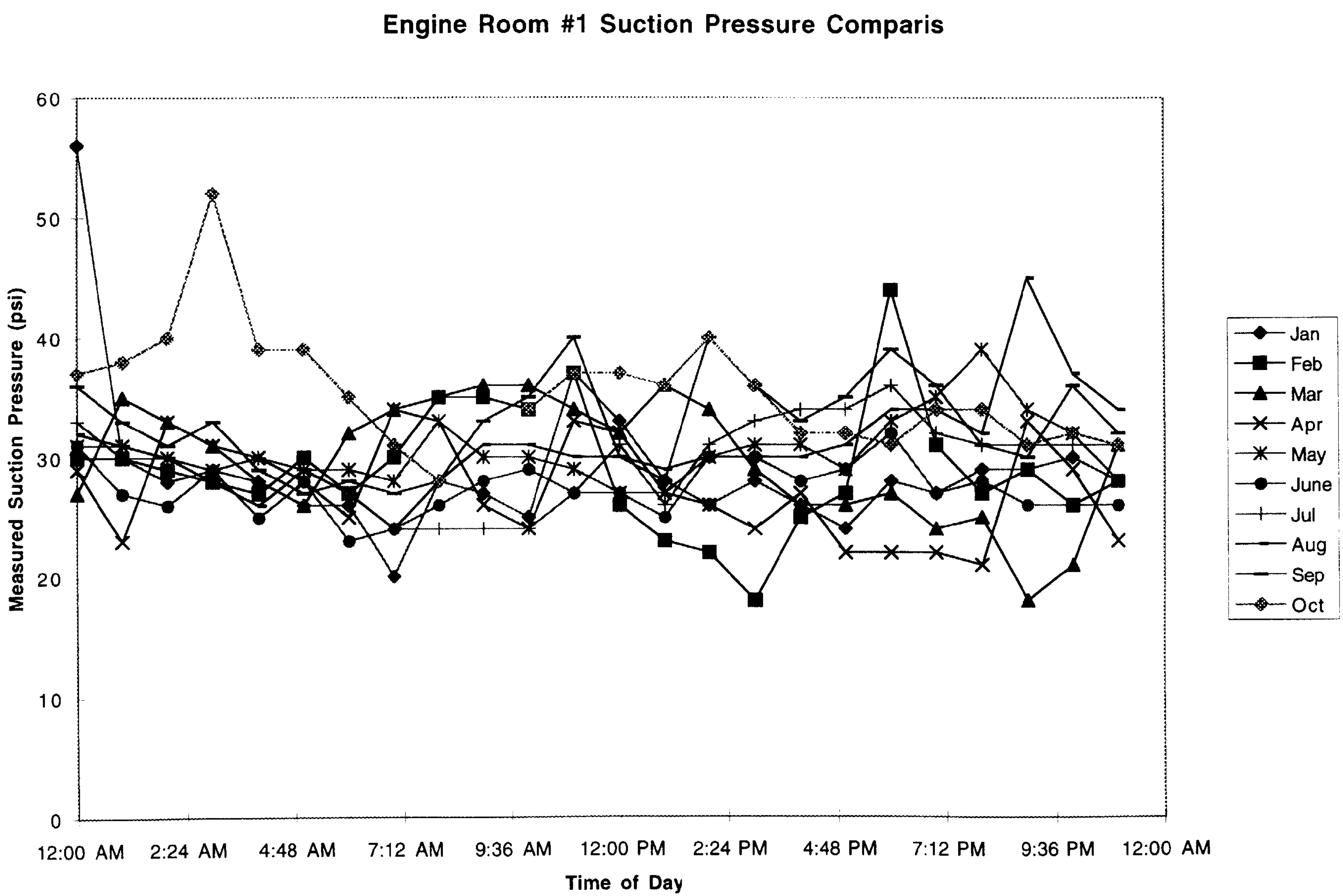
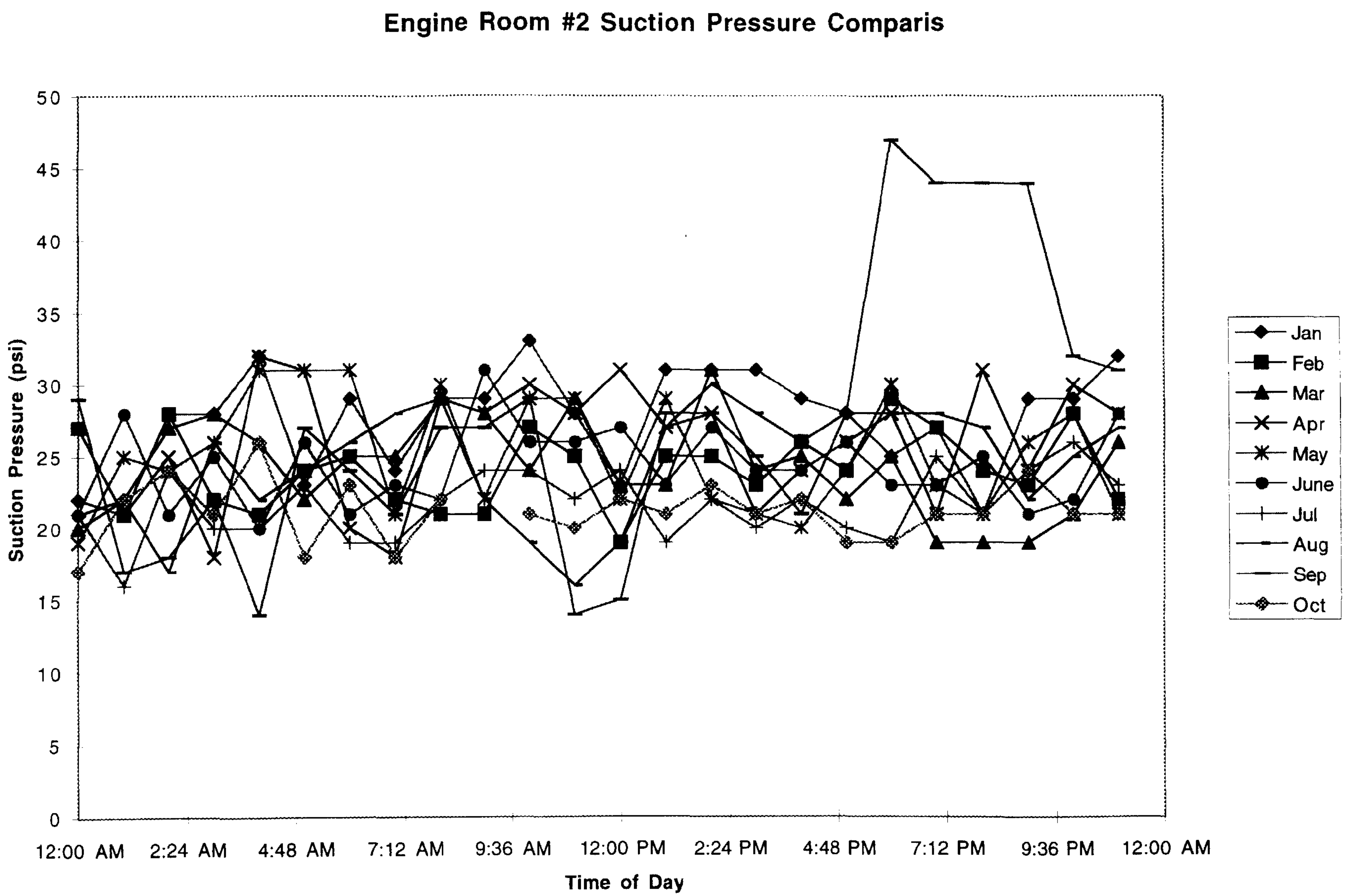
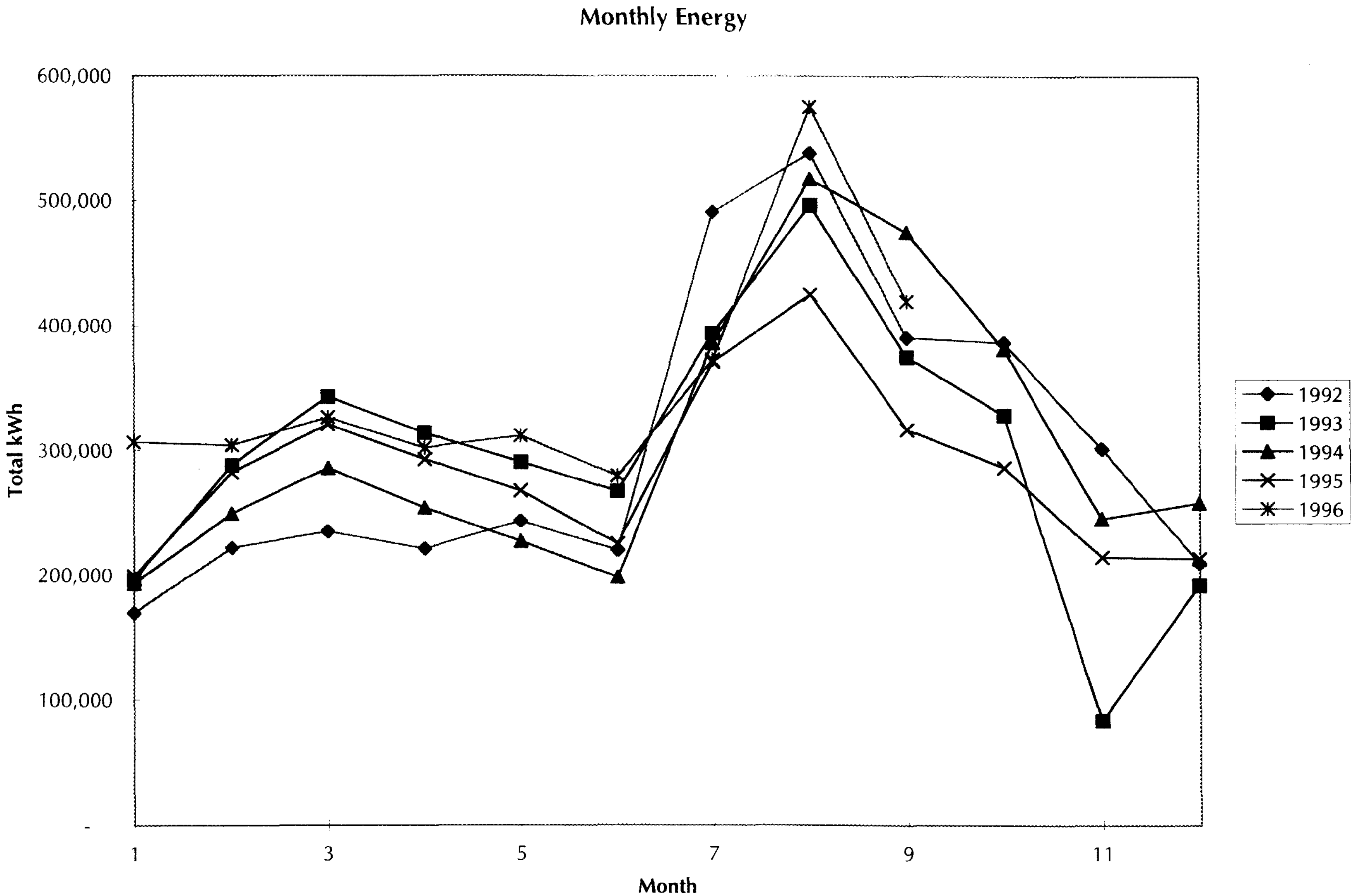


Exhibit 657-4




Monthly Energy
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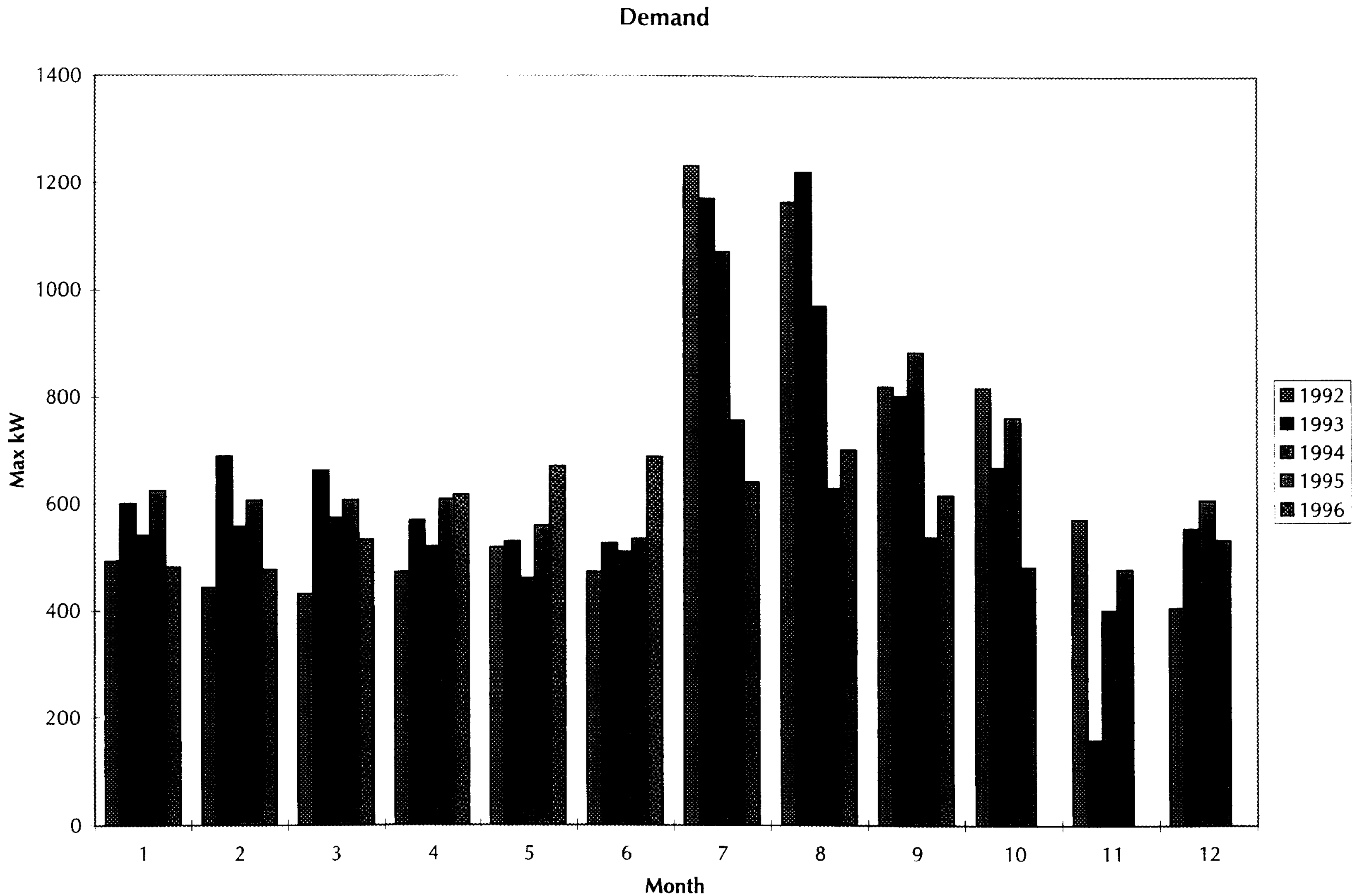
Demand
1400
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Max kW
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Month
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1994
1995
1996

Monthly Energy

Site_ID	Year	1	2	3	4	5	6	7	8	9	10	11	12	Oct-Sept	Percent of 1993
657	1992	169,431	221,799	234,847	220,910	243,257	219,693	490,746	538,014	390,129	386,131	301,748	209,692		
657	1993	195,976	287,927	342,983	313,732	290,375	266,848	393,853	496,355	374,505	328,313	83,093	192,021	3,860,126	
657	1994	192,581	249,122	285,786	253,996	226,801	198,020	385,871	517,516	474,824	380,893	245,761	258,293	3,387,942	88%
657	1995	198,570	282,284	320,777	292,662	267,261	224,897	370,897	424,700	316,584	286,350	214,503	213,250	3,583,579	93%
657	1996	306,259	303,916	326,229	301,834	311,492	279,149	372,452	575,303	419,301				3,910,038	101%

Monthly Max Demand

Site_ID	Year	1	2	3	4	5	6	7	8	9	10	11	12
657	1992	491	441	430	470	516	470	1231	1164	819	817	570	404
657	1993	600	689	662	568	528	525	1170	1220	801	668	157	553
657	1994	540	555	573	518	458	508	1071	970	884	761	400	606
657	1995	624	605	606	607	557	533	756	627	536	480	476	531
657	1996	480	476	531	616	669	687	639	700	615			

The above billing summary for site_id 657 was assembled to investigate the claimed impact levels of nearly 1,000,000 kWh.

The October - September annual kWh summary shows that usage has increased at this service address.
On-site records indicate that the quantity of product processed during the one-year period October 1995-September 1996 was average.
The energy impacts claimed in this application were not realized. Evaluation energy impacts are set to zero.
This is not surprising since on-site records have shown that many of the energy saving principles depicted in the application were not implemented following the EMS installation.

Demand savings, given the conservative nature of these estimates were accepted.

Site ID#:	2862
Check #	63612
Measure	Rerack warehouse, suction re-route, condenser replacement

Measure Description:

The retrofit site is a large agricultural cold storage facility, where produce are injected with ice, vacuum cooled, and stored for a short while prior to being shipped to market. The retrofit performed at this site consists of three distinct measures (all covered under a single application and recorded under a single MDSS record; action code 469):

1) Storage racks were added to the existing cold rooms to allow storage of additional iced product (pallets of broccoli); prior to the installation of these racks, cold storage capacity was often exceeded, resulting in approximately 25% of the pallets being stored outside. On average, the pallets stored outside would remain for one or two days and require re-icing once per day. Approximately 300 lbs of ice are required to re-ice a single pallet of broccoli. This increase in available cold storage has reduced the frequency of product storage outdoors, and therefore plant ice production.

2) The suction line feeding the cold storage was separated from the remainder of the system to allow a higher suction pressure for this particular application. A higher suction pressure provides a reduced pressure differential between the compressor discharge and the suction-side, leading to improved compressor performance. Prior to this system modification, a common suction was shared by all loads, leading to low suction pressures (that are not optimal for the cold storage application). A "pumper drum" liquid storage vessel was installed on the suction return from the cold storage room to augment the receiver vessel used by the remainder of the system (where liquid is removed from the vapor line before returning to the compressors). The separation of the cold storage suction line is desirable due to the high discharge pressure and low suction pressure requirements demanded by the ice-making equipment. According to information provided by the site contact, ice-making equipment are in use the majority of the time at this facility, and ice-making is estimated to account for roughly 60-70% of the system load.

3) The application also sites the replacement of two existing centrifugal fan evaporative condensers with a new axial fan evaporative condenser.

Summary of Calculations in the Original Application:

Bin models were developed to estimate equipment energy use at this site -- including condenser, compressor and evaporator energy use. Although the bin model results are reasonably documented, it is unclear if loads on the system were derived or simply applied to achieve a desired level of predicted energy use.

Comments on Calculations:

Estimates of ice-making deferred due to re-icing assume that re-icing is no longer required in the post-retrofit condition. Site contact information indicates, however, that some outdoor storage is still required (though post-retrofit frequency of outdoor storage was not quantified).

The suction re-routing measure included the installation of two 200 hp M&M compressors (though two existing 60 hp compressors are now off-line and remain only for standby purposes). Attachment 7 documentation suggest that one existing Mycom reciprocating compressor would be dedicated to the cold storage system, while in reality one of the new 200 hp M&M compressors were dedicated to that particular system.

The condenser replacement measure is not a replacement, but the addition of a new condenser.

The documentation and calculations provided make reference to liquid ammonia pumps (9 kW load) that is not used at this facility. liquid ammonia is distributed using the pressure differential between discharge and suction.

Evaluation Process: The evaluation does not attempt to reproduce the bin models provided in the application, but instead uses alternate methods to validate each estimate.

Current estimates were provided for iced product processed per year (8 million boxes vs 5 million from the application).

PG&E 15 minute interval load data were acquired for this particular site, providing a source for model calibration.

Since this retrofit occurred, an additional ice-making machine was purchased. Whenever possible, no ice is made during the peak period (noon - 6 PM). There is an active policy at this site to shift ice-making loads to the partial-peak periods.

Additional Notes: An on-site inspection of this facility was conducted on September 23, 1996 with Danny Vincent and Pete Zucker.

Impact Results for Site ID# 2862

	kW	kWh	Therm
Application	268	903,671	0
MDSS	268	903,671	0
Evaluation Estimates	186	903,671	0
Engineering Realization Rate	0.69	1.0	NA
Customer Billing Summary			

Exhibit 2862-1 Evaluation Energy and Demand Impacts			
Impact Measure	Annual Energy Use (kWh)	Peak Hour Demand (kW)	Recommended Evaluation Result
Re-rack Cold Room	430,532	67	Application
Re-route Suction	249,015	52	Appliation/Evaluation
Replace Condensers, ASD's	224,124	67	Application
Total	903,671	186	NA

* Review has resulted in a significant reduction in claimed demand, from 268 to 186 kW.

The contact provided the schedule during which ice is produced at this facility:

Daytype	Season	Pre-Retrofit Begin Ice Production	Pre-Retrofit End Ice Production	Pre-Retrofit Hours of Ice Production per Day	Post-Retrofit Begin Ice Production	Post-Retrofit End Ice Production	Post-Retrofit Hours of Ice Production per Day
Weekday	Summer*	12:00 midnight	12:00 midnight	24	6:00 PM	12:00 noon	16
Weekday	Non-Summer	12:00 midnight	12:00 midnight	24	12:00 midnight	12:00 midnight	24
Saturday	All	12:00 midnight	12:00 midnight	24	12:00 midnight	12:00 midnight	24
Sunday	All	12:00 midnight	12:00 midnight	24	12:00 midnight	12:00 midnight	24

* The PG&E summer season is defined as the period May 1 to October 31; the summer on-peak costing period during this time includes the hours 12:00 noon to 6:00 PM.
Although ice production has been successfully shifted from the peak period, this activity is not necessarily associated with the retrofit applied for and analyzed here.
For example, an ice machine was recently added (though not applied for under this application), yielding larger ice yields during partial- and off-peak periods.
Most of the time, ice production needs can be met during these non-peak periods. Ice is normally produced using the maximum capacity of each system.

Ice is made at this facility during the harvest season only -- 43 weeks per year. Therefore in the pre-retrofit case, ice making hours per year are

Annual hours of ice production = (43 weeks/year) x (7 days ice production/week) x (24 hours/day)
= 7,224 hours/year

The refrigerant suction and discharge setpoints/typical settings were gathered from the site contact

System	Pre-Retrofit Suction Pressure (psi)	Pre-Retrofit Discharge Pressure (psi)	Agrees with Observed Values During Site Visit	Post-Retrofit Suction Pressure (psi)	Post-Retrofit Discharge Pressure (psi)	Agrees with Observed Values During Site Visit
Cold rooms	21-22	145-160	No pre-visit	30-35	125-135	Yes
Ice production/vaccum tubes	21-22	145-160	No pre-visit	21-22	145-160	No Ice-Making Observed

Blue font designates an input.
Red font designates a calculation.
Green designates a result.

1) Assumptions:
There are 400 tons of ice storage capacity at this site.
Pallets that arrive directly from the field are normally iced with about 1,000 lbs of ice per pallet.
Pallets that are then stored outdoors, require approximately 300 lbs ice/pallet-day.
The on-site contact estimates that pallets were stored outdoors on average for one-to-two days (1.5 days assumed for calculations).

Therefore, to estimate the quantity of ice delivered on average to a single pallet kept outdoors

Lbs Re-Ice = (300 lbs re-ice/pallet-day) x (1.5 days)
= 450 Lbs re-ice/pallet

The application states that 5,000,000 cartons of broccoli require ice injection every year.
The site contact, however, estimates that production now requires that 8,000,000 cartons per year be iced.
Assume that the first year following this retrofit, the production rates are 6,500,000 cartons per year (the median of these two figures).
The site contact also estimates that pallets on average hold 44 cartons of broccoli.
Lastly, the site contact estimates that roughly 20% of the pre-retrofit cartons were stored outdoors.

2) Impact Calculations:
To estimate the number of pallets re-iced per year

Lbs Re-Ice = (450 lbs re-ice/pallet) x (6,500,000 cartons/year) x (1 pallet/44 cartons) x 20% re-ice rate
= 13,295,455 Lbs re-ice/year

Converting to tons

Tons Re-Ice = (13,295,455 lbs re-ice/year) x (1 ton/2,000 lbs ice)
= 6,648 Tons re-ice/year

For every ton of ice injected, additional ice must be made that is melted when make-up water is introduced.
Application records indicate that 23 gallons of 32 °F water are spilled during product injection.

To estimate the equivalent ice production associated with this spilled water (that must be replaced with 64 °F make-up water)

Lbs equiv. ice = (23 gallons/pallet) x (6,500,000 cartons/year) x (1 pallet/44 cartons) x (20% re-ice rate) x (8.34 lbs water/gallon) x (64-32 °F water differential) x (1 Btu/Lbm °F water) / 144 Btu/lb ice heat of fusion
= 1,259,424 Lbs Equiv ice/year

Converting to tons

Tons Re-Ice = (1,259,424 lbs equiv ice/year) x (1 ton/2,000 lbs ice)
= 630 Tons equiv ice/year

Finally, the energy consumption is estimated for making deferred ice (due to the retrofit).
Hard copy application records indicate that ice production requires 62 kWh/ton of ice produced.

Energy Impact = (6,648 tons re-ice/year + 630 tons equiv ice/year) x (62 kWh/ton)
= 451,201 kWh/year
The application estimate for this measure is 430,532 kWh/year.

Lastly, the demand estimate from the application is evaluated using the energy result.
The application assumes that ice is produced only 43 weeks per year during the harvest season.
It is also assumed that the ice is produced using the pre-retrofit production schedule, not the post-retrofit schedule.
Ice generation capacity has been expanded since this retrofit, thereby shifting peak hour ice production to the partial- and off-peak periods.

Using estimated annual hours of ice production (43 weeks/year, 24 hours per day, yields 7,224 hours), a mean demand impact is estimated as follows

Mean Demand = (451,201 kWh/year)/7,224 hours of ice production/year
= 62 kW

This serves as a lower bound (conservative) estimate of savings for the peak hour.

The application estimate of demand for this measure is 67 kW for the system peak hour.

3) Conclusions:

The purpose of the evaluation implemented for this measure is to verify the accuracy of application impacts, and to replace those estimates only in the event that a gross error is detected.

All impact loads were not necessarily included in the above calculations (for example, ice shaving, loading and delivery loads, and make-up water delivery loads were excluded from the evaluation estimates).

In a similar (though having an opposite effect) manner, these calculations also do not take into consideration the fact that some product is still stored outdoors in the post-retrofit condition.

The calculations performed have generally verified the accuracy of the application form methods. Both demand and energy impact estiamtes appear reliable.

1) Assumptions:

Following the retrofit, it is assumed that a new 200 hp M&M compressor (model 86C1362), is the only unit serving the cold rooms (according to information supplied by the site contact).

The raised suction temperature for the cold room system provides the savings for this measure.

Evaporator loads are identical in both the pre- and post-retrofit case. Additionally changes to the condenser load as a result of this retrofit are assumed to be insignificant.

2) Impact Calculations:

Estimate the maximum kW draw for the 200 hp M&M compressor

Compressor kW = (200 hp) x (0.746 kW/hp) x (1/0.90 motor efficiency)
= 166 kW maximum

Application records show compressor loads in excess of 300 kW for this system.

Using the application post-retrofit compressor energy usage for this measure in conjunction with the maximum kW estimate, equivalent full-load hours can be back-calculated.

The application compressor energy use in the post-retrofit condition is 1,513,864 kWh/year.

To estimate equivalent full load hours (EFLH)

EFLH = (1,513,864 kWh/year)/166 kW maximum
= 9,132 Hours of full load operation/year in the post-retrofit condition

There are only 8,760 hours in an entire year.

This result indicates that the cold room loads, that were used in the application to estimate impacts, are over-stated.

Application records assume that the cold room compressor runs approximately 5,000 full load hours per year (a more reasonable assumption)

EFLH = (1,513,864 kWh/year)/309.1 kW maximum
= 4,898 Hours of full load operation/year in the post-retrofit condition

Using actual compressor specifications in conjunction with 5,000 full load hours yields a more reliable post-retrofit energy profile

Evaluation Compressor Energy = (166 kW) x 5,000 hours/year
= 830,000 kWh/year in the post-retrofit condition

While advice filing records indicate 1,513,864 kWh/year

The application energy impact for this measure is 249,015 kWh/year (approximately 14% savings over the base condition).

The assumptions regarding base use for the cold rooms is not adequately documented in the application submitted.

On-site data support post-retrofit refrigerant conditions, the discharge pressure is assumed to be 153 psi (since it is assumed that ice-making occurs all day, though this may no any longer be true), and the suction temperature 32 psi.

While in the pre-retrofit condtion, discharge is 153 psi, and suction is 22 psi (according to information gathered on-site).

All told, there is an assumed a suction pressure differential of 10 psi.

Using Vilter ammonia compressor performance data, the effect of this differential can be determined as a function of Tons delivered and BHP.

Performance data lists condensing pressure rather than discharge, but this should not affect the differential.

Suction pressure of 20 psi and 155 psi discharge pressure:
Tons delivered = 197.6 BHP = 188.8

Suction pressure of 30 psi and 155 psi discharge pressure:
Tons delivered = 258.8 BHP = 192

The baseline condition has an efficiency level of 188.8 BHP to deliver 197.6 Tons refrigeration = 0.96 BHP/Ton

The post-retrofit condition has an efficiency level of 192 BHP to deliver 258.8 Tons refrigeration = 0.74 BHP/Ton

The relative efficiency can be used to estimate base usage from post-retrofit compressor results

Pre-retrofit compressor energy use = (0.96/0.74) x 830,000 kWh/year
= 1,076,757 kWh/year

Then, estimating the impacts

Compressor energy impact = (1,076,757 kWh/year - 830,000 kWh/year)
= 246,757 kWh/year

This impact is comparable to the application estimate of 249,015 kWh/year.

With the current operation, where ice is not produced during the peak hour, savings will be larger due to the lower discharge pressure when no ice-making equipment are shut down.

Lastly, the demand estimate from the application is evaluated using the energy result.
The application assumes that Guadalupe cooling is closed 9 weeks per year.
It is assumed that the cold room will also be shut down over this period, yielding just 43 weeks of operation.

Using estimated annual hours of ice production (43 weeks/year, 24 hours per day, yields 7,224 hours), a mean demand impact is estimated as follows

Mean Demand = (246,757 kWh/year)/7,224 hours of operation/year
= 34 kW

This serves as a lower bound (conservative) estimate of savings for the peak hour.
The application estimate of demand for this measure is 134 kW for the system peak hour.
Note that the estimated connected load for the new compressor is only 166 kW.

The conservative demand estimate of 34 kW fails to adjust for the relatively large loads observed at the time of system peak.
The relative demand at the time of system peak is captured within the application records, where hourly evaporator loads and associated kW are reported for the cold rooms.

The median hourly load for the cold rooms is 270 tons, while the maximum load is 360 tons.
The median hourly demand for the cold rooms is 203.15 kW, while the maximum demand is 309.1 kW.
The ratio of these two terms can be used to assess the expected demand during the peak hour:

Peak Demand = (309.1 kW/203.15 kW) x 34 kW
= 52 kW

This demand impact estimate is considered more reliable than that supported by the application form.
The estimate of 134 kW from the application form is appears to achieve considerable savings from improved high stage compressor performance.
The pre- vs post-retrofit compressor performance on the application is 0.97 vs 0.88, respectively, for this peak hour.
It is unclear why the separation of compressor loads for the cold rooms would improve the performance for the low temperature applications, such as ice making.

3) Conclusions:

The purpose of the evaluation implemented for this measure is to verify the accuracy of application impacts, and to replace those estimates only in the event that a gross error is detected.
All impact loads were not necessarily included in the above calculations (for example, evaporator loads and condenser loads were excluded from the evaluation estimates).
The calculations performed have generally verified the accuracy of the application form energy impacts. However, the demand impacts are thought to be in error.

1) Comments regarding the application estimates:

The application is for the replacement of two existing evaporative towers with a new large capacity evaporative tower. However, the existing units have not been replaced.
The application estimate specifies a new Baltimore Air Coil or Evapco model 1170, while on-site records identify this new unit as a Crepaco 1100, the "elevated" tower.
There were significant inconsistencies noted in the application spreadsheet models. For this reason, evaluation analyses are restricted to a review of those methods.

2) Summary of application estimates:

	Annual Energy Impacts (kWh)		Peak Demand Impacts (kW)	
Impact component	Pre-retrofit	Post-retrofit	Pre-retrofit	Post-retrofit
Cold Room Compressors	1,513,864	1,392,996	309	286
High Stage Compressors	4,249,586	4,382,094	888	888
Condensers	490,035	254,271	130	87
Evaporators	516,303	516,303	71	71
Liquid Pump	65,403	65,403	9	9
Total	6,835,191	6,611,067	1,407	1,341
Savings	224,124	kWh	66	kWh

The assumed condensing temperature used in each pre- and post-retrofit model is the driving parameter for compressor savings.
Note, however, according to the application (see above), the high stage compressor energy loads are greater in the post-retrofit case (though condensing temperatures are reduced).
In particular a problem was observed in the 55 and 60 °F temperature bins, where the combined pre-retrofit energy is 1,980,600 in these two bins, while post-retrofit is 2,101,552 kWh.
Looking at this more carfully

High Stage Analysis	Condensing Temperature (°F)		Compressor kW/ton		Compressor kWh	
Temperature Bin	Pre-retrofit	Post-retrofit	Pre-retrofit	Post-retrofit	Pre-retrofit	Post-retrofit
60 °F Bin	85	80	0.74	0.81	697,440	760,439
55 °F Bin	84	78	0.74	0.78	1,283,160	1,341,113
Difference	5 or 6	°F	- 0.4 or 0.7	kW/ton	-120,952	kWh

The result within these particular temperature bins does not make sense. A drop in condenser temperature results in poorer condenser performance and therefore a net increase in energy use.
The compressor kW/ton figures reported in the pre-retrofit condition are lowest for these two bins, while for colder outdoor temperature bins the kW/ton estimates are larger (0.79 kW/ton).
Lower ambient conditions should yield lower kW/ton, as was observed for the cold room (20 °F suction) system.

Additionally, reduced condensing temperatures at the time of system peak have an inconsistent effect on the cold room and high stage compressors, yet the receiver system is shared.
The following table explores this difference in greater detail

Compressor System	Condensing Temperature (°F)		Compressor kW/ton		Compressor kW	
for the Peak Bin*	Pre-retrofit	Post-retrofit	Pre-retrofit	Post-retrofit	Pre-retrofit	Post-retrofit
Cold Room (20 °F Suction)	91	85	0.86	0.79	309	286
High Stage (10 °F Suction)	91	85	0.88	0.88	888	888
Difference	6	°F	+ 0.4 or 0.0	kW/ton	+ 23 or 0	kW

* The peak bin is the 95 °F outdoor temperature condition.

The results within these particular temperature bins are inconsistent. A drop in condenser temperature results in no savings for the high stage system, while improving the cold room performance.

The application estimates show a dramatic reduction in fan and pump energy for the new condenser system.
The new condenser system is able to reject an equivalent quantity of heat while using approximately one-half the amount of fan and pump energy.
Although a reduced condensing temperature is achieved in the post-retrofit condition, the compressors contribute less heat (due to reduced head pressure).
The reduction, by one-half, of condenser energy is not considered to be reliable.

3) Conclusions:

The evaluation implemented for this particular measure is simply a review of the models submitted with the application.
Not only was the application found to be inaccurate regarding the intended replacement of existing condensers, but a review of the calculations submitted points to some erroneous results.

For this reason, the application impacts could not be verified, nor adapted for improvement.

Due to the many problems encountered with this particular measure, no update to the application impacts are recommended.

Site ID#:	2888
Check #	62984
Measure	Suction Sectionalization Project

Measure Description:

The retrofit site is an agricultural processing and packaging plant with a refrigerated warehouse for storage. Separate refrigeration suction lines have been dedicated for hydrocooler units (allowing higher suction temperatures for this unique application). In addition, the application indicates that the retrofit should have included the installation of recirculation pump drums (which store and supply cold refrigerant to the evaporator coils), but a new, dedicated receiver tank for the hydrocoolers was installed instead.

This retrofit allows for a closer approach temperature (differential between the refrigerant and the desired chilled water temperature), which reduces compressor loading and improves the compressor efficiency.

This retrofit is stored in the MDSS as action code 469, Refrigeration Add/Change.

Summary of Calculations in the Original Application:

Estimates are provided for improved compressor efficiency of the dedicated hydrocooler compressors (caused by a higher suction temperature following the sectionalization retrofit).

Comments on Calculations:

Impacts based upon a temperature bin model and mean kW/ton savings, due to the raised suction temperature.

Bin model is based upon mean savings of 0.063 kW/ton and a pre-retrofit condensing temperature of 85°F. Documentation does not appear to have adequate references for reproduction.

Evaluation Process:

During an on-site inspection of this facility the hydrocoolers and warehouse were found to share a common suction. Both systems were running using the same 30 psi suction gas. The system (following retrofit) is designed to use either a common or split suction, with valving and receiver systems available to support either system operating strategy.

Since the application calculations assume a common suction in the pre-retrofit condition, there are no savings associated with the retrofit performed. The site contact indicated that this system is normally run using a shared suction, not dedicated as suggested in the application.

Additional Notes:

An on-site inspection of this facility was conducted on September 23, 1996 with Charles Buick and Wayne Burke.

Impact Results for Site ID# 2888

	kW	kWh	Therm

Application	101	369,200	0
MDSS	101	369,200	0
Evaluation Estimates	0	0	0
Engineering Realization Rate	NA	0	NA
Customer Billing Summary			

Site ID#:	2909
Check #	62881
Measure	Install Bi-folding Doors to Replace Electric Air Curtains

Measure Description: Automatic doors were installed at the entrance/exit to a refrigerated warehouse; action code 469. The installation of these auto-closing doors reduces infiltration of outside air into the warehouse and allowed the fans serving the existing air curtain system to be removed. Motors that operate the new automatic doors add load to the PG&E system.

Summary of Calculations in the Original Application: A bin calculation (based on an ASHRAE calculation method) was used to estimate both pre- and post-retrofit infiltration impacts. Fan energy was modeled using an algorithm in conjunction with the business operating schedule. Similarly, motor energy to operate the automatic doors was estimated using an algorithm in conjunction with estimated forklift travel through each door.

Comments on Calculations: Application review has shown that the ASHRAE infiltration calculations were incorrectly applied. Refer to the exhibits which for details surrounding the errors in this method.

Evaluation Process: The warehouse operating schedule was verified. Pre-retrofit air curtain equipment operation was verified. Forklift travel through each door was verified. Amount of time that doors remain open was verified. Warehouse setpoint temperatures were verified and the refrigeration equipment were audited. All calculations were revised using updated information.

Additional Notes: An on-site inspection of this facility was conducted with Dennis Krieg on October 1, 1996. The inspection included a thorough explanation of the characteristics and operation of the pre- and post-retrofit equipment, measured door operation since the installation, compressor and condenser make and model, and measured R-22 refrigerant conditions (discharge, suction and condensate).

Impact Results for Site ID# 2909

	kW	kWh	Therm
Application	9.2	213,119	0
MDSS	9.2	213,119	0
Evaluation Estimates	79.94	175,202	0
Engineering Realization Rate			
Customer Billing Summary			

Exhibit 2909-1
Mean Outdoor Temperatures by Month and Time of Day

Month	Mean Outdoor Temperature by Time of Day 12 Midnight-8:00 AM (°F)	8:00 AM-4:00 PM (°F)	4:00 PM-12 Midnight (°F)
January	46	52	50
February	50	56	53
March	51	58	54
April	52	61	55
May	54	63	57
June	57	67	60
July	57	67	60
August	58	68	61
September	59	71	62
October	57	67	61
November	53	60	56
December	48	53	50

Average weather statistics were calculated using weather data from "Facility Design and Planning Engineering Weather Data", Departments of the Air Force, the Army, and the Navy, July 1, 1978.

Site: A California weather station on the east shore of the Bay Area.

The contact provided the schedule during which doors are in use:

Daytype	Hour Doors Begin Use	Hour Doors are Closed	12 Midnight - 8:00 AM Hours/Day Doors Open	8:00 AM - 4:00 PM Hours/Day Doors Open	4:00 PM - 12 Midnight Hours/Day Doors Open	Average Days per Year per Daytype	12 Midnight - 8:00 AM Hours/Year Doors Open	8:00 AM - 4:00 PM Hours per Year Doors Open	4:00 PM - 12 Midnight Hours per Year Doors Open	Annual Hours per Year Doors Open
Monday	7:00 AM	5:00 AM	6	8	8	52.1	312.9	417.1	417.1	1147.1
Tuesday	7:00 AM	5:00 AM	6	8	8	52.1	312.9	417.1	417.1	1147.1
Wednesday	7:00 AM	5:00 AM	6	8	8	52.1	312.9	417.1	417.1	1147.1
Thursday	7:00 AM	5:00 AM	6	8	8	52.1	312.9	417.1	417.1	1147.1
Friday	7:00 AM	6:00 PM	1	8	2	52.1	52.1	417.1	104.3	573.6
Saturday	Never Open	Never Open	0	0	0	52.1	0.0	0.0	0.0	0.0
Sunday	8:00 PM	5:00 AM	5	0	4	52.1	260.7	0.0	208.6	469.3
Total			30	40	38	365	1564	2086	1981	5631.4

Daytype	Hour Doors Begin Use	Hour Doors are Closed	Holidays per Year per Daytype	12 Midnight - 8:00 AM Holiday Adjusted Hours/Year Doors Open	8:00 AM - 4:00 PM Holiday Adjusted Hours per Year Doors Open	4:00 PM - 12 Midnight Holiday Adjusted Hours per Year Doors Open	Annual Holiday Adjusted Hours per Year Doors Open	12 Midnight - 8:00 AM Fraction of Hours/Year Doors Open	8:00 AM - 4:00 PM Fraction of Hours per Year Doors Open	4:00 PM - 12 Midnight Fraction of Hours per Year Doors Open
Monday	7:00 AM	5:00 AM	2	300.9	401.1	401.1	1103.1	0.72	0.96	0.96
Tuesday	7:00 AM	5:00 AM	2	300.9	401.1	401.1	1103.1	0.72	0.96	0.96
Wednesday	7:00 AM	5:00 AM	2	300.9	401.1	401.1	1103.1	0.72	0.96	0.96
Thursday	7:00 AM	5:00 AM	2	300.9	401.1	401.1	1103.1	0.72	0.96	0.96
Friday	7:00 AM	6:00 PM	2	50.1	401.1	100.3	551.6	0.12	0.96	0.24
Saturday	Never Open	Never Open	0	0.0	0.0	0.0	0.0	0.00	0.00	0.00
Sunday	8:00 PM	5:00 AM	0	260.7	0.0	208.6	469.3	0.63	0.00	0.50
Total			10	1514	2006	1913	5433.4	0.52	0.69	0.66

The on-site contact estimated the percentage of door openings that occur during certain periods of a typical day in the post-retrofit condition:

Daytype	Hour Doors Begin Use	Hour Doors are Closed	Description of Door Use	Percentage of Door Use		12 Midnight - 8:00 AM Distribution of Door Use/Year	8:00 AM - 4:00 PM Fraction of Door Use/Year	4:00 PM - 12 Midnight Fraction of Door Use/Year	Check Total Fraction of Door Use/Year	Total Hours with Door Openings
NA	7:30 AM	2:00 PM	Very Busy	50%		1.45	3.20	2.50	7.15	6.5
NA	2:00 PM	5:00 PM	Less Busy	10%						3
NA	5:00 PM	6:00 PM	Doors Shut	0%						1
NA	6:00 PM	3:00 AM	Busy	40%						9
Total				100%	Percent	20.28%	44.76%	34.97%	100.00%	

The on-site contact provided the temperature setpoints for cold storage by month.

	January	February	March	April	May	June	July	August	September	October	November	December
Cold Storage Temperature (°F)	40	40	41	43	43	45	46	46	44	44	40	40

The on-site contact provided the number of times each door had opened since the installation was completed on March 7, 1995

The on-site audit of this facility was conducted on 10/1/96.

	Door #1	Door #2		Number of Days w/ Openings in 1995	Number of Days w/ Openings in 1996
Number of Times Door Opened	200,092	244,741		299	273
Estimated Annual Door Openings	127,681	156,172			

The number of door openings measured during the first 1.5 years of operation is greater than the assumptions used to calculate impacts in the application (151,008 openings/yr).

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Red font designates a calculation.

Green designates a result.

Estimated energy required to condition the infiltration air with the existing air curtain system:

Month	Cold Storage Temperature (°F)	Midnight - 8AM Mean Outdoor Temperature (°F)	Midnight - 8AM Mean Outdoor Temperature (°F)	Midnight - 8AM Mean Outdoor Temperature (°F)	Mean Coincident Outdoor Temperature (°F)	Mean Coincident Outdoor Wet-bulb (°F)	Mean Coincident Relative Humidity	Dt	Df	E	Rs	Midnight - 8AM Qs/A (tons/sqft)	8AM - 4PM Qs/A (tons/sqft)	4PM - Midnight Qs/A (tons/sqft)
January	40	46	52	50	49	46	80%	1	1	0.25	0.62	0.02	0.05	0.04
February	40	50	56	53	53	50	82%	1	1	0.25	0.55	0.04	0.07	0.06
March	41	51	58	54	54	51	82%	1	1	0.25	0.54	0.04	0.07	0.06
April	43	52	61	55	56	52	77%	1	1	0.25	0.6	0.04	0.08	0.05
May	43	54	63	57	58	53	72%	1	1	0.25	0.62	0.05	0.09	0.05
June	45	57	67	60	61	56	73%	1	1	0.25	0.59	0.04	0.1	0.06
July	46	57	67	60	61	56	73%	1	1	0.25	0.59	0.04	0.09	0.06
August	46	58	68	61	62	56	69%	1	1	0.25	0.63	0.04	0.09	0.07
September	44	59	71	62	64	57	66%	1	1	0.25	0.59	0.06	0.15	0.09
October	44	57	67	61	62	56	69%	1	1	0.25	0.58	0.05	0.1	0.08
November	40	53	60	56	56	52	78%	1	1	0.25	0.58	0.06	0.09	0.07
December	40	48	53	50	50	47	80%	1	1	0.25	0.62	0.03	0.06	0.04

Month	H (ft)	W (ft)	12 Midnight-8:00 AM q (Btuh/Door)	8:00 AM-4:00 PM q (Btuh/Door)	4:00 PM-12 Midnight q (Btuh/Door)	# of Doors	12 Midnight-8:00 AM qt (Btuh/2 doors)	8:00 AM-4:00 PM qt (Btuh/2 doors)	4:00 PM-12 Midnight qt (Btuh/2 doors)	Days per Month	12 Midnight-8:00 AM Hours per Month Doors Open (hours)	8:00 AM-4:00 PM Hours per Month Doors Open (hours)	4:00 PM-12 Midnight Hours per Month Doors Open (hours)	Assumed Equipment Efficiency (kW/ton)	Monthly Load from Door Infiltration (ton-hrs/month)	Monthly Energy Use from Door Infiltration (kWh/month)
January	14	12	76,851	192,128	153,702	2	115,277	288,192	230,554	31	129	170	163	1.00	8,449	8,449
February	14	12	173,265	303,213	259,897	2	259,897	454,820	389,845	28	116	154	147	1.00	13,116	13,116
March	14	12	176,473	308,828	220,591	2	264,710	463,242	330,887	31	129	170	163	1.00	13,894	13,894
April	14	12	158,826	317,652	198,532	2	238,239	476,478	297,799	30	124	165	157	1.00	12,920	12,920
May	14	12	192,128	345,831	192,128	2	288,192	518,746	288,192	31	129	170	163	1.00	14,356	14,356
June	14	12	161,518	403,795	242,277	2	242,277	605,692	363,415	30	124	165	157	1.00	15,597	15,597
July	14	12	161,518	363,415	242,277	2	242,277	545,123	363,415	31	129	170	163	1.00	15,257	15,257
August	14	12	151,263	340,341	264,710	2	226,894	510,512	397,065	31	129	170	163	1.00	15,056	15,056
September	14	12	242,277	605,692	363,415	2	363,415	908,538	545,123	30	124	165	157	1.00	23,395	23,395
October	14	12	205,378	410,757	328,605	2	308,067	616,135	492,908	31	129	170	163	1.00	18,723	18,723
November	14	12	246,454	369,681	287,530	2	369,681	554,521	431,294	30	124	165	157	1.00	17,105	17,105
December	14	12	115,277	230,554	153,702	2	172,915	345,831	230,554	31	129	170	163	1.00	9,885	9,885
										Total	1,514	2,006	1,913		Total	177,751

Blue font designates an input.
Red font designates a calculation.
Green font designates a result.

This calculation uses the same methodology that was used to prepare the Customized Incentive application estimates, and certain accepted assumptions, as documented below.

The calculation methodology is based upon the 1994 ASHRAE Refrigeration Systems and Applications Handbook: Equation (9) and (12), p26.3 through 26.5.

(9) qt = q x Dt x Df x (1-E)

(12) q = 3790 x W x H^1.5 x (Qs/A) x (1/Rs)

Space setpoint temperature according to on-site established cold storage temperature requirements by month.

Dt: Decimal describing the percentage of time the doorway is open. This value is 1.0 in the pre-retrofit case during the period that the facility is operating.

Df: Doorway flow factor. This value is 1.0 in the pre-retrofit case, indicating that fully established flow is assumed.

E: Air curtain effectiveness. This value is 0.25, indicating that the assumed air curtain effectiveness was poor.

Rs: Sensible heat ratios are based upon the monthly mean outdoor dry bulb temperature, the coincident relative humidity and the cold storage temperature, using Table 7

Qs/A: Sensible heat load per sqft of door area, according to *ASHRAE Figure 3*.

H: Door height (ft).

W: Door width (ft).

q: Calculated per door refrigeration load for fully established flow (Btuh)

# of Doors: Two warehouse openings were retrofit with high-speed folding doors to reduce infiltration

qt: Average hourly heat gain for both doors combined under normal operation (Btuh)

Equipment efficiency assumed to be 1.0 kW/ton refrigeration, for compressors, evaporators and condensers. This is a conservative assumption (an efficient system equivalent to 12 EER).

Estimated energy required to condition the infiltration air with the retrofit fast-folding doors:

1) Estimates for hours when fast-folding doors are open and the facility is operating:

Month	Cold Storage Temperature (°F)	Midnight - 8AM Mean Outdoor Temperature (°F)	Midnight - 8AM Mean Outdoor Temperature (°F)	Midnight - 8AM Mean Outdoor Temperature (°F)	Mean Coincident Outdoor Temperature (°F)	Mean Coincident Outdoor Wet-bulb (°F)	Mean Coincident Relative Humidity	Dt	Df	E when doors are open	Re	Midnight - 8AM Qs/A (tons/sqft)	8AM - 4PM Qs/A (tons/sqft)	4PM - Midnight Qs/A (tons/sqft)	H (ft)	W when doors are open (ft)
January	40	46	52	50	49	46	80%	1	0.80	0	0.62	0.02	0.05	0.04	14	12
February	40	50	56	53	53	50	82%	1	0.80	0	0.55	0.04	0.07	0.06	14	12
March	41	51	58	54	54	51	82%	1	0.80	0	0.54	0.04	0.07	0.05	14	12
April	43	52	61	55	56	52	77%	1	0.80	0	0.6	0.04	0.08	0.05	14	12
May	43	54	63	57	58	53	72%	1	0.80	0	0.62	0.05	0.09	0.05	14	12
June	45	57	67	60	61	56	73%	1	0.80	0	0.59	0.04	0.1	0.06	14	12
July	46	57	67	60	61	56	73%	1	0.80	0	0.59	0.04	0.09	0.06	14	12
August	46	58	68	61	62	56	69%	1	0.80	0	0.63	0.04	0.09	0.07	14	12
September	44	59	71	62	64	57	66%	1	0.80	0	0.59	0.06	0.15	0.09	14	12
October	44	57	67	61	62	56	69%	1	0.80	0	0.58	0.05	0.1	0.08	14	12
November	40	53	60	56	56	52	78%	1	0.80	0	0.58	0.06	0.09	0.07	14	12
December	40	48	53	50	50	47	80%	1	0.80	0	0.62	0.03	0.06	0.04	14	12

Month	12 Midnight-8:00 AM q when doors are open (Btuh/Door)	8:00 AM-4:00 PM q when doors are open (Btuh/Door)	4:00 PM-12 Midnight q when doors are open (Btuh/Door)	# of Doors	12 Midnight-8:00 AM qt when doors are open (Btuh/2 doors)	8:00 AM-4:00 PM qt when doors are open (Btuh/2 doors)	4:00 PM-12 Midnight qt when doors are open (Btuh/2 doors)	12 Midnight-8:00 AM Fast Fold Door Openings (Openings/Month)	8:00 AM-4:00 PM Fast Fold Door Openings (Openings/Month)	4:00 PM-12 Midnight Fast Fold Door Openings (Openings/Month)	Amount of Time Door Remains Open per Pass (seconds)	12 Midnight-8:00 AM Hours per Month Doors Open (hours)	8:00 AM-4:00 PM Hours per Month Doors Open (hours)	4:00 PM-12 Midnight Hours per Month Doors Open (hours)	Days per Month	Assumed Equipment Efficiency (kW/ton)	Monthly Load from Door Infiltration when doors are open (ton hrs/month)	Monthly Energy Use from Door Infiltration when doors are open (kWh/month)
January	76,851	192,128	153,702	2	122,962	307,405	245,924	2,506	5,531	4,321	20	13.92	30.73	24.01	31	1.00	1,422	1,422
February	173,265	303,213	259,897	2	277,223	485,141	415,835	2,264	4,996	3,903	20	12.58	27.76	21.68	28	1.00	2,164	2,164
March	176,473	308,828	220,591	2	282,357	494,125	352,946	2,506	5,531	4,321	20	13.92	30.73	24.01	31	1.00	2,299	2,299
April	158,826	317,652	198,532	2	254,121	508,243	317,652	2,425	5,353	4,182	20	13.47	29.74	23.23	30	1.00	2,160	2,160
May	192,128	345,831	192,128	2	307,405	553,329	307,405	2,506	5,531	4,321	20	13.92	30.73	24.01	31	1.00	2,389	2,389
June	161,518	403,795	242,277	2	258,429	646,071	387,643	2,425	5,353	4,182	20	13.47	29.74	23.23	30	1.00	2,642	2,642
July	161,518	363,415	242,277	2	258,429	581,464	387,643	2,506	5,531	4,321	20	13.92	30.73	24.01	31	1.00	2,564	2,564
August	151,263	340,341	264,710	2	242,020	544,546	423,536	2,506	5,531	4,321	20	13.92	30.73	24.01	31	1.00	2,523	2,523
September	242,277	605,692	363,415	2	387,643	969,107	581,464	2,425	5,353	4,182	20	13.47	29.74	23.23	30	1.00	3,963	3,963
October	205,378	410,757	328,605	2	328,605	657,211	525,768	2,506	5,531	4,321	20	13.92	30.73	24.01	31	1.00	3,116	3,116
November	246,454	369,681	287,530	2	394,326	591,489	460,047	2,425	5,353	4,182	20	13.47	29.74	23.23	30	1.00	2,799	2,799
December	115,277	230,554	153,702	2	184,443	368,886	245,924	2,506	5,531	4,321	20	13.92	30.73	24.01	31	1.00	1,651	1,651
																	Total	29,691

2) Estimates for hours when fast-folding doors are closed but the facility is operating:

Month	Cold Storage Temperature (°F)	Midnight - 8AM Mean Outdoor Temperature (°F)	Midnight - 8AM Mean Outdoor Temperature (°F)	Midnight - 8AM Mean Outdoor Temperature (°F)	Mean Coincident Outdoor Temperature (°F)	Mean Coincident Outdoor Wet-bulb (°F)	Mean Coincident Relative Humidity	Dt	Df	E when doors are closed	Re	Midnight - 8AM Qs/A (tons/sqft)	8AM - 4PM Qs/A (tons/sqft)	4PM - Midnight Qs/A (tons/sqft)	H (ft)	W when doors are closed (ft)
January	40	46	52	50	49	46	80%	1	0.80	0.95	0.62	0.02	0.05	0.04	14	15
February	40	50	56	53	53	50	82%	1	0.80	0.95	0.55	0.04	0.07	0.06	14	15
March	41	51	58	54	54	51	82%	1	0.80	0.95	0.54	0.04	0.07	0.05	14	15
April	43	52	61	55	56	52	77%	1	0.80	0.95	0.6	0.04	0.08	0.05	14	15
May	43	54	63	57	58	53	72%	1	0.80	0.95	0.62	0.05	0.09	0.05	14	15
June	45	57	67	60	61	56	73%	1	0.80	0.95	0.59	0.04	0.1	0.06	14	15
July	46	57	67	60	61	56	73%	1	0.80	0.95	0.59	0.04	0.09	0.06	14	15
August	46	58	68	61	62	56	69%	1	0.80	0.95	0.63	0.04	0.09	0.07	14	15
September	44	59	71	62	64	57	66%	1	0.80	0.95	0.59	0.06	0.15	0.09	14	15
October	44	57	67	61	62	56	69%	1	0.80	0.95	0.58	0.05	0.1	0.08	14	15
November	40	53	60	56	56	52	78%	1	0.80	0.95	0.58	0.06	0.09	0.07	14	15
December	40	48	53	50	50	47	80%	1	0.80	0.95	0.62	0.03	0.06	0.04	14	15

Month	12 Midnight-8:00 AM q when doors are closed (Btuh/Door)	8:00 AM-4:00 PM q when doors are closed (Btuh/Door)	4:00 PM-12 Midnight q when doors are closed (Btuh/Door)	# of Doors	12 Midnight-8:00 AM qt when doors are closed (Btuh/2 doors)	8:00 AM-4:00 PM qt when doors are closed (Btuh/2 doors)	4:00 PM-12 Midnight qt when doors are closed (Btuh/2 doors)		12 Midnight-8:00 AM Hours per Month Doors Closed (hours)	8:00 AM-4:00 PM Hours per Month Doors Closed (hours)	4:00 PM-12 Midnight Hours per Month Doors Closed (hours)	Days per Month	Assumed Equipment Efficiency (kW/ton)	Monthly Load from Door Infiltration when doors are closed (ton-hrs/month)	Monthly Energy Use from Door Infiltration when doors are closed (kWh/month)
January	96,064	240,160	192,128	2	7,685	19,213	15,370		115	140	139	31	1.00	474	474
February	216,581	379,016	324,871	2	17,326	30,321	25,990		104	126	125	28	1.00	739	739
March	220,591	386,035	275,739	2	17,647	30,883	22,059		115	140	139	31	1.00	783	783
April	198,532	397,065	248,165	2	15,883	31,765	19,853		111	135	134	30	1.00	726	726
May	240,160	432,288	240,160	2	19,213	34,583	19,213		115	140	139	31	1.00	808	808
June	201,897	504,743	302,846	2	16,152	40,379	24,228		111	135	134	30	1.00	875	875
July	201,897	454,269	302,846	2	16,152	36,342	24,228		115	140	139	31	1.00	857	857
August	189,078	425,426	330,887	2	15,126	34,034	26,471		115	140	139	31	1.00	846	846
September	302,846	757,115	454,269	2	24,228	60,569	36,342		111	135	134	30	1.00	1,312	1,312
October	256,723	513,446	410,757	2	20,538	41,076	32,861		115	140	139	31	1.00	1,053	1,053
November	308,067	462,101	359,412	2	24,645	36,968	28,753		111	135	134	30	1.00	965	965
December	144,096	288,192	192,128	2	11,528	23,055	15,370		115	140	139	31	1.00	556	556
								Total	1,350	1,644	1,631			Total	9,994

Blue font designates an input.
Red font designates a calculation.
Green font designates a result.

This calculation uses the same methodology that was used to prepare the Customized Incentive application estimates, and certain accepted assumpations, as documented below.

The calculation methodology is based upon the 1994 ASHRAE Refrigeration Systems and Applications Handbook. Equation (9) and (12), p26.3 through 26.5.

(9) qt = q x Dt x Df x (1-E)

(12) q = 3790 x W x H^1.5 x (Qs/A) x (1/Rs)

Space setpoint temperature according to on-site established cold storage temperature requirements by month.

Dt: Decimal describing the percentage of time the doorway is open. This value is 1.0 when calculations are made for an entire hour with the automatic doors either open or closed.

Df: Doorway flow factor. This value is 0.8 during the periods when the automatic doors are open, indicating some blocked flow due to door folding and unfolding. 0.8 is also applied when the automatic doors are closed (due to protruding warehouse walls).

E: Door effectiveness. This value is 1.0, during the period that the automatic doors are open, and 0.95 during the period that the automatic doors are closed (0.95 is recommended by ASHRAE for fast-fold doors).

Rs: Sensible heat ratios are based upon the monthly mean outdoor dry bulb temperature, the coincident relative humidity and the cold storage temperature, using Table 7.

Qs/A: Sensible heat load per sqft of door area, according to ASHRAE Figure 3.

H: Door height (ft).

W: Door width (ft). The effective doorway width increases when the automatic doors are deployed to 15 ft.

q: Calculated per door refrigeration load for fully established flow (Btuh)

# of Doors: Two warehouse openings were retrofit with high-speed folding doors to reduce infiltration.

qt: Average hourly heat gain for both doors combined under normal operation (Btuh).

Equipment efficiency assumed to be 1.0 kW/ton refrigeration, for compressors, evaporators and condensers. This is a conservative assumption (an efficient system equivalent to 12 EER).

Estimated energy required to condition the infiltration air with the existing air curtain system:

Outdoor Temperature Bin (°F)	Cold Storage Temperature (°F)	Peak Hour Outdoor Temperature (°F)	Mean Coincident Outdoor Wet-bulb (°F)	Mean Coincident Relative Humidity	Dt	Df	E	Rs	Peak Hour Qs/A (tons/sqft)
Peak Day	46	92	66	24%	1	1	0.25	0.92	0.3

Outdoor Temperature Bin (°F)	H (ft)	W (ft)	Peak Hour q (Btuh/Door)	# of Doors	Peak Hour qt (Btuh/2 doors)	Peak Hour Duration Doors Open (hours)	Assumed Equipment Efficiency (kW/ton)	Peak Hour Load from Door Infiltration (ton-hrs/hr)	Peak Hour Demand from Door Infiltration (kW)
Peak Day	14	12	776,866	2	1,165,299	1	1.00	97	97

Estimated energy required to condition the infiltration air with the retrofit fast-folding doors:

1) Estimates for hours when fast-folding doors are open and the facility is operating:

Outdoor Temperature Bin (°F)	Cold Storage Temperature (°F)	Peak Hour Outdoor Temperature (°F)	Mean Coincident Outdoor Wet-bulb (°F)	Mean Coincident Relative Humidity	Dt	Df	E when doors are open	Rs	Peak Hour Qs/A (tons/sqft)
Peak Day	46	92	66	24%	1	0.80	0	0.92	0.3

Outdoor Temperature Bin (°F)	H (ft)	W when doors are open (ft)	Peak Hour q when doors are open (Btuh/Door)	# of Doors	Peak Hour qt when doors are open (Btuh/2 doors)	Peak Hour Fraction of Time Doors are Open (hours)	Assumed Equipment Efficiency (kW/ton)	Peak Hour Load from Door Infiltration when doors are open (ton-hrs/hr)	Peak Hour Demand from Door Infiltration when doors are open (kW)
Peak Day	14	12	776,866	2	1,242,985	0.18	1.00	19	19

2) Estimates for hours when fast-folding doors are closed but the facility is operating:

Outdoor Temperature Bin (°F)	Cold Storage Temperature (°F)	Peak Hour Outdoor Temperature (°F)	Mean Coincident Outdoor Wet-bulb (°F)	Mean Coincident Relative Humidity	Dt	Df	E when doors are closed	Rs	Peak Hour Qs/A (tons/sqft)
Peak Day	46	92	66	24%	1	0.80	0.95	0.92	0.3

Outdoor Temperature Bin (°F)	H (ft)	W when doors are closed (ft)	Peak Hour q when doors are closed (Btuh/Door)	# of Doors	Peak Hour qt when doors are closed (Btuh/2 doors)	Peak Hour Fraction of Time Doors Closed (hours)	Assumed Equipment Efficiency (kW/ton)	Monthly Load from Door Infiltration when doors are closed (ton-hrs/hr)	Peak Hour Demand from Door Infiltration when doors are closed (kW)
Peak Day	14	15	971,082	2	77,687	0.82	1.00	5	5

Estimated energy required to operate the pre-retrofit air curtain system:

Annual hours of air curtain operation are equal to the number of hours of warehouse operation (during which the doors are always open)

Hours per year	5,433	The application estimate was for 5,396 hours per year.

Estimated air curtain fan kW during operation (all six fans)

From application	6.88	kW

Estimate of energy use per year for all six fans

6.88 x 5433 =	37,382	kWh/year saved

Estimated energy required to operate the post-retrofit fast-fold doors (motor actuated):

Motor operation to open and close doors depends upon the number of times each door opens per year (gathered during on-site)

Cycles per year	283,853	The application estimate was for only 151,000 cycles per year.

Estimates were provided from the application for the amount of time each motor must operate to open and close each automatic door

Time to open from application	1.71	seconds
Time to close from application	3.43	seconds

Estimates are then made for the number of hours per year spent opening and closing these fast-fold doors

Hours per year opening	134.8	hours
Hours per year closing	270.4	hours

Estimates were provided from the application for the kW/door required during opening and closing of the fast-fold doors

kW to open from application	0.478	kW
kW to close from application	0.669	kW

Finally, energy estimates are made for annual door motor use required to operate both doors

(0.478 x 134.8) =	64	kWh/year additional use to open automatic doors
(0.669 x 270.4) =	181	kWh/year additional use to close automatic doors

Estimated demand at the time of system peak for the pre-retrofit air curtain system:

The probability of fan operation at the time of system peak is 1.0 in the pre-retrofit condition

Probability on	1	The application estimate also assumed 100% fan operation at the time of system peak

Estimated air curtain fan kW during operation (all six fans)

From application	6.88	kW

Estimate of on-peak demand for all six fans

	6.88	kW

Estimated demand required to operate the post-retrofit fast-fold doors (motor actuated):

Motor operation to open and close doors depends upon the number of times each door opens at the time of system peak (gathered during on-site)

Seconds open at system peak	649	seconds
Seconds opening	56	seconds/door
Seconds closing	111	seconds/door

Estimates are then made for the number of hours during the peak spent opening and closing these fast-fold doors

Fraction of peak hour opening	0.01542	hours/door
Fraction of peak hour closing	0.03094	hours/door

Estimates were provided from the application for the kW/door required during opening and closing of the fast-fold doors

kW to open from application	0.478	kW
kW to close from application	0.669	kW

Finally, demand estimates are made for door motor use required to operate both doors during the peak hour

(0.478 x 0.01542) x 2 =	0.015	kW additional use to open automatic doors
(0.669 x 0.03094) x 2 =	0.041	kW additional use to close automatic doors

Exhibit 2909-2
Evaluation Energy and Demand Impacts

	Annual Energy Use (kWh)		
Impact Component	Pre-Retrofit	Post-Retrofit	Impact
Open Door Infiltration	177,751	29,691	148,060
Closed Door Infiltration	-	9,994	-9,994
Air Curtain Fans	37,382	-	37,382
Automatic Door Motors	-	245	-245
Total	215,133	39,930	175,202

	Peak Hour Demand (kW)		
Impact Component	Pre-Retrofit	Post-Retrofit	Impact
Open Door Infiltration	97.11	18.69	78.42
Closed Door Infiltration	-	5.31	-5.31
Air Curtain Fans	6.88	-	6.88
Automatic Door Motors	-	0.06	-0.06
Total	103.99	24.05	79.94

Site ID#:	3103
Check #	62236
Measure	EMS for Lighting, anti-sweats, HVAC and condenser

Measure Description: "EMS for lighting, ASW, HVAC & condenser"; action code 453, refrigeration EMS. The application form reviewed is incomplete (no calculations), however, during an on-site inspection of this grocery, information was gathered regarding the retrofit.

Summary of Calculations in the Original Application: Very unclear records; no calculations are provided. Recommendations are made by PG&E reviewers, however, to drop the assumed pre-retrofit condensing temperature from 105 °F to 98 °F (for calculations surrounding floating head pressure controls that were installed). No invoices were attached to verify the equipment installed.

Comments on Calculations: Because no calculations are contained within this particular application, the methods used to achieve results cannot be readily reviewed. Although the application of this particular EMS measure saves energy within the lighting, HVAC and refrigeration end uses, energy impacts are recorded in the MDSS under the refrigeration action code 453 only.

Evaluation Process: An audit of this site yielded equipment holdings and the schedule of operation for those systems in both the pre- and post-retrofit condition (as affected by the EMS installation). These data are used to independently assess the savings for this site.

Additional Notes: An on-site inspection of this facility was conducted with Pat Flannigan on September 27, 1996. The inspection included a thorough explanation of the characteristics and operation of the equipment before and after the installation of EMS controls. Additionally, an equipment inventory was conducted, and R-22 refrigerant conditions were measured during this inspection (discharge, suction and condensate temperatures).

Impact Results for Site ID# 3103

	kW	kWh	Therm
Application	0	264,878	0
MDSS	0	264,878	0
Evaluation Estimates	8.65	264,878	0
Engineering Realization Rate	-	1.00	
Customer Billing Summary			

			% of lights on at the time below on Jul. weekdays				
			3-4 PM	100			
			4-5 PM	100			
Lighting Technology Category (Key)	Number of Lamps per Fixture	Lamp Wattage	Total No. of Lamps Counted	No. of Lamps On	No. of Lamps on 24 Hours	No. of Lamps Burned Out	Location Notes
4 Ft. T12 MB	4	34	88	88	44	0	Main Sales Floor
8 Ft. T12 MB	2	60	436	436	218	0	Main Sales Floor
4 Ft. T8 EB	3	30	81	81	40	0	Main Sales Floor
4 Ft. T8 EB	2	30	8	8	4	0	Main Sales Floor
4 Ft. T8 EB	2	30	18	18	9	0	Main Sales Floor
4 Ft. T8 EB	1	30	8	8	4	0	Deli Case
8 Ft T8 EB	1	60	35	31	18	0	Back Storage
4 Ft T8 EB	1	32	1	1	1	0	Back Storage
4 Ft. T8 EB	2	30	76	76	38	0	Meat Department
Mercury lamp	1	200	12	12	6	0	Main Sales Floor
Halogen Spots	1	50	8	5	4	3	Main Sales Floor

Main Sales Floor Lighting (Pre-Retrofit)				Main Sales Floor Lighting (Post-Retrofit)			
Daytype	Start time	Stop time	Avg. On	Daytype	Start time	Stop time	Avg. On
All (open)	6	0.25	100%	All (open)	6	0.25	100%
All (closed)	0.25	6	100%	All (closed)	0.25	6	50%

Back Storage (Pre-Retrofit)				Back Storage (Post-Retrofit)			
Daytype	Start time	Stop time	Avg. On	Daytype	Start time	Stop time	Avg. On
All (open)	8	0.25	100%	All (open)	8	0.25	100%
All (closed)	0.25	8	100%	All (closed)	0.25	8	50%

Meat Department (Pre-Retrofit)				Meat Department (Post-Retrofit)			
Daytype	Start time	Stop time	Avg. On	Daytype	Start time	Stop time	Avg. On
All (open)	6	22	100%	All (open)	6	22	100%
All (closed)	22	6	100%	All (closed)	22	6	50%

Deli Case (Pre-Retrofit)				Deli Case (Post-Retrofit)			
Daytype	Start time	Stop time	Avg. On	Daytype	Start time	Stop time	Avg. On
All (open)	6	22	100%	All (open)	6	22	100%
All (closed)	22	6	100%	All (closed)	22	6	50%

STORAGE AND DISPLAY CASES

Walk-in for Dairy	440	Square Feet	40	Temperature		Evap Fan kW	24	Fan Cycles or Continuous?
Walk-in for Produce	500	Square Feet	40	Temperature		Evap Fan kW	24	Fan Cycles or Continuous?
Walk-in for Frozen	312	Square Feet	0	Temperature		Evap Fan kW	24	Fan Cycles or Continuous?
Walk-in for Meat	484	Square Feet	32	Temperature		Evap Fan kW	24	Fan Cycles or Continuous?
Walk-in for frozen	120	Square Feet	32	Temperature		Evap Fan kW	24	Fan Cycles or Continuous?
Walk-in for Beverage/Floral		Square Feet		Temperature		Evap Fan kW		Fan Cycles or Continuous?

Display Type	Manuf	Single Deck	Multi Deck	Open	Strip Curtain Time (from:to)	Glass Door Reach In	Lineal Feet	Lamp Count	Lamps /Fixt	Watts /Lamp	Fixt length (feet)	Fixt Descrip	Number of Lamps Burned Out
Vegetable	Hussman	√		√			40	60	2	40	4	T-12	0
Iced Vegetable	Hussman	√		√			16	0					
Flowers	Hussman					√	9	6	1	55	6	T-12	0
Dairy	Hussman		√	√			60	10	1	55	6	T-12	0
Ice Cream	Hussman					√	72	12	1	55	6	T-12	3
Frozen Food	Hussman					√	72	12	1	55	6	T-12	0
Frozen Food	Hussman					√	9	3	1	55	6	T-12	3
Frozen Food	Hussman					√	72	12	1	55	6	T-12	0
Deli Cheese	Hussman		√	√			72	12	1	55	6	T-12	0
Ice Cream	Hussman					√	8	1	1	55	6	T-12	0
Vegetable Platforms	Hussman			√			144	0					
Beverage	Hussman		√	√			58	9	1	55	6	T-12	0
Sea Food	Hussman						20	10	2	40	4'	T-12	0
Meat	Hussman		√	√			60	30	2	40	4'	T-12	0
Frozen Meat	Hussman			√			36	0					

Meat Display Lighting (Pre-Retrofit)

Daytype	Start time	Stop time	Avg. On
All (open)	5	23	100%
All (closed)	23	5	100%

Meat Display Lighting (Post-Retrofit)

Daytype	Start time	Stop time	Avg. On
All (open)	5	23	100%
All (closed)	23	5	0%

Produce Display Lighting (Pre-Retrofit)

Daytype	Start time	Stop time	Avg. On
All (open)	7	23	100%
All (closed)	23	7	100%

Produce Display Lighting (Post-Retrofit)

Daytype	Start time	Stop time	Avg. On
All (open)	7	23	100%
All (closed)	23	7	0%

Dairy/Frozen Display Lighting (Pre-Retrofit)

Daytype	Start time	Stop time	Avg. On
All (open)	2	1	100%
All (closed)	1	2	100%

Dairy/Frozen Display Lighting (Post-Retrofit)†

Daytype	Start time	Stop time	Avg. On
All (open)	2	1	100%
All (closed)	1	2	0%

† The settings for the display lights were found to be mistakenly set to shut off for just 1 hour per day. This was updated durng the on-site.

Estimated energy impacts due to EMS control of the lighting systems:

The overhead lighting systems are controlled by the EMS during store after-hours.
During certain hours of the night 50% of the lights throughout the store are turned off while the remaing lights operate.
In pre-retrofit condition all store overhead lights operate 24 hrs/day and 365 days per year.

Lighting Technology Category (Key)	Number of Lamps per Fixture	Location Notes	Connected Load of the Lighting System (kW)	Pre-retrofit Annual Hours of Operation	Post-retrofit Annual Hours of Operation (Open)	Post-retrofit Annual Hours of Operation (Closed)	Annual Energy Impact	
4 Ft. T12 MB	4	Main Sales Floor	2.99	8,760	6,661	1,049	3,140	
8 Ft. T12 MB	2	Main Sales Floor	26.16	8,760	6,661	1,049	27,452	
4 Ft. T8 EB	3	Main Sales Floor	2.43	8,760	6,661	1,049	2,550	
4 Ft. T8 EB	2	Main Sales Floor	0.24	8,760	6,661	1,049	252	
4 Ft. T8 EB	2	Main Sales Floor	0.54	8,760	6,661	1,049	567	
4 Ft. T8 EB	1	Deli Case	0.24	8,760	5,840	1,460	350	
8 Ft T8 EB	1	Back Storage	2.10	8,760	5,931	1,414	2,970	
4 Ft T8 EB	1	Back Storage	0.03	8,760	5,931	1,414	45	
4 Ft. T8 EB	2	Meat Department	2.28	8,760	5,840	1,460	3,329	
Mercury lamp	1	Main Sales Floor	2.40	8,760	6,661	1,049	2,519	
Halogen Spots	1	Main Sales Floor	0.40	8,760	6,661	1,049	420	
		Total	39.81				43,593	kWh

The EMS does not reduce lighting system use at the time of system peak (3:00 PM to 4:00 PM)
Therefore EMS control of the overhead lighting systems does not yield demand savings.
Both the evaluation and the application estimates indicate no demand impact during the system peak.

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Estimated energy impacts due to EMS control of the anti-sweat systems:

Due to insufficient documentation within this particular application, anti-sweat device connected load estimates were not available.
Anti-sweat loads were available, however, from an alternate paid year 1995 application (same store chain).

Anti-Sweat Connected Load = 17.30 kW

The EMS controls the anti-sweat heater operation by cycling on just 50% of the load for a particular 10 minute period.
Two circuits supply anti-sweat loads, though just one circuit operates at a given time.
In the pre-retrofit condition, anti-sweat heaters were all operated at once, 24 hours/day and 365 days per year (8,760 hours per year).
The EMS duty cycle applied reduces the coincident demand of these heaters by one-half.

Anti-Sweat Demand Impact = 17.30 noncoincident kW demand x 0.50
= 8.65 kW

The application estimate of demand for this measure is 0.0 kW.
PG&E only allows energy savings for anti-sweat control devices, not demand.
The evaluation estimate of 8.65 kW are, however, legitimately saved at this site.

Estimated of energy savings

Anti-Sweat Energy Impact = 17.30 noncoincident kW demand x 8,760 hours/year x 0.50
= 75,774 kWh/year saved

The application energy estimate for this measure is unknown.
PG&E only allows energy savings for anti-sweat control devices, not demand.
The evaluation estimate of 8.65 kW are, however, legitimately saved at this site.

Display Lighting Calculations

Estimated energy impacts due to EMS control of the display lighting systems:

The display lighting systems are controlled by the EMS during store after-hours.
During certain hours of the night lights within the displays are shut off.
In pre-retrofit condition all store display lights operate 24 hrs/day and 365 days per year.

Fixt Type	Lamps /Fixt	Display Type	Connected Load of the Lighting System (kW)	Pre-retrofit Annual Hours of Operation	Post-retrofit Annual Hours of Operation (Open)	Post-retrofit Annual Hours of Operation (Closed)	Annual Energy Impact	
T-12	2	Vegetable	2.40	8,760	5,840	2,920	7,008	
		Iced Vegetable	0.00	8,760	5,840	2,920	0	
T-12	1	Flowers	0.33	8,760	8,395	365	120	
T-12	1	Dairy	0.55	8,760	8,395	365	201	
T-12	1	Ice Cream	0.66	8,760	8,395	365	241	
T-12	1	Frozen Food	0.66	8,760	8,395	365	241	
T-12	1	Frozen Food	0.17	8,760	8,395	365	60	
T-12	1	Frozen Food	0.66	8,760	8,395	365	241	
T-12	1	Deli Cheese	0.66	8,760	8,395	365	241	
T-12	1	Ice Cream	0.06	8,760	8,395	365	20	
		Vegetable Platforms	0.00	8,760	8,395	365	0	
T-12	1	Beverage	0.50	8,760	8,395	365	181	
T-12	2	Sea Food	0.40	8,760	6,570	2,190	876	
T-12	2	Meat	1.20	8,760	6,570	2,190	2,628	
		Frozen Meat	0.00	8,760	6,570	2,190	0	
		Total	8.24				12,058	kWh

The EMS does not reduce display lighting use at the time of system peak (3:00 PM to 4:00 PM)
Therefore EMS control of the display lighting systems does not yield demand savings.
Both the evaluation and the application estimates indicate no demand impact during the system peak.

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Since the information surrounding the application estimates for the condenser retrofit and the floating head pressure measure are incomplete, the remainder of this analysis will scrutinize the overall impact attributed to this application.

For the condenser and floating head pressure measures, application records indicate that impact figures were carefully scrutinized. Therefore, a combined analysis, using application records for those particular measures is specified below

Measure	Energy Impact	Demand Impact	Source of Impact
Overhead Lighting	43,593	0	Evaluation
Anti-Sweat Controls	75,774	8.65	Evaluation
Display Lighting	12,058	0	Evaluation
Adjustable Speed Drive	91,480	0	Application
Floating Head Pressure	40,700	0	Application
Total	263,605	8.65	

The application specifies an energy impact of 264,878 kWh.
The application specifies a demand impact of 0 kW.

The application energy estimate has therefore been verified.
Recommend using the evaluation estimate for demand, however, which incorporates impacts associated with anti-sweat control.

Site ID#:	3110
Check #	62100
Measure	EMS controlling anti-sweat devices in refrigerated cases

Measure Description: "EMS - lighting and anti-sweats"; action code 453, refrigeration EMS, and action code 164, lighting EMS.

Summary of Calculations in the Original Application: Estimates prepared for lighting and anti-sweat savings are based upon reduced system operation during nighttime hours (when the store is closed).

Comments on Calculations: Calculations performed are well documented for this grocery site.

Evaluation Process: Although the application form reviewed included an assessment of savings due to the control of overhead lights, only the portion of the retrofit associated with refrigeration controls is reviewed in this site report. Alternate analysis methods (though not presented here) were used to analyze Customized Incentives retrofit savings for lighting systems.

An audit of this site yielded the schedule of operation for lighting systems in the refrigerated displays (in both the pre- and post-retrofit condition, as affected by the EMS installation). These data were used to supplement the savings calculations within the application by generating an independent assessment of the savings associated with the refrigerated case display light controls.

An inspection of the compressor room also suggests that the EMS system is used to control additional components of the refrigeration system. No savings estimates were applied for, however, surrounding these additional controls. It is therefore likely, that the savings estimates provided in the application submitted have greatly underestimated the impacts associated with this EMS retrofit. Unfortunately, data available on-site did not support an assessment of these other refrigeration control strategies.

Additional Notes: An on-site inspection of this facility was conducted with Kevin Sank on October 23, 1996. The inspection included an explanation surrounding the operation of the equipment before and after the installation of EMS controls. Additionally, a refrigeration compressor inventory was conducted, and R-502 refrigerant conditions were measured during this inspection (discharge, suction and condensate temperatures).

Impact Results for Site ID# 3110

	kW	kWh	Therm
Application	0	75,781	0
MDSS	0	75,781	0
Evaluation Estimates	8.65	82,660	0
Engineering Realization Rate	-	1.09	
Customer Billing Summary			

Although the on-site audit conducted did not include a thorough examination of the lighting systems serving store refrigeration displays, estimates of display lighting loads were available from an alternate paid year 1995 application (same store chain).

Information gathered during the on-site indicated that freezer and beverage display lights are turned off for 7 hours every night (11:00 PM til 6:00 AM). Lighting system estimates for just those particular displays are provided below

STORAGE AND DISPLAY CASES

Display Type	Manuf	Single Deck	Multi Deck	Open	Strip Curtain Time (from:to)	Glass Door Reach In	Lineal Feet	Lamp Count	Lamps /Fixt	Watts /Lamp	Fixt length (feet)	Fixt Descrip	Number of Lamps Burned Out
Ice Cream	Hussman					√	72	12	1	55	6	T-12	3
Frozen Food	Hussman					√	72	12	1	55	6	T-12	0
Frozen Food	Hussman					√	9	3	1	55	6	T-12	3
Frozen Food	Hussman					√	72	12	1	55	6	T-12	0
Ice Cream	Hussman					√	8	1	1	55	6	T-12	0
Beverage	Hussman		√	√			58	9	1	55	6	T-12	0

The pre- and post-retrofit schedules for those lights are as follows

Controlled Display Lighting (Pre-Retrofit)

Daytype	Start time	Stop time	Avg. On
All (open)	6	23	100%
All (closed)	23	6	100%

Controlled Display Lighting (Post-Retrofit)

Daytype	Start time	Stop time	Avg. On
All (open)	6	23	100%
All (closed)	23	6	0%

Estimated energy impacts due to EMS control of the anti-sweat systems:		
Anti-Sweat Connected Load =	17.30	kW
The EMS controls the anti-sweat heater operation by cycling on just 50% of the load for a particular 10 minute period.		
Two circuits supply anti-sweat loads, though just one circuit operates at a given time.		
In the pre-retrofit condition, anti-sweat heaters were all operated at once, 24 hours/day and 365 days per year (8,760 hours per year).		
The EMS duty cycle applied reduces the coincident demand of these heaters by one-half.		
Anti-Sweat Demand Impact =	17.30 noncoincident kW demand x 0.50	
=	8.65	kW
	The application estimate of demand for this measure is 0.0 kW.	
	PG&E only allows energy savings for anti-sweat control devices, not demand.	
	The evaluation estimate of 8.65 kW are, however, legitimately saved at this site.	
Estimated of energy savings		
Anti-Sweat Energy Impact =	17.30 noncoincident kW demand x 8,760 hours/year x 0.50	
=	75,774	kWh/year saved
	The application energy estimate for this measure is comparable, 75,781 kWh.	

Estimated energy impacts due to EMS control of the display lighting systems:

The display lighting systems are controlled by the EMS during store after-hours.
During certain hours of the night lights within the displays are shut off.
In pre-retrofit condition all store display lights operate 24 hrs/day and 365 days per year.

Fixt Type	Lamps /Fixt	Display Type	Connected Load of the Lighting System (kW)	Pre-retrofit Annual Hours of Operation	Post-retrofit Annual Hours of Operation (Open)	Post-retrofit Annual Hours of Operation (Closed)	Annual Energy Impact	
T-12	1	Ice Cream	0.66	8,760	6,205	2,555	1,686	
T-12	1	Frozen Food	0.66	8,760	6,205	2,555	1,686	
T-12	1	Frozen Food	0.17	8,760	6,205	2,555	422	
T-12	1	Frozen Food	0.66	8,760	6,205	2,555	1,686	
T-12	1	Ice Cream	0.06	8,760	6,205	2,555	141	
T-12	1	Beverage	0.50	8,760	6,205	2,555	1,265	
		Total	2.70				6,886	kWh

The EMS does not reduce display lighting use at the time of system peak (3:00 PM to 4:00 PM)
Therefore EMS control of the display lighting systems does not yield demand savings.
The savings projected for display lighting controls are in addition to those projected in the application.

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Green font designates a result.

Refrigeration Summary

Results listed are revised based upon application review/evaluation					
	Measure	Energy Impact	Demand Impact	Source of Impact	
	Anti-Sweat Controls	75,774	8.65	Evaluation	
	Display Lighting	6,886	0	Evaluation	
	Total	82,660	8.65		
		The application specifies an energy impact of 75,781 kWh.			
		The application specifies a demand impact of 0 kW.			
The application energy and demand estimates have been revised.					
	In the future, PG&E should consider the incorporation of demand impacts due to anti-sweat control.				

Site ID#:	3946
Check #	61634
Measure	Replacement of Refrigeration Equipment

Measure Description: The retrofit site is a cold storage facility with an agricultural food processing plant contained within the refrigerated warehouse. The retrofit performed at this site consists of the replacement of older refrigeration equipment with new compressors, condensers, evaporators and controls; action code 469:

Summary of Calculations in the Original Application: Estimates are provided for the refrigeration load difference of the replaced and new system. The application clearly documents both the new and replaced systems, and all assumptions regarding the operating hours required to maintain warehouse setpoint temperatures.

The assumptions used to generate the estimates in this calculation, though based on very old pre-existing equipment, are conservative. Energy savings associated with evaporator defrost controls are not included in the savings estimates. Nor are demand savings claimed.

Comments on Calculations: The new equipment are designed to meet the refrigerated warehouse loads while operating at optimal efficiency using modern energy management system (EMS) control strategies. The Hench EMS system provides both evaporator control using the 2T8 panel and compressor and condenser control using the Omni panel. Monitoring provides real-time measured condensing temperatures, indoor air temperatures at each evaporator, elapsed evaporator runtime, and outdoor dry bulb and wet bulb temperatures.

Evaluation Process: Based on the sound engineering methods applied in the application, the evaluation analysis focuses on verification of the equipment installed rather than an analysis of the calculations performed.

Additional Notes: An on-site inspection of this facility was conducted on October 5, 1996 with Fred Doty and Rick Pate (a PG&E representative).

Impact Results for Site ID# 3946

	kW	kWh	Therm
Application	0	484,156	0
MDSS	0	484,156	0
Evaluation Estimates	0	484,156	0
Engineering Realization Rate	NA	1.0	NA
Customer Billing Summary			

During an on-site inspection information were gathered regarding the equipment retrofit:

Equipment Description	Number of Units	Notes
M&M 100 hp compressor	1	Matches application.
M&M 200 hp compressor	1	Matches application.
Evaporative Condenser w/ 5 hp water pump & 25 hp fan	1	Matches application. 2 speed fan motor.
Krack Evaporators w/ 5 fans each @ 1/3 hp	12	Matches application.
Hench 2T8 and Omni EMS controls	1	Based on application records.

Data were provided regarding the significant differences in evaporator defrosting pre-to-post retrofit.

With the current system, defrost occurs just once per day on average, based on fan runtime monitoring.
The duration of each defrost is just 15 minutes, using hot gas.
No pumping is required. The evaporators are located up high on the wall and can be drained down to the reciever for holding using hot gas.

With the old evaporators (located at ground level), defrost required significant pumping to remove liquid prior to hot gas defrosting.
The total duration of each defrost was 45 minutes, including the significant amount of time required to pump down the system.

The benefits of this improved defrost system were not included in the application savings.

Site ID#:	3970
Check #	62984
Measure	Floating Head Pressure Controls and Liquid Pressure Amplifier

Measure Description:

The retrofit site is a small 25,000 sq ft grocery. The retrofit performed is designed to lower the condensing temperature (and therefore discharge pressure), thereby improving the efficiency of compressors at this site. The retrofit measure includes the installation of two liquid pressure amplifiers (LPAs) to maintain adequate liquid pressure leading to the refrigerated cases and other end uses.

Two 1/2 hp LPAs were installed next to each of two compressor racks, in-line with the condensate return feeding the store cases (located upstairs in the back of the store). Both compressor racks are R-502 Hussman systems. The LPA devices add pressure to the subcooled refrigerant, thereby eliminating the formation of flash gas.

This retrofit is stored in the MDSS as action code 486, Booster Desuperheater.

Summary of Calculations in the Original Application:

A temperature bin model (of pre- and post-retrofit compressor energy use and compressor loading) was used to model this refrigeration system. Impact estimates assume that subcooling will account for a maximum 35 °F drop in condensing temperature, and that there is a 1% savings in energy for every degree of condenser temperature reduction. Calculations are based upon an assumed 5,883 hours of compressor operation per year.

Comments on Calculations:

The bin model provided indicates that there is a dramatic decrease in refrigeration case loads with a reduction in outdoor ambient conditions. The model also suggests, however, that the pre-retrofit condenser temperature is relatively constant, and only varies during the highest outdoor temperatures. If this is the case, then store case loads and compressor loads should not be affected by ambient conditions -- the store indoor temperature is constant (the primary case load) and a static condensing temperatures indicate a constant discharge pressure.

Also, the condenser fan hp modeled is smaller in magnitude than actual equipment found at the site.

In addition, although the application clearly states that 5,883 full load hours are assumed for both the low and medium temperature applications, the medium temperature bin analysis assumes a significantly lower load.

Lastly, the medium temperature compressors are modeled as an R-22 system. An on-site inspection has shown that both compressor racks are charged with R-502.

Evaluation Process:

The bin models were rerun with updated assumption regarding case loads as a function of outdoor temperature and full load hours of runtime. In addition, condenser fan loads were increased to compensate for the increased hp observed.

Additional Notes: An on-site inspection of this facility was conducted on September 24, 1996 with Fred Zanotto.

During the on-site inspection equipment records were recorded and various temperature measurements performed to verify floating head pressure controls. During the visit outdoor ambient conditions were 74 °F, and condensing temperatures were 74-87 °F (depending on the location and time of each measurement), which is consistent with application assumptions surrounding post-retrofit condensing temperatures.

Impact Results for Site ID# 3970

	kW	kWh	Therm
Application	0	107,048	0
MDSS	0	107,048	0
Evaluation Estimates	0	147,887	0
Engineering Realization Rate	NA	1.38	NA
Customer Billing Summary			

Data used in these calcualtions are provided below based largely upon information gathered during the on-site, or alternatively from the application.

Equipment inventory

Manufacturer	Model	Number of Units Installed	Notes
Hussman	PR4204RLKU	1	Low temperature (LT) R-502 compressor rack; 2 reciprocating compressors.
Hussman	PR4005RSKU	1	Medium temperature (MT) R-502 compressor rack; 2 reciprocating compressors.
Hussman	HACD-92-K	1	Air-cooled condenser, 8 fans @ 0.75 hp each.
Hussman	HACD-69-K	1	Air-cooled condenser, 6 fans @ 0.75 hp each.

First, various equipment were recorded

Equipment	Amperage	Phase	Voltage	Efficiency	Power Factor	Maximum kW
MT Compressor	87	3	220.0	0.87	0.85	32.39
MT Compressor	87	3	220.0	0.87	0.85	32.39
LT Compressor	64	3	220.0	0.87	0.85	23.83
LT Compressor	64	3	220.0	0.87	0.85	23.83

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Green designates a result.

Estimated energy required to meet the low temperature refrigeration load.

Weather data from the application for Moffett Field were used.

Outdoor Dry Bulb Temperature (°F)	Annual Observations per Bin (hours)	Annual Operating Hours (hours)	Pre-Retrofit Condensing Temperature (°F)	Full Load (tons)	Rated Efficiency (kW/ton)	Baseline Compressor Energy Use (kWh)	Condensing Temperature w/ Subcooling (°F)	Reduction in Condensing Temperature (°F)	Savings per Degree Condensing Reduction	Subcooling Savings (kWh)	Additional Condenser Fan Use to Reject Heat (kW)	LPA Use (kW)	Added Load (kWh)	
90	6	4	103	11.5	3.34	155	103	0	1%	0		0.51	2	
85	24	16	97	11.5	3.34	620	97	0	1%	0		0.51	8	
80	84	56	95	11.5	3.34	2,168	92	3	1%	65		0.51	29	
75	207	139	95	11.5	3.34	5,343	86	9	1%	481	0.6	0.51	159	
70	535	360	95	11.5	3.34	13,810	80	15	1%	2071	0.6	0.51	410	
65	1,076	723	95	11.5	3.34	27,775	75	20	1%	5555	0.6	0.51	824	
60	1,754	1,179	95	11.5	3.34	45,276	69	26	1%	11772	0.6	0.51	1343	
55	1,975	1,327	95	11.5	3.34	50,980	63	32	1%	16314	0.6	0.51	1512	
50	1,545	1,038	95	11.5	3.34	39,881	60	35	1%	13958	0.6	0.51	1183	
45	934	628	95	11.5	3.34	24,109	60	35	1%	8438	0.6	0.51	715	
40	451	303	95	11.5	3.34	11,642	60	35	1%	4075	0.6	0.51	345	
35	138	93	95	11.5	3.34	3,562	60	35	1%	1247	0.6	0.51	106	
30	24	16	95	11.5	3.34	620	60	35	1%	217		0.51	8	
25	1	1	95	11.5	3.34	26	60	35	1%	9		0.51	0	
	8,754	5,883				225,966	kWh			64,202	kWh		6,645	kWh

Application estimate is 225,896 kWh.

Application estimate is 62,081 kWh.

Application estimate is 4,089 kWh.

Gross Impact 57,557 kWh

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Estimated energy required to meet the medium temperature refrigeration load.

Weather data from the application for Moffett Field were used.

Outdoor Dry Bulb Temperature (°F)	Annual Observations per Bin (hours)	Annual Operating Hours (hours)	Pre-Retrofit Condensing Temperature (°F)	Full Load (tons)	Rated Efficiency (kW/ton)	Baseline Compressor Energy Use (kWh)	Condensing Temperature w/ Subcooling (°F)	Reduction in Condensing Temperature (°F)	Savings per Degree Condensing Reduction	Subcooling Savings (kWh)	Additional Condenser Fan Use to Reject Heat (kW)	LPA Use (kW)	Added Load (kWh)
90	6	4	105	26.0	1.27	133	103	2	1.25%	3		0.51	2
85	24	16	105	26.0	1.27	533	97	8	1.25%	53		0.51	8
80	84	56	105	26.0	1.27	1,864	90	15	1.25%	350		0.51	29
75	207	139	105	26.0	1.27	4,593	84	21	1.25%	1206	0.8	0.51	188
70	535	360	105	26.0	1.27	11,872	78	27	1.25%	4007	0.8	0.51	485
65	1,076	723	105	26.0	1.27	23,877	72	33	1.25%	9849	0.8	0.51	976
60	1,754	1,179	105	26.0	1.27	38,922	65	40	1.25%	19461	0.8	0.51	1590
55	1,975	1,327	105	26.0	1.27	43,826	60	45	1.25%	24652	0.8	0.51	1791
50	1,545	1,038	105	26.0	1.27	34,285	60	45	1.25%	19285	0.8	0.51	1401
45	934	628	105	26.0	1.27	20,726	60	45	1.25%	11658	0.8	0.51	847
40	451	303	105	26.0	1.27	10,008	60	45	1.25%	5629	0.8	0.51	409
35	138	93	105	26.0	1.27	3,062	60	45	1.25%	1723	0.8	0.51	125
30	24	16	105	26.0	1.27	533	60	45	1.25%	300		0.51	8
25	1	1	105	26.0	1.27	22	60	45	1.25%	12		0.51	0
	8,754	5,883				194,257	kWh			98,189	kWh		7,859 kWh
						Application estimate is 109,583 kWh.				Application estimate is 52,510 kWh.			Application estimate is 2,734 kWh.
										Gross Impact	90,330	kWh	

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Site ID#:	4519
Check #	63748
Measure	Energy Management System and Controls Optimization

Measure Description: An Energy Management System (EMS) was installed at a large commercial refrigeration company; action code 453. The EMS controls refrigeration equipment that serve three warehouse buildings. Three engine rooms drive this R-717 ammonia system, though only two of these rooms are serviced by the new EMS system. This warehouse processes, cools and freezes vegetables and fish. The application states that the control system saves energy using the following strategies: floating head pressure, floating suction pressure, evaporator coil defrost optimization, and evaporator fan control.

Summary of Calculations in the Original Application: Bin models were developed to estimate equipment energy use at this site -- including condensers, compressors, evaporators and other cooling equipment. Assumptions and model results are well documented.

Comments on Calculations: The majority of the savings at this site are associated with improved compressor performance. Reduced condensing temperatures and reduced discharge temperatures are the parameters used in the calculations to dictate these savings. Reduced condensing temperatures effectively reduce the compressor energy requirements, while increasing the condenser energy use. Savings result because the head pressure (against which the compressor is working) is reduced. Reduced discharge temperatures also provide a reduction in the discharge pressure and a corresponding compressor savings.

Calculations for warehouse impacts are based upon a pre-retrofit minimum condensing temperature of 85 °F, and a post-retrofit minimum condensing temperature of 70 °F.

Calculations for blast freezer impacts are based upon a pre-retrofit minimum discharge temperature of 85 °F and a pre-retrofit minimum discharge temperature of 70 °F.

Condenser energy use is modeled as a function of heat rejected.

Impacts are not provided for either evaporator fan run-time reduction nor evaporator defrost optimization.

Evaluation Process: On-site records indicate that the suction pressure and discharge pressure settings have not changed since the EMS system was installed. This also means that condensing temperatures also have not changed (and that floating head pressure control was used prior to the EMS retrofit). Although this suggests that the compressor savings should not have been claimed, compressor savings were achieved at this site -- however, these savings were achieved by increasing the suction pressure on the warehouse loads. Compressor savings are actually achieved by reducing the pressure differential across the compressor, regardless of whether the cause of this reduction is associated with reduced discharge pressure or increased suction pressure.

Since the EMS was installed, ice production at this facility has increased dramatically. The refrigerant conditions used during ice production require both a high discharge pressure and a relatively low suction pressure. The high discharge pressure (and temperature) is needed to ensure that hot gas will "release" ice from the ice-machines. However, these conditions are not desirable for the warehouse loads. The EMS system has contributed to a design to tailor the warehouse suction setpoints for that particular load. During periods of ice production (all hours except the summer on-peak time-of-use period) there are substantial savings associated with this elevated suction pressure.

Additionally, because condensing temperatures have not changed since the EMS system was installed, the condenser penalties modeled in the application estimates of savings are not applicable.

The evaluation does not attempt to reproduce the bin models provided in the application, but instead uses alternate methods to validate those estimates.

Additional Notes: An on-site inspection of this facility was conducted on October 5, 1996 with David Gros and Rick Pate, a PG&E representative.

Impact Results for Site ID# 4519

	kW	kWh	Therm
Application	61	527,473	0
MDSS	61	527,473	0
Evaluation Estimates	61	527,473	0
Engineering Realization Rate	1.0	1.0	NA
Customer Billing Summary			

The contact provided the schedule during which ice is produced at this facility:

Daytype	Season	Post-Retrofit Begin Ice Production	Post-Retrofit End Ice Production	Post-Retrofit Hours of Ice Production per Day
Weekday	Summer*	6:00 PM	12:00 noon	16
Weekday	Non-Summer	12:00 midnight	12:00 midnight	24
Saturday	All	12:00 midnight	12:00 midnight	24
Sunday	All	12:00 midnight	12:00 midnight	24

* The PG&E summer season is defined as the period May 1 to October 31; the summer on-peak costing period during this time includes the hours 12:00 noon to 6:00 PM.
Although ice production has been successfully shifted from the peak period, this activity is not necessarily associated with the retrofit applied for and analyzed here.
Most of the time, ice production needs can be met during these non-peak periods. Ice is normally produced using the maximum capacity of each system.

This site "shuts down" December through March every year. During this period, usage surrounding ice making, vaccum tubes, and pressure cooling is suspended.

"shut down"
= [(31 days in December) + (31 days in January) + (28 days in February) + (31 days in March)] x (24 hours/day)
= 2,904 hours/year

During the shut down period and durng the summer on-peak period, suction temperatures can be raised due to the suspension of ice making and other high pressure refrigerant end uses.

Site contact records provided the following:

System	Post-Retrofit Suction Pressure (psi)	Post-Retrofit Discharge Pressure (psi)	Notes
Cold rooms	20	140	Tries to achieve 120 psi discharge whenever possible
Ice production/vaccum tubes/pressure cooling	16	150	

The ice production (etc) conditions also apply to pre-retrofit cold room operation during the periods when those systems are operating.
In the post-retrofit condition, separate suction (and compressors) are dedicated to the cold rooms during all periods.

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1) Assumptions:

Following the retrofit, the site contact estimates that 1200 hp of compressors are dedicated to the cold rooms (when operating at the higher suction temperature).
When ice making equipment (or other high pressure discharge loads) were provided in the pre-retrofit case, this same load was met by roughly 1,575 hp.
This added load is due to the difference in compressor efficiency caused by the higher discharge pressure and the lower suction pressure.

2) Impact Calculations:

The difference in hp required to meet load is applicable only during the hours that ice is produced in the post-retrofit condition.
During all other hours (the summer on-peak TOU period and the winter "shutdown" period), the discharge and suction pressures are set for optimal cold room refrigerant conditions anyway.

Estimating the connected load on the cold room compressor system in the pre-retrofit condition

Compressor kW = (1575 hp) x (0.746 kW/hp) x (1/0.90 motor efficiency)
= 1,306 kW maximum

Estimating the connected load on the cold room compressor system in the post-retrofit condition

Compressor kW = (1200 hp) x (0.746 kW/hp) x (1/0.90 motor efficiency)
= 995 kW maximum

Using the application post-retrofit compressor energy usage for this measure in conjunction with the maximum compressor kW estimate, equivalent full-load hours can be back-calculated.
The application compressor energy use in the post-retrofit condition is 1,549,182 kWh/year at one facility.
The application compressor energy use in the post-retrofit condition is 514,797 kWh/year at another facility.
The application compressor energy use in the post-retrofit condition is 514,236 kWh/year for blast freezing.
The application compressor connected load is 1,759 kW.

To estimate equivalent full load hours (EFLH)

EFLH = ((1,549,182 kWh/year) + (514,797 kWh/year) + (514,236 kWh/year)) / 1,759 kW maximum
= 1,466 Hours of full load operation/year in the post-retrofit condition

To adjust for the "shut down" period, it is assumed that only 33% of normal compressor loads are observed during this period

EFLH = [(EFLH x 4 months x 3) +(EFLH x 8 months)]/12
= 2,443 Adjusted compressor full load operation/year in the post-retrofit condition
This is a conservative estimate of compressor full load hours of operation.

Next, the hours per year with ice making (or other compressor intensive activity) is estimated

Hours ice making is restricted to all partial peak and off-peak periods during the summer season
Hours = (((31+30+31+31+30) days) x [(5/7 x 18) + (2/7 x 24)] hours/day) + [(30+31+30)*24]
= 5,200 Hours per year with high pressure discharge

To calculate the impacts associated with a reduced compressor load

Energy Impact = (5,200 hours / 8,760 hours) x 2,433 full load hours x (1,306 kW - 995 kW)
= 450,768 kWh compressor savings per year.
The application energy impact is 527,473 kWh/year in total
These are the benefits resulting from just one implemented facility operational change, that has evolved as a result of the EMS retrofit.
Other savings at the site, though not quantified here, will certainly contribute (for example, evaporator fan controls -- both cycling and defrost controls)

Because there is no ice making at the time of system peak, there are no peak savings associated with this particular measure.

3) Conclusions:

The purpose of the evaluation implemented for this EMS retrofit is to verify the accuracy of application impacts, and to replace those estimates only in the event that a gross error is detected.
All impact loads were not necessarily included in the above calculations (for example, evaporator loads loads were excluded from the evaluation estimates and condenser loads are assumed to not change).
The calculations performed have generally verified the accuracy of the application form energy impacts.
On-peak demand impacts, though not realized for the measure explored here, could not be rejected based upon this analysis alone.

Site ID#:	4521
Check #	57720
Measure	Ice Water Recovery System for Produce Injector System

Measure Description:

The retrofit site is a large agricultural cold storage facility, where produce are injected with ice and stored for a short period prior to being shipped to market. The retrofit performed at this site consists of an ice water recovery system for the produce injector system; action code 489:

An ice-water slurry is applied, via an ice injector, to broccoli at the this cold storage facility. The pre-retrofit system looses all spilled ice and water which is simply drained away. An ice and water recovery system was installed to recycle this spilled slurry, thereby reducing make-up water requirements and ice production.

Summary of Calculations in the Original Application:

Estimates are provided for the quantity of water and ice lost per pallet as a forklift removes each pallet from the ice injector system -- 90 gallons of water and 30 lb of ice. The liquid recovered is then converted to equivalent ice recovered, 202 lb per pallet, and the annual volume of ice recovered -- 4,000 tons. Estimates are then provided for the annual refrigeration requirements at that plant to produce 4,000 tons of ice, and thus the savings -- 165,042 kWh/year. No demand savings are claimed.

Comments on Calculations:

The majority of the ice production savings for this retrofit is due to the reduction in make-up water that is added to the system. The injector actually delivers an ice-water slurry. Make-up water must be added, to maintain the necessary ratio of ice and water, and thus ensure appropriate delivery of ice to each pallet of product. By recovering 32 °F water, and thus reducing the requirements for 65 °F make-up water, less ice is melted to attain the desired slurry.

The site contact indicated that ice production does not occur during the summer on peak period, thereby verifying the decision (made on the application) to exclude peak period impacts.

The refrigeration system (compressors and condensers) serving this facility are maintained and operated by an adjacent (neighbor) company. Therefore, the PG&E account shown on the application is not the account where savings associated with the retrofit are realized. This affected the downstream billing analysis.

Evaluation Process: Calculations are revised using data collected from the site contact regarding the quantity of ice delivered to each pallet, the reduction in make-up water, and verified assumptions from the application.

Additional Notes: An on-site inspection of this facility was conducted on September 24, 1996 with Eloy. A follow-up interview was also conducted with Randy Ford for additional details.

Impact Results for Site ID# 4521

	kW	kWh	Therm
Application	0	165,042	0
MDSS	0	165,042	0
Evaluation Estimates	0	165,042	0
Engineering Realization Rate	NA	1.0	NA
Customer Billing Summary			

The contact provided the schedule during which ice is produced at this facility:

Daytype	Season	Begin Ice Production	End Ice Production	Hours of Ice Production per Day
Weekday	Summer*	6:00 PM	12:00 noon	16
Weekday	Non-Summer	12:00 midnight	12:00 midnight	24
Saturday	All	12:00 midnight	12:00 midnight	24
Sunday	All	12:00 midnight	12:00 midnight	24

* The PG&E summer season is defined as the period May 1 to October 31; the summer on-peak costing period during this time includes the hours 12:00 noon to 6:00 PM.

The ice making machine normally runs at 100% of capacity.

There are 300 tons of ice storage at this facility.

Additional data contributing to the calculations includes the following:

Parameter	Value Reported	Units of Parameter	Notes
Cartons of Broccoli Iced	2,000,000	cartons/year	Site contact unable to update this application record.
Cartons per Pallet	48	cartons/pallet	Provided by site contact.
Pounds of Ice Added	1,000	lbs ice/pallet	Although a larger quantity is delivered, the remainder is spilled as water and ice.
Reduction in make-up water	0.67	dimensionless	There has been a 2/3 reduction in make-up water delivered since the retrofit.
Pre-Retrofit Spilled Ice	30	lbs ice/pallet	Based on application records.
Pre-Retrofit Spilled Water	90	gallons/pallet	Based on application records.
Ton Ice Conversion	1.5	tons/ton ice/24 hrs	Based on application records.
Spilled Water Temperature	32	°F	
Make-up Water Temperature	65	°F	
Pounds of Water Conversion	8.34	lbs water/gallon	
Ice Heat of Fusion	144	Btu/lb ice	
kW Conversion	0.746	kW/hp	
Ice-maker Suction Pressure	20.0	psi	Based on site contact records.
Ice-maker Discharge Pressure	155.0	psi	Based on site contact records.
20 psi Suction and 85 Condensing	227.5	tons refrigeration	Based on application records for remote ammonia ice makers.
20 psi Suction and 85 Condensing	286.0	BHP	Based on application records for remote ammonia ice makers.
20 psi Suction and 95 Condensing	218.1	tons refrigeration	Based on application records for remote ammonia ice makers.
20 psi Suction and 95 Condensing	321.1	BHP	Based on application records for remote ammonia ice makers.
20 psi Suction and 87 Condensing	293.0	BHP	Based on 20 °F suction (per site contact) and 87 °F suction (per application).
20 psi Suction and 87 Condensing	225.6	tons refrigeration	Based on 20 °F suction (per site contact) and 87 °F suction (per application).
Tons Refrigeration Conversion	1.3	BHP/ton	Based on 20 °F suction. Application records are based on a suction temperature of 15 °F, yielding 1.42.
Compressor Motor Efficiency	92%	% efficient	Based on application records.

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1) Assumptions:

There are 2,000,000 cartons of broccoli iced per year @ 48 cartons per pallet, or 41,667 pallets/year.
Pallets that arrive directly from the field are normally iced with about 1,000 lbs of ice per pallet.
Based on application records for the pre-retrofit condition, a slurry containing 90 gallons of water and 30 lbs of ice was normally spilled during the injection of each pallet.
According to those records, 100% of this spilled slurry was lost to the drain.

With the ice recovery system in place, it is assumed that all of this spilled water and ice is saved.
The recovery of the the water reduces the quantity of make-up water that must be added to the system, which in-turn reduces the quantify of ice melted to achieve the desired slurry consistency.
This in-turn reduces the quantify of ice melted to achieve the desired slurry consistency.
This in-turn reduces the quantify of ice melted to achieve the desired slurry consistency.

2) Impact Calculations:

For every ton of ice injected, additional ice must be made that is melted when make-up water is introduced.
Application records indicate that 90 gallons of 32 °F water are spilled during product injection.

To estimate the equivalent ice production associated with this spilled water (that must be replaced with 65 °F make-up water)

Lbs equiv. ice = (90 gallons/pallet) x (2,000,000 cartons/year) x (1 pallet/48 cartons) x (8.34 lbs water/gallon) x (65-32 °F water differential) x (1 Btu/Lbm °F water) / 144 Btu/lb ice heat of fusion
= 7,167,188 Lbs Equiv ice/year

Converting to tons

Tons Ice = (7,167,188 lbs equiv ice/year) x (1 ton/2,000 lbs ice)
= 3,584 Tons equiv ice/year

Additionally, spilled ice is recovered

Lbs ice = (30 lbs ice/pallet) x (2,000,000 cartons/year) x (1 pallet/48 cartons)
= 1,250,000 Lbs Equiv ice/year

Converting to tons

Tons Ice = (1,250,000 lbs ice/year) x (1 ton/2,000 lbs ice)
= 625 Ton ice/year

Summing all saved ice

Tons Ice = (3,584 tons ice/year) + (625 tons ice/year)
= 4,209 Tons ice/year
The application assumes 4,000 tons ice/year

Finally, the energy consumption is estimated for making deferred ice (due to the retrofit).
Hard copy application records indicate that ice production requires 1.42 BHP/ton ice, while evaluation results are based on 1.3 BHP/ton ice at 20 psi suction.

Energy Impact = (4,209 tons ice/year) x (1.3 BHP/ton refrigeration) x (1.5 tons refrigeration/ton ice/24 hrs) x (24 hrs/day) x (0.746 kW/hp) / (0.92 motor efficiency)
= 159,555 kWh/year
The application estimate is 165,042 kWh/year.

3) Conclusions:

The purpose of the evaluation implemented for this measure is to verify the accuracy of application impacts, and to replace those estimates only in the event that a gross error is detected.
All impact loads were not necessarily included in the above calculations (for example, ice shaving, loading and delivery loads, and condenser loads were excluded from the evaluation estimates).
The application impacts therefore are a conservative estimate of savings.
The calculations performed have generally verified the accuracy of the application form methods. These energy impact estimates appear reliable.

Site ID#:	5499
Check #	60407
Measure	EMS for store lighting, case lighting, anti-sweats and condensers; VSD retrofit for the condenser fans

Measure Description: "Installation of EMS/Refrigeration/lighting control" and variable speed drive for the condenser; action code 453, refrigeration EMS.

Summary of Calculations in the Original Application: Savings are estimated in this application for improved compressor efficiency resulting from a reduced minimum condensing temperature setpoint (from 85 °F to 70 °F).

Additionally, the EMS controls store overhead lights, and refrigerated case lights and anti-sweat heaters.

Lastly, condensing fans have been retrofit with variable frequency drive (VSD) fan speed controls.

Comments on Calculations: This application is well documented and clearly explains the proposed retrofit at this grocery store and all assumptions regarding the associated savings.

Evaluation Process: An on-site audit of this facility has shown that all equipment specified in the application were installed and that the systems specified are currently controlled by the EMS.

Condensing temperatures measured at the time of this audit indicate that a floating head control strategy is used for the condenser. Condensing temperature leaving the condenser (before liquid subcooling) ranged from 72 °F to 76 °F, while ambient dry bulb conditions were 62 °F. These measurements are consistent with application minimum condensing setpoint assumptions.

The final impact verification consisted of a billing comparison. Billing records clearly show an impact following this retrofit that is at least as large as claimed savings. Impacts in the application were adopted as the evaluation estimate of savings.

Additional Notes: An on-site inspection of this facility was conducted with Eric Hansen on October 18, 1996. The inspection included a thorough explanation of the characteristics and operation of the equipment before and after the installation of EMS controls. Additionally, an equipment inventory was conducted, and R-404A refrigerant conditions were measured during this inspection (discharge, suction and condensate temperatures).

Impact Results for Site ID# 5499

	kW	kWh	Therm
Application	10.2	213,981	0
MDSS	10.2	213,981	0
Evaluation Estimates	10.2	213,981	0
Engineering Realization Rate	1.00	1.00	NA
Customer Billing Summary	11	388,502	

Monthly Energy

Site_ID	Year	1	2	3	4	5	6	7	8	9	10	11	12	Calander	Oct-Sept	
5499	1992	182,724	174,890	189,280	188,412	216,497	203,768	216,408	224,772	213,591	216,822	199,274	185,173	2,411,611		
5499	1993	215,418	195,770	216,075	201,040	215,574	207,151	219,002	223,717	211,588	209,886	204,980	182,816	2,503,018	2,506,604	
5499	1994	200,061	181,440	208,341	201,943	211,216	219,819	241,081	239,433	225,246	220,779	204,952	162,870	2,517,181	2,526,262	101%
5499	1995	181,859	173,526	191,416	172,556	178,364	177,396	193,253	191,949	181,329	182,704	172,677	117,488	2,114,516	2,230,249	89%
5499	1996	170,055	164,309	176,378	172,348	185,696	188,280	198,363	197,251	121,067				1,573,745	2,046,614	82%

Monthly Max Demand

Site_ID	Year	1	2	3	4	5	6	7	8	9	10	11	12	Maximum
5499	1992	290	269	304	307	336	365	360	370	365	363	363	349	370
5499	1993	341	347	344	325	342	349	360	368	355	357	354	315	368
5499	1994	314	317	325	347	342	366	376	370	368	350	346	275	376
5499	1995	286	302	299	310	302	307	304	336	333	310	307	315	336
5499	1996	310	307	315	285	301	301	307	325	357				357

Energy Comparison of Calendar 1995 and Calendar 1993:

1993-1995= **388,502** kWh savings per year

Energy Comparable to, and in fact exceeds the claimed savings of 213,981 kWh/year

(2,503,018 kWh - 2,114,516 kWh) / 2,503,018 kWh

16% Savings to the 1993 bill.

A calendar year 1993 vs 1995 comparison was selected since a post-retrofit inspection was not conducted until December of 1994.

Note that a 1992 or 1994 base year yields a similar savings estimate.

Demand Comparison of Calendar 1996 and Calendar 1993:

Max 1993-1996= **11** kW

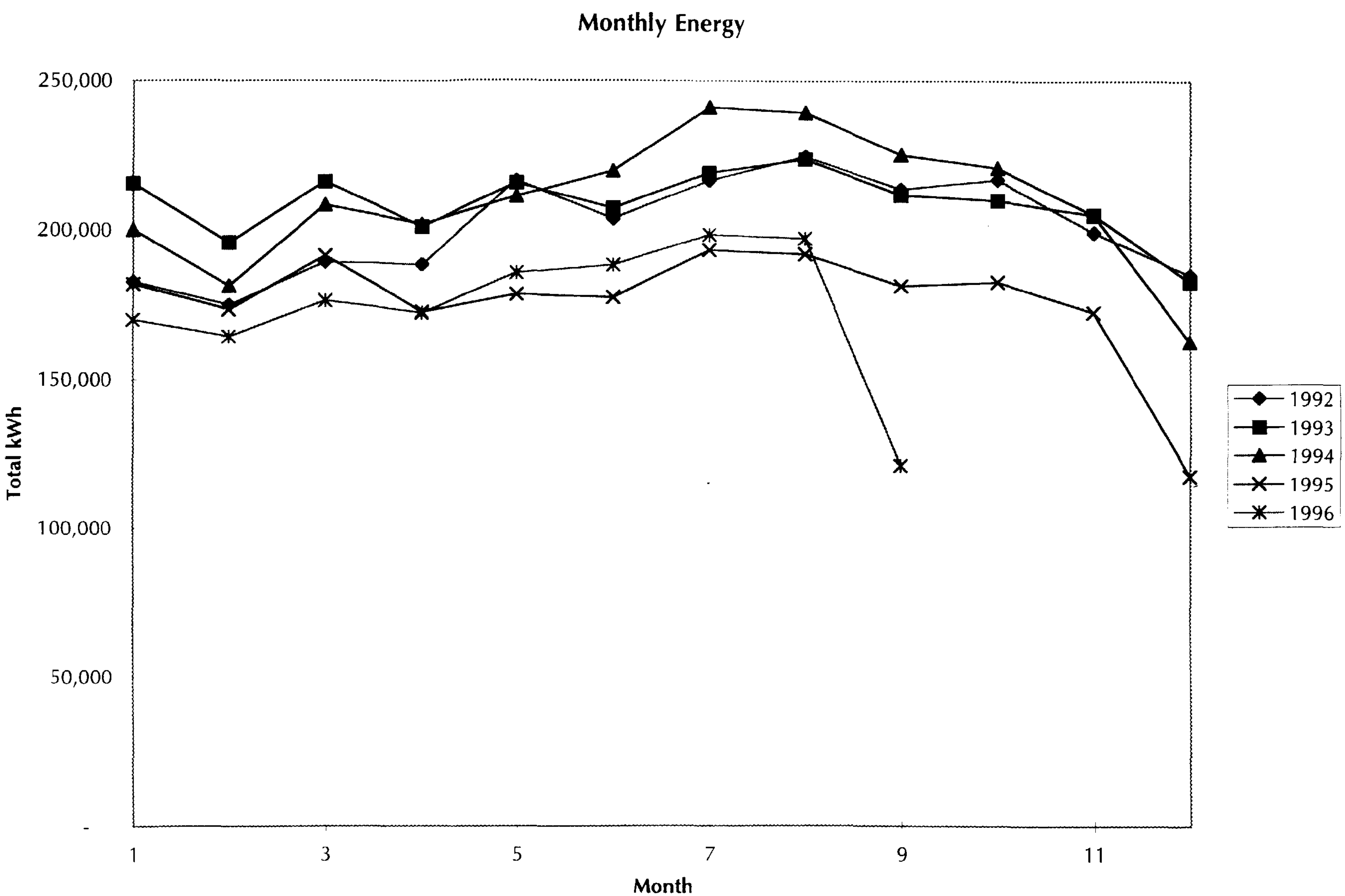
Demand comparable to the claimed savings of 10.1 kW

(368 kW - 357 kW) / 368 kW

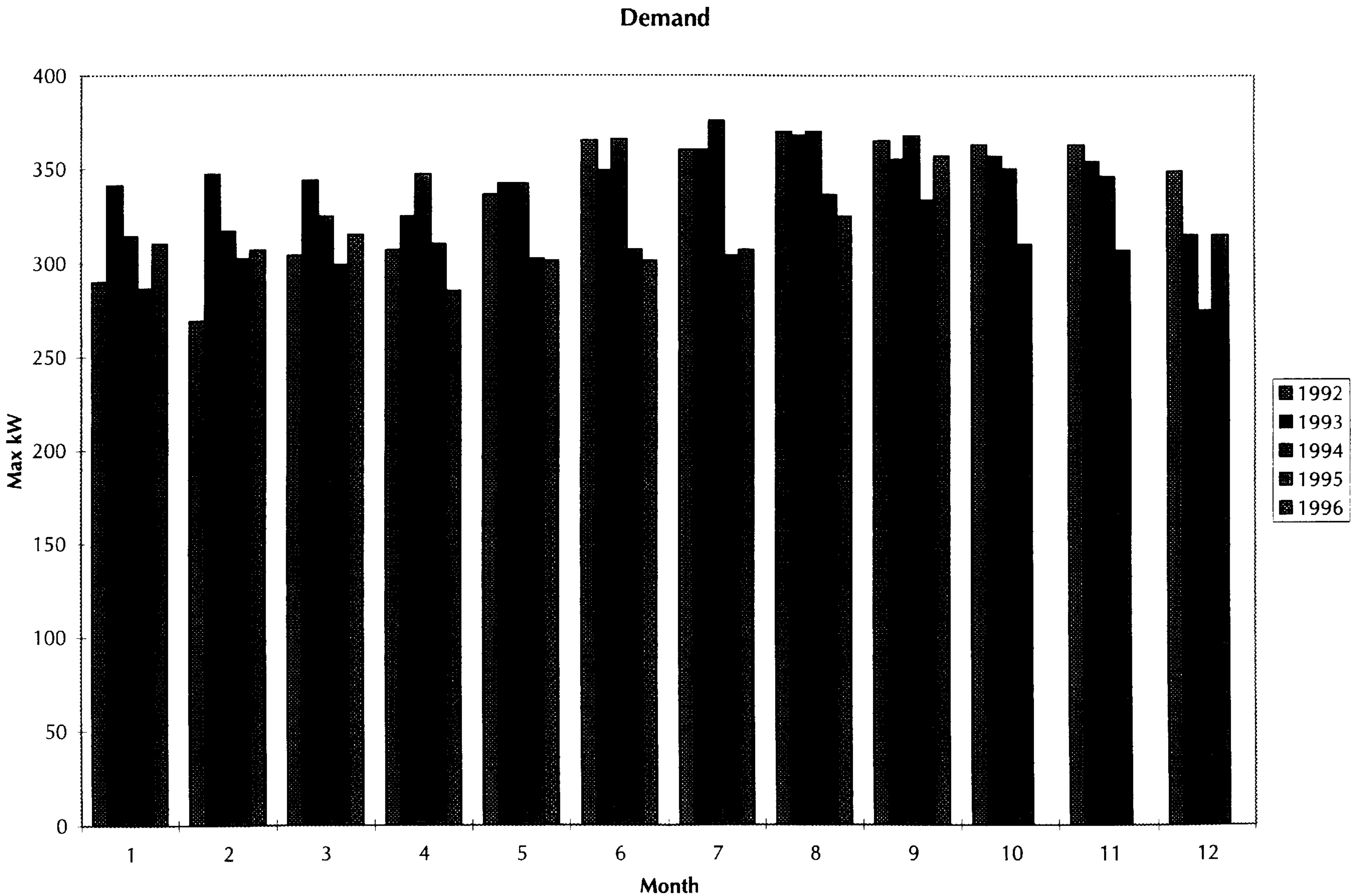
3% Savings to the 1993 bill.

A calendar year 1993 vs 1996 comparison was selected to be conservative.

Note that a comparison with the 1995 peak would have suggested a larger impact.



Monthly Energy
250,000
200,000
150,000
100,000
50,000
-
Total kWh
1
3
5
7
9
11
Month
1992
1993
1994
1995
1996


Demand
400
350
300
250
200
150
100
50
0
Max kW
1
2
3
4
5
6
7
8
9
10
11
12
Month
1992
1993
1994
1995
1996

Appendix C
Billing Regression Analysis

C. BILLING REGRESSION ANALYSIS

This appendix documents the detailed analytical steps undertaken in the billing regression analysis of Pacific Gas and Electric Company's (PG&E's) 1995 Nonresidential Retrofit Program for the Commercial Sector (the Commercial Program). Both net and gross billing analysis models were implemented, however, the net model was unable to provide statistically valid results due to problems of multi-colinearity. This appendix begins with a discussion of the analysis periods and data sources used in the billing regression analysis. Then, the results of the data censoring that was applied to the billing analysis sample are provided. Next, the gross billing analysis regression model specification and SAE coefficients are presented, along with the relative precision calculations. Finally, the net billing analysis regression model specification and results are presented.

C.1 OVERVIEW

The key objective of the billing analysis is to determine the first-year program energy impacts. A statistical analysis is employed to model the differences of customers' energy usage between pre- and post-installation periods. The model is specified using actual customer billing data and independent variables that explain changes in customers' energy usage, including engineering estimates of program participation. This statistically adjusted engineering (SAE) analysis is consistent with the requirements of the Load Impact Regression Model (LIRM) defined in the California Public Utilities Commission's (CPUC's) Measurement and Evaluation Protocols (the Protocols).

The results of the billing regression analysis are estimated as ratios, termed "SAE coefficients," of realized impacts to engineering impact estimates. Realized impacts represent the fractions of the engineering estimates actually "observed" or "detected" in the statistical analysis of actual billing data. The SAE coefficients estimated in the billing analysis regression models are relative to the results of the evaluation-based engineering estimates, not the PG&E Program ex ante estimates. The SAE coefficients, the estimation of which is the topic of this appendix, are then used to estimate program impacts and realization rates relative to the ex ante estimates.

As discussed below, the billing regression analysis was conducted on a sample of telephone surveyed participants and nonparticipants. Because many Commercial Program participants installed measures under multiple end uses, one integrated billing analysis approach was used to model the Lighting, HVAC and Refrigeration end uses.

C.2 DATA SOURCES FOR BILLING REGRESSION ANALYSIS

The billing regression analysis for the 1995 Commercial Program Evaluation uses data from five primary data sources: the PG&E Management Decision Support System (MDSS) tracking database, the billing database, the telephone survey data, the engineering estimates of changes of usage between the pre- and post-installation periods, and the weather data tapes from PG&E's load research weather sites. A summary of the data elements used in the regression analysis are presented below.

C.2.1 Program Participant Tracking System

The participant tracking system for the Retrofit Express (RE), Retrofit Efficiency Options (REO) and Customized Incentives Programs was maintained as part of the MDSS. It contains program applications, rebate and technical information about installed measures, including measure description, quantity, rebate amount, and ex ante demand, ad energy and therm savings estimates. The MDSS database is linked to the billing database and other program databases through PG&E's customers control numbers.

C.2.2 PG&E Billing Data

For this evaluation, the PG&E billing data were obtained from two different data sources within PG&E. The original nonresidential billing dataset contains monthly energy usage for all nonresidential accounts in PG&E's service territory, and was used in the sample design as described in *Appendix A: Sample Design*. The billing histories contained in this data base only run through September 1995.

The second billing dataset, which consists only of customer accounts in the surveyed dataset, was later obtained from PG&E Load Data Services. This billing dataset contains bill readings that run through September 1996, and was therefore used in the billing regression analysis. In addition, the billing series from this database is the PG&E pro-rated monthly usage data, a series calculated by PG&E for each calendar month, from January 1992 to September 1996.

C.2.3 Weather Data

The hourly dry bulb temperature collected for 25 PG&E load research weather sites was used in the billing regression analysis to calculate total monthly cooling and heating degree days for each month in the analysis period. For each customer in the analysis dataset, the appropriate weather site was linked to that customer by using the PG&E-defined weather site to PG&E local office mapping.

C.2.4 Telephone Survey Data

All available telephone surveys (except for the Canvass surveys, which do not collect detailed information regarding changes that have occurred at the premise) collected as part of the evaluation for the Commercial Sector Program were used in the billing regression analysis. Four telephone survey samples totaling 1,217 participants and 652 nonparticipants were collected for the Commercial Sector Evaluation. The 1,217 participant surveys included 614 Lighting participants, 487 HVAC participants, and 241 Refrigeration participants. Because of the significant levels of cross-over among participants across the Commercial Program end uses, one integrated billing regression model was developed to evaluate all three Commercial Program end uses.

The data collected in the telephone survey supplies information on energy-related changes at each site for the billing period covered by the billing regression analysis. For a detailed discussion of the telephone survey sample design and the final sample distribution, see *Appendix A: Sample Design*.

C.2.5 Engineering Estimates

Engineering estimates of savings were estimated for each of the 1,217 participants. Separate estimates were calculated for every measure installed under the Commercial Sector Program. The engineering estimates were calculated based on expected savings from the pre-installation technology to the post-installation technology. For some technologies, such as Central A/Cs installed in the HVAC program, the savings estimates will differ from the impact estimates. This is due to the impacts being calculated relative to a baseline efficiency, compared to the savings estimates which are based on a pre-existing unit's efficiency. *Appendix B: Engineering Detailed Computational Methods* discusses the calculation of the savings estimates used in the billing analysis in greater detail.

For all measures, customer-specific engineering estimates were used in the SAE billing regression model, except for some Customized Incentive measures. For customers with EMS and "Other HVAC" Customized Incentive measures who were not on-site audited, the impact estimates supporting the application were used as the engineering estimates for the SAE analysis. From the engineering analysis based on the on-site audited measures, it was determined that the application's energy estimate was reasonable and accurate for all but one EMS application (which was not part of the SAE analysis).

For the "Other HVAC" Customized Incentive measures, the measures can be so unique and the impact estimates so dependent on building characteristics and other equipment installed at the facility, that it is very difficult to estimate an impact without performing an on-site audit. However, the level of documentation provided along with the applications was sufficient to allow for an assessment of the quality of the impact calculations made. A review of the applications associated with the "Other HVAC" Customized Incentive measures indicated that the applications provided the best data for use in the SAE analysis. In other words, performing an engineering analysis based solely on the application, without an on-site audit, would result in reverting to the application's estimate.

C.3 DATA AGGREGATION AND ANALYSIS DATASET DEVELOPMENT

Because many measures installed under the Commercial Program affected multiple customer accounts within a unique site, the billing analysis had to be performed at the site level. Therefore, all account level data had to be aggregated up to the site level. In PG&E's billing data, an array of variables are defined to track a customer. These include the following:

- Control number, which is the finest level of aggregation, and is usually unique to a meter.
- Premise number, which is used to define a unique site, but can sometimes contain multiple buildings. The premise number may map to many control numbers, but a control number maps to a unique premise number.
- Corporation number, which is used to define a unique corporation, which can map to many premise numbers. A premise number maps to a unique corporation number.

Of the three, the premise number serves as the best indicator of a unique site. However, there are some premise numbers that contain multiple sites. To address this issue, service address was also used to help identify a unique site. If there was more than one service address for a premise number, it was broken out into multiple sites. Therefore, a unique site was defined as all of the control numbers within a unique combination of service address,[1] premise number, and corporation number. A unique Site ID was created based on this combination of address, premise, and corporation to serve as the key variable for linking data.

The billing data was provided at the control number level. Therefore, the monthly billing data was aggregated to the Site ID level. A concern with aggregating to the Site ID level is that there may be control numbers associated with a different premise number, service address, or corporation number that are in the same physical site and are being affected by the installed measures. If this is

[1] Because of potential data entry errors in the billing system, or inconsistencies in tracking service addresses in the billing system, only the first eight characters of the service address were used. Generally, this would contain the numeric portion of the address and the first few characters of the street name. For the large majority of records in the billing system, premise number and service address were unique.

the case, the billing analysis will have the effect of underestimating the impacts. This a topic that will be discussed further in the *Data Censoring* section below.

The telephone surveys were sampled at the Site ID level, and all questions were phrased to ask about all of the control numbers associated with the Site ID.

The engineering estimates of change were also aggregated to the Site ID level. However, prior to aggregating to the Site ID level, the installation dates for each individual measure were analyzed to ensure that only the impacts occurring within the billing analysis periods were being aggregated. The selection of analysis periods is discussed in the next section.

All data elements mentioned above were linked to the final analysis database by Site ID. Exhibits C-1 through C-4 below provide the sample frame that was available for the billing analysis for each end use (Lighting, HVAC, and Refrigeration) and also for nonparticipants. The sample sizes are provided by business type and technology (for participants). The values presented are the unique number of the Site IDs within a given segment.

Exhibit C-1
Billing Analysis Sample Frame
Pre-Censoring
Indoor Lighting End-Use Technologies

	Business Type												
Program and Technology Group	**Office**	**Retail**	**College/ University**	**School**	**Grocery**	**Restaurant**	**Health Care**	**Hotel/Motel**	**Warehouse**	**Personal Service**	**Community Service**	**Misc.**	**Total**
Retrofit Express Program													
Compact Fluorescent	61	29	4	57	9	11	19	17	6	3	17	3	236
Incandescent to Fluorescent	5	-	-	4	-	1	-	2	2	-	2	-	16
Efficient Ballast	8	7	2	7	4	-	2	-	2	-	1	1	34
T8 Lamps and Electronic Ballasts	154	68	8	115	30	17	29	8	25	8	33	9	504
Optical Reflectors w/ Fluor. Delamp	75	32	5	34	13	11	10	1	10	5	7	4	207
High Intensity Discharge	8	7	2	13	1	1	-	1	15	5	5	7	65
Halogen	13	4	2	8	-	2	1	1	1	-	6	1	39
Exit Signs	38	12	3	29	2	5	5	1	2	1	7	1	106
Controls	28	2	3	34	1	1	5	2	4	1	6	5	92
Retrofit Express Total	177	80	9	120	42	27	33	21	34	14	42	15	614
Customized Incentives Program													
Compact Fluorescent													
Standard Fluorescent													
High Intensity Discharge													
Halogen													
Exit Signs													
Controls													
Other													
Customized Incentives Total	5	1	0	0	10	0	0	0	1	0	1	0	18
Total	177	80	9	120	42	27	33	21	34	14	42	15	614

Exhibit C-2
Billing Analysis Sample Frame
Pre-Censoring
HVAC End-Use Technologies

Program and Technology Group	Business Type												
	Office	Retail	College/ University	School	Grocery	Restaurant	Health Care	Hotel/Motel	Warehouse	Personal Service	Community Service	Misc.	Total
Retrofit Express Program													
Central A/C	93	32	1	30	4	12	24	3	8	5	27	5	244
Variable Speed Drive HVAC Fan	16	11	1	2	-	-	-	1	-	-	-	1	32
Package Terminal A/C	2	-	-	7	-	2	-	15	-	-	-	-	26
Programmable Thermostat	53	12	-	14	-	7	7	2	3	3	15	1	117
Reflective Window Film	44	9	1	3	3	2	12	4	5	2	10	2	97
Water Chiller	1	1	-	1	-	-	1	-	-	-	2	-	6
Other RE Measures	1	1	-	1	1	1	1	-	-	-	1	-	7
Retrofit Express Total	170	52	3	49	8	19	37	23	13	8	40	7	429
Retrofit Efficiency Options Program													
Variable Frequency Drive	1	-	1	-	-	-	-	-	-	-	-	-	2
Water Chiller	-	-	-	1	-	-	2	-	-	-	1	-	4
CAV to VAV	1	-	-	-	-	-	-	-	-	-	-	-	1
Cooling Tower	-	-	-	1	-	-	-	-	-	-	-	-	1
Retrofit Efficiency Options Total	2	-	1	1	-	-	2	-	-	-	1	-	7
Customized Incentives Program													
HVAC Variable Speed Drive	2	1	-	-	1	-	-	-	-	-	1	-	5
High Efficiency Chiller	1	-	-	-	-	-	-	-	-	-	-	-	1
Energy Management System	8	-	2	17	1	-	2	1	1	-	-	-	32
Other CI Measures	9	-	1	4	-	-	5	-	2	-	1	1	23
Customized Incentives Total	20	1	3	20	2	-	6	1	2	-	2	1	58
Total	190	53	6	68	10	19	43	24	15	8	43	8	487

Exhibit C-3
Billing Analysis Sample Frame
Pre-Censoring
Refrigeration End-Use Technologies

Program and Technology	Office	Retail	College/ University	School	Grocery	Restaurant	Health Care	Hotel/Motel	Warehouse	Personal Service	Community Service	Misc.	Total
	Business Type												
Retrofit Express Program													
Refrigeration Load Reduction													
Low Temperature Glass/Acrylic Door	-	-	-	-	-	-	-	-	-	-	-	-	-
Heatless Door	-	-	-	-	2	-	-	-	-	-	-	-	2
Cooler/Freezer Door Gaskets	-	1	-	-	11	3	-	-	-	1	-	-	16
Auto Closer for Cooler/Freezer	-	1	-	-	2	1	-	1	-	1	-	-	6
Medium Temperature Case w/ Door	1	-	-	-	6	2	-	-	-	-	-	-	9
Strip Curtains for Walk-in	1	1	-	-	8	5	-	-	6	-	1	-	22
Low Temperature Case w/ Door	-	-	-	-	3	1	-	-	-	-	-	-	4
Night Covers for Display Cases	-	1	-	-	21	1	-	-	-	-	-	-	23
Compressor Upgrades													
Mechanical Subcooler	-	-	-	-	1	-	-	-	-	-	-	-	1
Multiplex Comprssor System	-	-	-	-	1	-	-	-	-	-	-	-	1
Adjustable Speed Drive	-	-	-	-	-	-	-	-	1	-	-	-	1
Floating Head Pressure Controls	-	-	-	-	-	-	-	-	-	-	-	-	-
Condenser Upgrades													
Oversized Air-Cooled Condenser	-	-	-	-	1	-	-	-	-	-	-	-	1
Oversized Evaporative Condenser	-	-	-	-	-	-	-	-	1	-	-	1	2
Evaporator Upgrades													
Walk-in Cooler PSC Evaporator Motor	-	-	-	-	1	-	-	-	-	-	-	-	1
Display PSC Evaporator Motor	-	-	-	-	2	-	-	-	-	-	-	-	2
Other													
Anti-Sweat Heater Control	-	-	-	-	1	-	-	-	-	-	-	-	1
Suction Line Insulation	1	-	-	-	1	-	-	-	1	-	-	-	3
Display Case Electronic Ballast	-	1	-	-	4	-	-	-	1	-	-	-	6
Non-Electric Condensate Evaporator	3	4	1	2	17	120	-	1	1	3	12	1	165
Retrofit Express Total	5	8	1	2	63	128	-	1	8	4	13	2	235
Customized Incentives Program													
Compressor Upgrades													
Floating Head Pressure Controls	-	-	-	-	-	-	-	-	-	-	-	-	-
Booster Desuperheaters	-	-	-	-	-	-	-	-	-	-	-	-	-
Condenser Upgrades													
Oversized Condensers	-	-	-	-	-	-	-	-	-	-	-	-	-
Other													
Refrigeration EMS	-	1	-	-	2	-	-	-		-	-	1	4
Refrigeration Add/Change	1	-	-	-	-	-	-	-	-	-	-	1	2
Refrigeration Other	-	1	-	-		-	-	-	1	-	-	-	2
Customized Incentives Total	1	1	-	-	2	-	-	-	1	-	-	2	7
Total	6	8	1	2	64	128	-	1	10	4	13	3	241

Exhibit C-4
Billing Analysis Sample Frame
Pre-Censoring
Nonparticipants

	Business Type												
Program and Technology Group	Office	Retail	College/ University	School	Grocery	Restaurant	Health Care	Hotel/Motel	Warehouse	Personal Service	Community Service	Misc.	Total
Total	75	130	2	28	190	35	28	16	58	6	34	50	652

C.4 ANALYSIS PERIODS

When the billing regression analysis is used to model the change of consumption attributable to the program measures, the first step is to isolate the pre- and post-installation periods for each customer in the analysis database so that the impact of these measures can be verified.

In accordance with the Protocols, participants are defined by the "paid date" instead of "installation date." Therefore, all customers actually installed measures in 1992, 1993, 1994 or 1995, with 1995 installations accounting for approximately two-thirds of total installations.

C.4.1 Selection of Installation Date

Although installation date is a field in the MDSS it is rarely collected (only 2 percent of the time). Because the "paid date" can be off by as much as 3 years from the installation date, another approach was developed to estimate installation date. For 68 percent of the MDSS records, a pre- and post-installation inspection date was collected. From these two variables, an interval containing the installation date could be determined. Another date field in the MDSS that is populated 100 percent of the time is the date the application was received by PG&E. This date always occurs after the pre-installation inspection date (when populated) and rarely exceeds the post-installation inspection date (when populated) by more than a month (6 percent). In fact, the application received date and post-installation inspection date are within a month of each other 78 percent of the time. Therefore, the application received date was used as a proxy for the installation date.

In addition, the telephone survey asked every participant to estimate the installation date. If the installation date provided through the self reported survey fell between the pre- and post-installation inspection dates, the customer reported date was used over the application received date.

C.4.2 Selection of Analysis Periods

Billing data were available from January 1992 through September 1996. To maximize the number of post installation months, a post period of October 1995 through September 1996 was used. Because the majority of installations occurred during 1995, the only feasible pre-periods were October 1992 through September 1993 and October 1993 through September 1994. Survey data gathered change information dating back from the beginning of 1993. Therefore, both pre-installation periods could be used. However, the further back the pre-installation period is chosen, the more likely there are to be changes that have occurred at the site. To minimize the number of changes that have occurred outside the program between the pre- and post-installation periods (and to minimize the errors associated with self-reported changes and dates the changes occurred), the October 1993 through September 1994 pre-installation period was selected.

The only disadvantage to selecting the more recent pre-installation period is that some participants may have actually installed the participating measure during or before the pre-installation period. There were no rebated Lighting or Refrigeration installations, and only 18 rebated HVAC installations (2 percent of HVAC) in the analysis sample that occurred prior to the pre-installation period. In addition, only 2 percent of the rebated Lighting and Refrigeration installations, and 8 percent of the rebated HVAC installations occurred during the pre-installation period.

For installations that occurred prior to the pre-installation period, the engineering impact is set to zero. For installation that occurred during either the pre- or post-installation period, the engineering impact is only aggregated over the months for which there is an impact that should be realized.

Exhibits C-5 through C-7 provide the cumulative participation by month for the participants that are part of the billing analysis sample frame.

Exhibit C-5
Commercial Lighting Rebated Technologies
By Estimated Installation Date

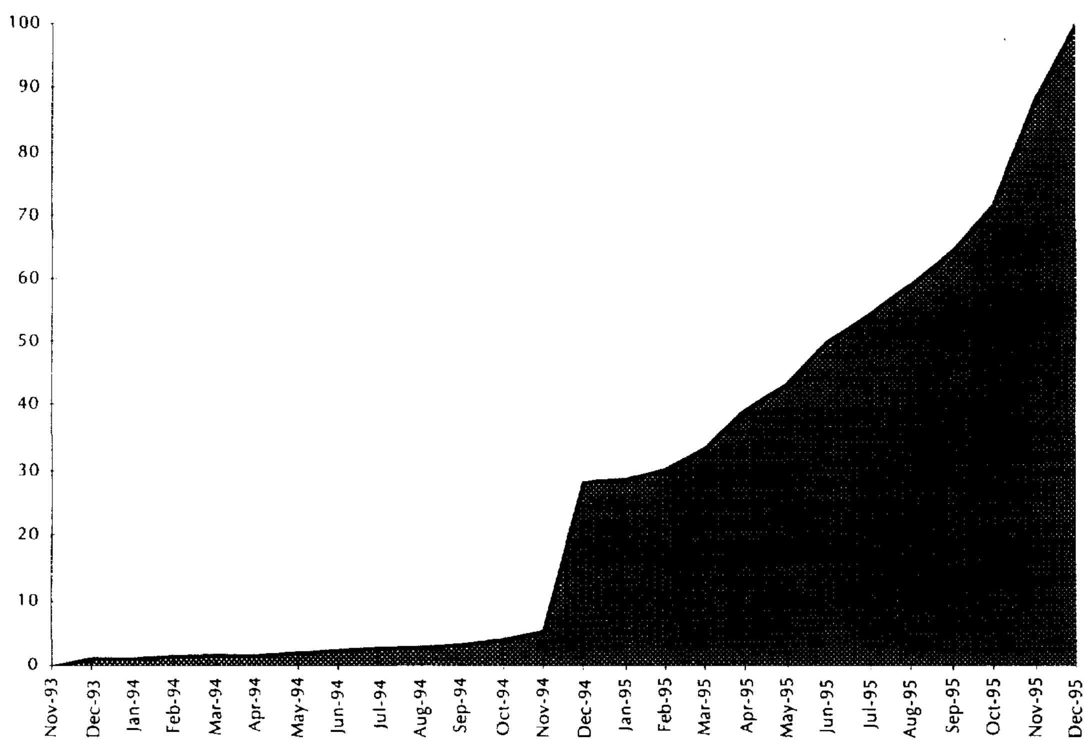


Exhibit C-6
Commercial HVAC Rebated Technologies
By Estimated Installation Date

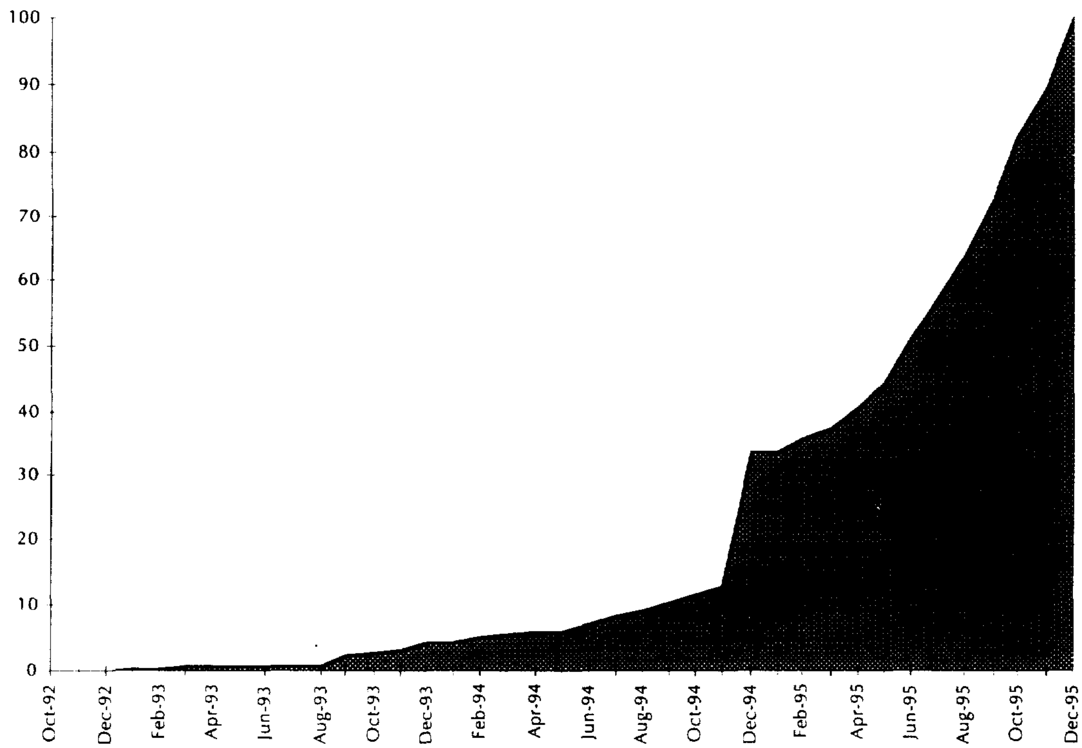
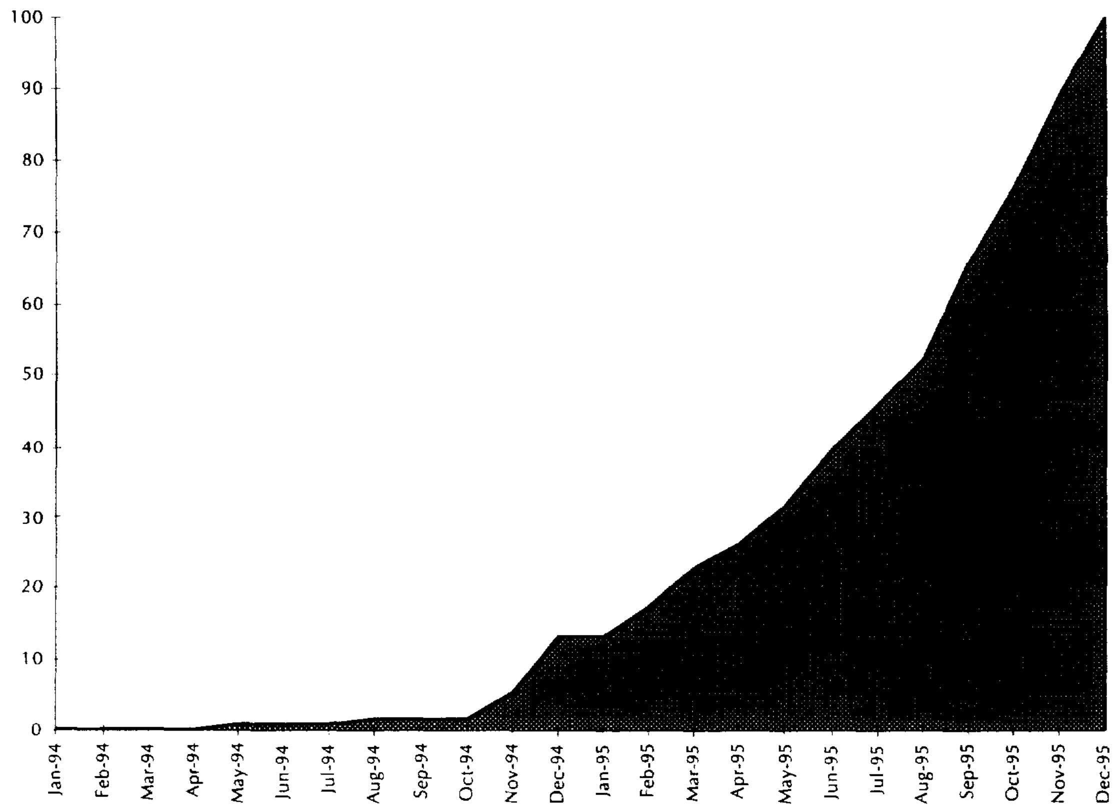


Exhibit C-7
Commercial Refrigeration Rebated Technologies
By Estimated Installation Date



C.5 DATA CENSORING

Three types of data censoring screens were applied to the billing analysis sample frame to remove customers that have invalid billing data, that may not have had their bill properly aggregated to the Site ID level, or that were extremely large users.

C.5.1 Invalid Usage

For customers to be included in the final billing analysis, customers had to have billing data that met the following three criteria.

The pre- and post-installation annual bills had to have been comprised of at least six non-zero monthly bills. If there were seven or more monthly bills with zero energy, the customer was removed from the analysis. If there were between one and six monthly bills with zero energy, the remaining months were prorated to an annual estimate.

The pre-installation annual bill could not be more than three times or less than one third of the post-installation bill. If this occurred, the customer was removed from the analysis.

The pre-installation annual bill could not be more than twice or less than one half the post-installation bill, unless the telephone survey responses indicated that the customer had a change at the site that may have caused an increase or decrease in usage, respectively. For example, if a customer doubled their usage and reported an increase in square footage, or an increase in employees, or an additional measure installed, the customer remained in the sample. However, if the customer reported no changes, or only changes that would indicate a decrease in usage, such as a removal of a measure, then the customer was removed from the analysis.

Exhibit C-8 presents the number of participants and nonparticipants that were deleted for each of the above criteria. Note that only 22 nonparticipants were deleted, whereas 123 participants were deleted. This is due to the fact that the nonparticipants were pre-screened to have relatively valid billing data prior to being selected into the nonparticipant survey sample frame. The participants, however, were often a census and no pre-screening was done on their billing data prior to being selected into the participant survey sample frame. Of the 123 participants, 87 were deleted due to the zero bill criteria.

Exhibit C-8
Distribution of Customers Removed from Billing Analysis
By Data Censoring Criteria
Customers with Invalid Billing Data

Participant or Nonparticipant	Zero Monthly Bills >6?	Usage Doubled or Cut in Half, No Corresponding Change at Site?	Usage Tripled or Cut to a Third?	Number Removed From Analysis
NP	NO	NO	YES	4
NP	NO	YES	YES	3
NP	YES	NO	NO	3
NP	YES	NO	YES	3
NP	YES	YES	NO	1
NP	YES	YES	YES	8
TOTAL				22
P	NO	NO	YES	17
P	NO	NO	YES	3
P	NO	YES	NO	2
P	NO	YES	YES	7
P	NO	YES	YES	6
P	NO	YES	YES	1
P	YES	NO	NO	2
P	YES	NO	NO	8
P	YES	NO	YES	5
P	YES	NO	YES	2
P	YES	YES	NO	5
P	YES	YES	NO	5
P	YES	YES	NO	1
P	YES	YES	YES	38
P	YES	YES	YES	21
TOTAL				123

C.5.2 Large Customers

Customers whose annual post-installation energy consumption exceeded three million kWh were excluded from the billing analysis. Customers of this size were deleted for a number of reasons.

First, there were 98 participants dropped for this reason, compared to only 10 nonparticipants. This indicated that the nonparticipants would not provide a good control for this group of participants. Very large customers are more likely to participate because they are more aware of the program, since they have more contact with PG&E representatives. Therefore, it is difficult to find a sample of nonparticipants that adequately represents these customers.

Large customers installing measures that provide relatively low levels of savings are particularly problematic in billing analyses of this type. It is very difficult to detect an annual impact even as large as 10,000 kWh in a customer's bill which exceeds 10 million kWh, for example. In addition, large customers are more likely to have made changes at the site, which could significantly affect their energy usage. If the model does not adequately capture all of these changes (possibly due to the unique nature of the change, or an error in the self-reported survey responses) it is likely that the coefficient on the program *energy* impact may reflect the change. While this is true of all customers, regardless of size, it is more of a concern for larger customers because the magnitude of their changes can have significant influence over the results of the model.

C.5.3 Aggregation to Site ID Level

As mentioned above, one concern with aggregating to the Site ID level is that there may be control numbers associated with a different premise number, service address, or corporation number that are in the same physical site and are being affected by the installed measures. If this is the case, the billing analysis will have the effect of underestimating the impacts. Therefore, a comparison was made between the engineering energy impact and the pre- and post-installation bills to identify any customers where this problem of bill aggregation may exist.

There were 148 participants that were identified as having total Commercial Sector Program energy impacts that were either more than 50 percent of their pre-installation usage or more than 100 percent of their post-installation usage. These 148 participants were further analyzed to determine whether the impact was large relative to usage because of a problem in aggregating the bill, or if the engineering estimates were just over-estimated, in which case the customer would not be removed from the billing analysis.

Three criteria were used to determine if there was a problem with aggregating the bill for these 148 participants. If a participant failed any of these criteria, the customer was removed from the analysis on the basis that the bills were not properly aggregated and the entire impact will not be detected in an analysis of the customer's billing data.

If the customer's annual kWh per square foot was in the bottom tenth percentile of all participants, the customer was removed.

If the customer's annual kWh per employee was in the bottom tenth percentile of all participants, the customer was removed.

The first billing data pull, which consisted of every nonresidential customer in PG&E's service territory over the period of January 1992 to September 1995, was compared to the second data pull, which is being used for the billing analysis. Customer bills from the first billing data pull were aggregated to the Site ID level in the same way described above. These annual aggregated bills were compared to the aggregated bills used in the analysis. If the aggregated bills from the first data pull were more than 50 percent larger than the bills being used in the billing analysis, the customer was removed. This would indicate that either not all of the control numbers that link to a site were provided in the second data pull or, more likely, since 1995 (when the first billing data was pulled and when the customer participated) there has been customer turnover at the site, and there are now additional premise numbers that no longer link to one unique site.

As a results of these three criteria, 102 of the 148 premises were removed. Of the 102 removed customers, 45 failed the invalid usage data screening checks as well. Therefore, only 57 premises were removed solely on these data screening criteria alone.

Exhibit C-9 presents the number of participants that were removed from the analysis for each of the above criteria.

Exhibit C-9
Distribution of Customers Removed from Billing Analysis
By Data Censoring Criteria
Customers with Billing Aggregation Problems

Low Usage per Sqft?	Low Usage Per Employee?	Low Usage Relative to 1995 Billing Data Pull?	Number of Participants Removed
YES	NO	NO	3
YES	YES	NO	1
YES	YES	YES	1
NO	NO	YES	5
NO	YES	NO	1
NO	YES	YES	2
YES	NO	NO	27
YES	NO	YES	11
YES	YES	NO	9
YES	YES	YES	7
NO	NO	YES	1
NO	YES	NO	2
NO	YES	YES	1
YES	NO	NO	12
YES	NO	YES	2
YES	YES	NO	11
YES	YES	YES	6
TOTAL			102

C.5.4 Other Censoring

In addition to all of the above censoring, three other participants were removed from the analysis for the following reasons. One customer was removed from the analysis because the customer was noted as a "Z-Customer" in the MDSS. PG&E does not claim impacts on "Z-Coded" customers.

Another site had a retrofit performed that will affect a neighboring customer's utility bill. The refrigeration equipment (compressors and condensers) serving the participant are maintained and operated by a nonparticipant. The participant buys liquid ammonia from the nonparticipant via lines running under an adjacent road (driveway) and suction gas is returned to the nonparticipant following use. The impacts of this retrofit (which affect ice production) will be realized by the manufacturer of the liquid ammonia product, a nonparticipant. Therefore, the participating customer was removed from the analysis.

Finally, two other customers were identified as having added the rebated measure installed under the Commercial Program, causing a net increase in energy from the pre- to post-installation period. One of these customers was previously identified as being a large customer and deleted. Therefore, only one extra customer was removed.

Exhibit C-10 summarizes the total number of participants and nonparticipants that were removed from the billing analysis. Exhibits C-11 to C-14 present the final sample sizes used in the billing analysis by business type and technology for participants and by business type for nonparticipants.

Exhibit C-10
Distribution of Customers Removed from Billing Analysis
By Data Censoring Criteria

Participant or Nonparticipant	Zero Monthly Bills >6?	Usage Doubled or Cut in Half, No Corresponding Change at Site?	Usage Tripled or Cut to a Third?	PG&E's Z-Coded Customer?	Impact Affects NP Site?	Rebated Measure Increases Usage?	Large Customer?	Bill Not Aggregated Properly?	Number Removed From Analysis
NP	NO	NO	NO	NO	NO	NO	YES	NO	10
NP	NO	NO	YES	NO	NO	NO	NO	NO	4
NP	NO	YES	YES	NO	NO	NO	NO	NO	3
NP	YES	NO	NO	NO	NO	NO	NO	NO	3
NP	YES	NO	YES	NO	NO	NO	NO	NO	3
NP	YES	YES	NO	NO	NO	NO	NO	NO	1
NP	YES	YES	YES	NO	NO	NO	NO	NO	8
TOTAL									32
P	NO	NO	NO	NO	NO	NO	NO	YES	57
P	NO	NO	NO	NO	NO	NO	YES	NO	98
P	NO	NO	NO	NO	NO	YES	YES	NO	1
P	NO	NO	NO	NO	NO	YES	NO	NO	1
P	NO	NO	NO	NO	YES	NO	NO	NO	1
P	NO	NO	NO	YES	NO	NO	NO	NO	1
P	NO	NO	YES	NO	NO	NO	NO	NO	17
P	NO	NO	YES	NO	NO	NO	NO	YES	3
P	NO	YES	NO	NO	NO	NO	NO	NO	2
P	NO	YES	YES	NO	NO	NO	NO	NO	7
P	NO	YES	YES	NO	NO	NO	NO	YES	6
P	NO	YES	YES	NO	NO	NO	YES	NO	1
P	YES	NO	NO	NO	NO	NO	NO	NO	2
P	YES	NO	NO	NO	NO	NO	NO	YES	8
P	YES	NO	YES	NO	NO	NO	NO	NO	5
P	YES	NO	YES	NO	NO	NO	NO	YES	2
P	YES	YES	NO	NO	NO	NO	NO	NO	5
P	YES	YES	NO	NO	NO	NO	NO	YES	5
P	YES	YES	NO	NO	NO	NO	YES	NO	1
P	YES	YES	YES	NO	NO	NO	NO	NO	38
P	YES	YES	YES	NO	NO	NO	NO	YES	21
TOTAL									282

Exhibit C-11
Billing Analysis Sample Used
Post-Censoring
Indoor Lighting End-Use Technologies

Program and Technology Group	Business Type												
	Office	Retail	College/ University	School	Grocery	Restaurant	Health Care	Hotel/Motel	Warehouse	Personal Service	Community Service	Misc.	Total
Retrofit Express Program													
Compact Fluorescent	46	20	2	47	8	10	15	13	5	3	12	2	183
Incandescent to Fluorescent	5	0	0	3	0	1	0	1	0	0	1	0	11
Efficient Ballast	5	7	1	4	4	0	1	0	1	0	1	0	24
T8 Lamps and Electronic Ballasts	109	53	2	95	29	13	25	6	16	8	22	6	384
Optical Reflectors w/ Fluor. Delamp	60	24	2	26	12	10	8	1	5	5	4	2	159
High Intensity Discharge	3	5	1	10	0	0	0	1	10	4	2	5	41
Halogen	8	3	1	7	1	2	1	1	1	0	5	1	31
Exit Signs	29	10	1	22	2	5	4	0	2	1	5	1	82
Controls	14	1	0	25	0	1	3	2	2	1	4	4	57
Retrofit Express Total	123	61	3	99	40	22	27	16	20	13	30	10	464
Customized Incentives Program													
Compact Fluorescent	[redacted]												
Standard Fluorescent	[redacted]												
High Intensity Discharge	[redacted]												
Halogen	[redacted]												
Exit Signs	[redacted]												
Controls	[redacted]												
Other	[redacted]												
Customized Incentives Total	5	0	0	0	9	0	0	0	1	0	0	0	15
Total	123	61	3	99	40	22	27	16	20	13	30	10	464

Exhibit C-12
Billing Analysis Sample Used
Post-Censoring
HVAC End-Use Technologies

Program and Technology Group	Business Type												
	Office	Retail	College/ University	School	Grocery	Restaurant	Health Care	Hotel/Motel	Warehouse	Personal Service	Community Service	Misc.	Total
Retrofit Express Program													
Central A/C	75	26	-	24	4	10	20	3	8	4	19	5	198
Variable Speed Drive HVAC Fan	12	10	-	2	-	-	-	-	-	-	-	1	25
Package Terminal A/C	2	-	-	7	-	2	-	13	-	-	-	-	24
Programmable Thermostat	36	10	-	13	-	6	7	2	2	2	10	1	89
Reflective Window Film	34	9	-	3	3	2	7	3	3	2	8	2	76
Water Chiller	-	1	-	1	-	-	-	-	-	-	2	-	4
Other RE Measures	-	1	-	-	1	1	-	-	-	-	-	-	3
Retrofit Express Total	131	45	-	41	8	17	27	19	11	7	30	7	343
Retrofit Efficiency Options Program													
Variable Frequency Drive	-	-	-	-	-	-	-	-	-	-	-	-	-
Water Chiller	-	-	-	1	-	-	-	-	-	-	-	-	1
CAV to VAV	-	-	-	-	-	-	-	-	-	-	-	-	-
Cooling Tower	-	-	-	1	-	-	-	-	-	-	-	-	1
Retrofit Efficiency Options Total	-	-	-	1	-	-	-	-	-	-	-	-	1
Customized Incentives Program													
HVAC Variable Speed Drive	1	-	-	-	1	-	-	-	-	-	-	-	2
High Efficiency Chiller	-	-	-	-	-	-	-	-	-	-	-	-	-
Energy Management System	4	-	-	14	1	-	-	-	1	-	-	-	20
Other CI Measures	2	-	1	1	-	-	-	-	1	-	-	-	5
Customized Incentives Total	7	-	1	15	2	-	-	-	1	-	-	-	26
Total	138	45	1	55	10	17	27	19	12	7	30	7	368

Exhibit C-13
Billing Analysis Sample Used
Post-Censoring
Refrigeration End-Use Technologies

Program and Technology	Business Type: Office	Retail	College/ University	School	Grocery	Restaurant	Health Care	Hotel/Motel	Warehouse	Personal Service	Community Service	Misc.	Total
Retrofit Express Program													
Refrigeration Load Reduction													
Low Temperature Glass/Acrylic Door	-	-	-	-	-	-	-	-	-	-	-	-	-
Heatless Door	-	-	-	-	2	-	-	-	-	-	-	-	2
Cooler/Freezer Door Gaskets	-	1	-	-	11	3	-	-	-	1	-	-	16
Auto Closer for Cooler/Freezer	-	1	-	-	2	1	-	1	-	1	-	-	6
Medium Temperature Case w/ Door	-	-	-	-	6	1	-	-	-	-	-	-	7
Strip Curtains for Walk-in	1	1	-	-	7	5	-	-	1	-	1	-	16
Low Temperature Case w/ Door	-	-	-	-	3	1	-	-	-	-	-	-	4
Night Covers for Display Cases	-	1	-	-	21	1	-	-	-	-	-	-	23
Compressor Upgrades													
Mechanical Subcooler	-	-	-	-	1	-	-	-	-	-	-	-	1
Multiplex Comprssor System	-	-	-	-	1	-	-	-	-	-	-	-	1
Adjustable Speed Drive	-	-	-	-	-	-	-	-	-	-	-	-	-
Floating Head Pressure Controls	-	-	-	-	-	-	-	-	-	-	-	-	-
Condenser Upgrades													
Oversized Air-Cooled Condenser	-	-	-	-	1	-	-	-	-	-	-	-	1
Oversized Evaporative Condenser	-	-	-	-	-	-	-	-	-	-	-	-	-
Evaporator Upgrades													
Walk-in Cooler PSC Evaporator Motor	-	-	-	-	1	-	-	-	-	-	-	-	1
Display PSC Evaporator Motor	-	-	-	-	2	-	-	-	-	-	-	-	2
Other													
Anti-Sweat Heater Control	-	-	-	-	1	-	-	-	-	-	-	-	1
Suction Line Insulation	1	-	-	-	1	-	-	-	-	-	-	-	2
Display Case Electronic Ballast	-	1	-	-	4	-	-	-	-	-	-	-	5
Non-Electric Condensate Evaporator	3	3	1	2	11	87	-	1	1	3	9	-	121
Retrofit Express Total	4	7	1	2	56	94	-	1	2	4	10	-	181
Customized Incentives Program													
Compressor Upgrades													
Floating Head Pressure Controls	-	-	-	-	-	-	-	-	-	-	-	-	-
Booster Desuperheaters	-	-	-	-	-	-	-	-	-	-	-	-	-
Condenser Upgrades													
Oversized Condensers	-	-	-	-	-	-	-	-	-	-	-	-	-
Other													
Refrigeration EMS	-	-	-	-	2	-	-	-	-	-	-	-	2
Refrigeration Add/Change	1	-	-	-	-	-	-	-	-	-	-	-	1
Refrigeration Other	-	-	-	-	-	-	-	-	-	-	-	-	-
Customized Incentives Total	1	-	-	-	2	-	-	-	-	-	-	-	3
Total	5	7	1	2	57	94	-	1	2	4	10	-	183

Exhibit C-14
Billing Analysis Sample Used
Post-Censoring
Nonparticipants

	Business Type												
Program and Technology Group	**Office**	**Retail**	**College/ University**	**School**	**Grocery**	**Restaurant**	**Health Care**	**Hotel/Motel**	**Warehouse**	**Personal Service**	**Community Service**	**Misc.**	**Total**
Total	74	124	1	26	185	34	27	15	53	6	31	44	620

C.6 MODEL SPECIFICATION

The billing regression analysis for the Commercial Program Evaluation used two different multivariate regression models under an integrated framework of providing unbiased and robust model estimates in the commercial sector. The key feature of the approach is that it employs a simultaneous equation approach to account for both the year-to-year and cross-sectional variation in a manner that consistently and efficiently isolates program impacts.

A baseline model is initially estimated using only the comparison group sample. This model estimates a relationship that is then used to forecast the post-installation-year energy consumption for participants as a function of pre-installation year usage. In this way, baseline energy usage is forecasted for participants by assuming that their usage will change, on average, in the same way that usage did for the comparison group.

The resulting SAE coefficients are used to adjust the engineering estimates of expected annual energy impacts for the entire participant population. These impacts are presented in *Section 4* and are used to compute program realization rates.

C.6.1 Baseline Model

The baseline model explains post-installation energy usage as a function of the pre-installation energy usage, weather changes, and customer self-reports of factors that could affect energy usage. In order to isolate the program impact from the energy usage changes, only the comparison group is used to fit this model. The baseline model has the following functional form:

$$kWh_{post,i} = \sum_j (\alpha_j + \beta_j kWh_{pre,i}) + \gamma(\Delta CDD_i) * kWh_{pre,i} + \phi(\Delta HDD_i) * Elec_i * kWh_{pre,i} + \sum_k \eta_k Chg_{i,k} + \varepsilon$$

Where

$kWh_{post,i}$ and $kWh_{pre,i}$ are customer i's annualized energy usage for the post- and pre-installation periods, respectively;

ΔCDD_i and ΔHDD_i are the annual change of cooling and heating degree days (base 65°F) between the post-installation year and pre-installation year;

$Elec_i$ is an indicator variable (0/1) for the ith customer, which equals 1 if the customer has electric heating;

$Chg_{i,k}$ are the customer self-reported change variables from the survey data, including adding, replacing, or removing equipment associated with major end uses, changes in number of employees and square footage;

α_j is the indicator variable (0/1) for the jth business type, which equals 1 if the customer is in that business type and 0 otherwise;

β, γ and ϕ are the estimated slopes on their respective independent variables. Separate slopes on pre-usage are estimated by business type; and,

ε is the random error term of the model.

For each customer in the analysis dataset, a post-installation predicted usage value is calculated using the parameters of the baseline models estimated for the 1994 to 1996 analysis period. They both take the same functional form with different segment-level intercept series (α_j) and slopes (β, γ and ϕ):

$$k\hat{W}h_{post,i} = F_{pre}(kWh_{pre}, \Delta CDD, \Delta HDD) = \sum_j (\alpha_j + \beta_j kWh_{pre,i}) + \gamma(\Delta CDD_i) * kWh_{pre,i} + \phi(\Delta HDD_i) * Elec_i * kWh_{pre,i}$$

Exhibit C-15 summarizes the final baseline model results that were estimated using 620 customers, as discussed in the *Data Censoring* section. Exhibit C-15 summaries the independent variables used in the baseline model, together with the t-statistics and the sample sizes available for each parameter estimate used to predict the post-period usage. The final functional relation is estimated as follows:

Baseline Model (1994 to 1996):

$$\begin{aligned}
k\hat{W}h_{96,i} = & -40834 * OFF_LG + 1349 * OFF_SM - 19849 * RET_LG - 120 * RET_SM \\
& +942 * SCHOOLS + 5378 * GROCERY + 8461 * SUPERMKT + 4756 * REST \\
& +10964 * HEALTH + 2403 * HOTEL + 4167 * WAREHOUS + 675 * PERSONAL \\
& +4795 * COMMUN + 37895 * MISCBT \\
& +1.13 * OFF_LG4 + 0.91 * OFF_SM4 + 0.99 * RET_LG4 + 1.00 * RET_SM4 \\
& +1.00 * SCHOOLS4 + 0.98 * GROCERY4 + 0.98 * SUPERMKT4 + 0.99 * REST4 \\
& +0.99 * COLLEGE4 + 0.94 * HEALTH4 + 1.02 * HOTEL4 + 1.04 * WAREHOUS4 \\
& +0.94 * PERSONAL4 + 0.95 * COMMUN4 + 0.95 * MISCBT4 \\
& +0.0000456 * CDD_{96-94,i} * kWh_{94,i} + 0.0000324 * HDD_{96-94,i} * kWh_{94,i}
\end{aligned}$$

Exhibit C-15
Billing Regression Analysis Final Baseline Model Outputs

Parameter Descriptions	Analysis Variable Name	Units	Parameter Estimate	t-Statistic	Sample Size
Intercepts					
Large Office	OFF_LG	(0,1)	-40834	0.99	19
Small Office	OFF_SM	(0,1)	1349	0.07	55
Large Retail	RET_LG	(0,1)	19849	0.44	22
Small Retail	RET_SM	(0,1)	-121	0.01	102
Schools	SCHOOLS	(0,1)	942	0.04	26
Grocery	GROCERY	(0,1)	5378	0.33	127
Supermarket	SUPERMKT	(0,1)	8461	0.30	58
Restaruant	REST	(0,1)	4756	0.19	34
College/University	COLLEGE	(0,1)	0	-	1
Health Care	HEALTH	(0,1)	10964	0.50	27
Hotel/Motel	HOTEL	(0,1)	2403	0.07	15
Warehouse	WAREHOUS	(0,1)	4167	0.19	53
Personal Service	PERSONAL	(0,1)	675	0.01	6
Community Service	COMMUN	(0,1)	4795	0.25	31
Miscellaneous	MISCBT	(0,1)	37895	1.95	44
Pre Usage					
Large Office	OFF_LG4	kWh	1.13	27.16	19
Small Office	OFF_SM4	kWh	0.91	7.39	55
Large Retail	RET_LG4	kWh	0.99	26.44	22
Small Retail	RET_SM4	kWh	1.00	9.48	102
Schools	SCHOOLS4	kWh	1.00	33.42	26
Grocery	GROCERY4	kWh	0.98	8.90	127
Supermarket	SUPERMKT4	kWh	0.98	38.46	58
Restaruant	REST4	kWh	0.99	10.94	34
College/University	COLLEGE4	kWh	0.99	3.36	1
Health Care	HEALTH4	kWh	0.94	28.61	27
Hotel/Motel	HOTEL4	kWh	1.02	9.50	15
Warehouse	WAREHOUS4	kWh	1.04	53.01	53
Personal Service	PERSONAL4	kWh	0.94	4.37	6
Community Service	COMMUN4	kWh	0.95	25.30	31
Miscellaneous	MISCBT4	kWh	0.95	35.82	44
Weather Variables					
Change in HDD	HDD9694	HDD*kWh	0.0000324	1.06	620
Change in CDD	CDD9694	CDD*kWh	0.0000456	0.78	620

C.6.2 SAE Model

Using the predicted post-installation usage values estimated in the baseline model, a simultaneous equation model is specified to estimate the SAE coefficients on energy impact. The SAE simultaneous system can be described as follows:

$$kWh_{96,i} - F_{94}(kWh_{94}, \Delta CDD\ \Delta HDD) = \sum_m \beta_m' Eng_m + \sum_k \eta_k' Chg_{i,k} + \mu_i$$

The difference between predicted and actual usage in 1996 was used as the dependent variable in a SAE model. Based upon the estimated participation month, the pro-rated engineering estimates and change variables were used to explain the deviation of the actual usage from the predicted usage. As discussed above, the predicted usage is estimated using only the comparison group to forecast the 1996 usage as a function of 1994 usage and change of cooling and heating degree days from 1994 to 1996. This usage prediction presents what would have happened in the absence of the program.

C.7 BILLING REGRESSION ANALYSIS RESULTS

The coefficients of the engineering impact, termed the SAE coefficients, are used to calculate the ex post gross energy impacts. Independent realization rates are estimated to provide PG&E with business type- and technology group-level results. Exhibit C-16 summarizes the final SAE model results that were estimated using 935 participants, as discussed in the *Data Censoring* section. Exhibit C-16 summaries the independent variables used in the SAE model, together with the t-statistics and the sample sizes available for each parameter estimate.

Exhibit C-16
Billing Regression Analysis Final Model Outputs

Parameter Descriptions	Units	Parameter Estimate	t-Statistic	Sample Size
SAE Coefficients				
Lighting End Use				
Office Flourescents	kWh	-1.00	14.67	116
Other Flourescents	kWh	-0.68	7.41	261
Controls	kWh	-1.38	2.09	57
Warehouse HIDs	kWh	0.02	0.07	10
School HIDS	kWh	0.11	0.30	10
Other RE Lighting	kWh	-1.26	2.15	119
Custom Lighting	kWh	-0.51	3.07	15
HVAC End Use				
Central A/Cs	kWh	-2.07	3.67	184
ASDs	kWh	-1.90	6.75	27
Chillers	kWh	-1.58	2.39	5
EMS	kWh	-1.03	8.38	20
Other Custom HVAC	kWh	-0.65	4.76	5
Office Thermostats	kWh	0.05	1.06	36
Other RE/REO HVAC	kWh	-0.90	2.89	153
Refrigeration				
Custom Refrigeration	kWh	-0.75	2.00	3
RE/REO Refrigeration	kWh	-0.53	1.98	181
Other End Uses	kWh			
Other	kWh	-1.71	2.90	62
Change Variables	kWh			
Cooling System Replacement	(0,1)*kWh	-0.03	0.70	10
Lighting System Replacement	(0,1)*kWh	-0.08	4.17	48
Change in Employees	(±1,0)*kWh	0.01	0.64	57
Square Foot Change	± sqft	4.42	2.37	27
Heating System Replacement	(0,1)*kWh	-0.07	0.04	4
Other Equipment Change	(0,1)*kWh	0.03	1.17	42
Remove Equipment	(0,1)*kWh	0.08	0.64	2
Refrigeration Replacement	(0,1)*kWh	0.00	0.01	3
Add Equipement	(0,1)*kWh	0.11	0.49	11
Other Additions	(0,1)*kWh	0.14	12.41	375

The dependent variable is the difference between the actual and predicted 1996 usage using the 1994 baseline model.

SAE coefficients are calculated for 16 different combinations of business type and measure. Primarily those measures that have broad participation and relatively high expected impacts were supported by separate SAE coefficients. In addition, a separate SAE coefficient was calculated for other Commercial Program measures outside Lighting, HVAC, and Refrigeration.

Attempts were made to estimate the SAE coefficients at a finer level of segmentation, but generally either one of two problems were encountered. First, available sample sizes were too small to support a finer level of segmentation. Second, certain parameters were correlated with each other and needed to be combined into a single parameter (a standard econometric solution to solving the problem of colinearity). For example, it was determined that there was a high incidence of compact and standard fluorescent installations at the same site in office buildings. Therefore, there was enough correlation between the compact and fluorescent engineering estimates to warrant combining the two estimates into a single fluorescent estimate in the model.

All but three of the SAE coefficients are significant at the 95 percent confidence level (t-statistics greater than 1.96). In addition, all of the statistically significant SAE coefficients were the correct sign, and therefore were used in the calculation of the final ex post energy calculations. The three SAE coefficients that were not significant at the 95 percent confidence interval (HIDs in warehouses and schools, and thermostats in offices) were not used in the final ex post energy calculations. Because each of the insignificant SAE coefficients were also the wrong sign, they were set to zero. Therefore, no energy impacts are being claimed for these three segments.

All the of the HVAC technologies are represented in the SAE billing analysis, except for REO Variable Frequency Drives (VFD), REO CAV to VAV, and Customized Incentive Chillers, as shown in Exhibit C-12. Although these measures represent only ten percent of the energy impact, an approach needed to be developed for adjusting the engineering energy impact estimate for these measures.

The REO VFD measure is very similar to those installed under the RE and Customized Incentive programs, and the engineering estimate is calculated using the same approach. Therefore, engineering energy impact estimate for the REO VFD measure was adjusted by the SAE coefficient estimated for the RE and Customized Incentive measures.

Three approaches were considered for adjusting the engineering energy impact estimate for the REO CAV to VAV measure: (1) applying the Other RE HVAC SAE coefficient, (2) applying the Other Custom HVAC SAE coefficient, or (3) leaving the engineering estimate unadjusted. Because the REO CAV to VAV measure is usually installed in large businesses, typical of those installing Customized Incentive measures, the Other Custom HVAC SAE coefficient was used to adjust the engineering energy impact estimate for the REO CAV to VAV measure. This is also the most conservative approach since the SAE coefficient is only 0.65.

The engineering energy impact for Chillers was estimated differently for Customized Incentive applications than for RE and REO applications, due to the different types of businesses that install these measures. Therefore, the engineering energy impact estimate for Customized Incentive Chillers was left unadjusted, which is conservative compared to the alternative approach of applying the 1.58 SAE coefficient estimated for the RE and REO applications.

The SAE coefficient of 0.65 for Other Custom HVAC measures is based on a sample size of only five sites, compared to the 43 unique sites that installed "Other" Customized Incentive HVAC measures in 1995. In addition, these five sites represent only seven percent of the total ex ante energy impact contributed by these 43 sites. Also, one third of the customers installing "Other" Customized Incentive HVAC measures have usage over 3 million kWh per year, which are not represented in the SAE analysis.

The larger customers (usage over 3 million kWh per year), however, are very well represented in the on-site audit sample, for which calibrated engineering energy impacts were estimated. Sixteen sites, which represent 53 percent of the total ex ante energy impact, were on-site audited, one of which was included in the SAE billing analysis. The ratio of the engineering energy impact estimate to the ex ante estimate is 0.79 for the on-site audit sample. This can be directly compared to the SAE coefficient, because ex ante estimates were used as the engineering energy impact estimates for the billing analysis, as mentioned above.

Three approaches were considered for estimating the ex post gross energy impact for the "Other" Customized Incentive HVAC measures:

- The SAE coefficient of 0.65 could be applied to the ex ante estimate of gross energy impact for the population.
- The 0.79 ratio of engineering energy engineering energy impact estimate to the ex ante estimate from the on-site audit sample could be applied to the ex ante estimate of gross energy impact for the population.
- The SAE coefficient of 0.65 could be applied to the ex ante estimate of gross energy impact for the population that is most similar to the SAE sample, and the 0.79 ratio of engineering energy engineering energy impact estimate to the ex ante estimate could be applied to the population most similar to the on-site audit sample.

The approach of applying the SAE coefficient to the ex ante estimate of gross energy impact for the population, which is the most conservative method, was chosen for two reasons. First, the SAE coefficient provides a statistically adjusted result that is significant at the 95 percent confidence level. Second, the 0.79 ratio based on the on-site audit is very sensitive to a few individual on-site results. For example, the ratio of the engineering to ex ante estimate is 1.51 for the site with the largest energy impact. If the engineering estimate was set equal to the ex ante estimate for this customer, the overall ratio for all on-sites would be 0.64. Conversely, if the site with the second largest energy impact, which has a ratio of 0.41, had an engineering estimate set equal to the ex ant estimate, the overall ratio would be 0.95.

The SAE coefficient of 0.75 for Customized Incentive Refrigeration measures is based on a sample size of only three sites, compared to the 53 unique sites that installed Customized Incentive Refrigeration measures in 1995. Adjusting the engineering estimates of energy impact by 0.75 for all Customized Incentive measures should be considered conservative because it is likely that a sample size of three may not be representative of the population. An alternative approach would be to adjust only those measures that are similar to the three represented in the billing analysis, and leave the remaining measures unadjusted. It was found that the ratio of the engineering energy to the ex ante gross energy estimate was 98 percent over all 53 unique sites, and 94 percent for the three sites used in the SAE analysis. Because the ratio for the SAE sample is similar to the population's ratio and because the SAE coefficient was statistically significant at the 95 percent confidence level, the conservative approach of adjusting all Customized Incentive Refrigeration measures by 0.75 was chosen.

Impact estimates from the MDSS for other end uses were included in the model for customers that installed measures outside the Lighting, HVAC, and Refrigeration end uses. Although this result is statistically significant and the correct sign, it is not recommended that this value be used because the sample may not be representative of the population of participants installing these measures.

The majority of the change variables that were included in the model were not statistically significant at the 95 percent confidence level. Most of the parameter estimates are the correct sign, and those that are not have very low t-statistics. All but one variable, was determined solely on telephone survey responses. The change variable termed "other additions" was determined by comparing the predicted estimate of post-installation usage, based on the baseline model, to the actual post-installation usage. If the predicted usage is less than the actual post-installation usage, it is likely that some change occurred at the premise that would cause the usage to increase. An analysis of these customers revealed that two thirds of them indicated through the telephone survey that some change did occur at the premise. However, almost half of these customers did not provide a date for when the change occurred. Therefore, the "other additions" variable was created in an attempt to capture other changes that would cause usage to increase, which were not explained by the other independent variables in the model.

The final SAE coefficients for the Lighting, HVAC, and Refrigeration end uses are provided in Exhibits C-17 through C-19, respectively. The SAE coefficients are multiplied by the evaluation estimates of gross energy impact to calculate the gross ex post energy impacts.

Exhibit C-17
Commercial Indoor Lighting Gross Energy Impact SAE Coefficients
By Business Type and Technology Group

Business Type / Program and Technology Group	SAE Coefficients												
	Office	Retail	College/ University	School	Grocery	Restaurant	Health Care	Hotel/Motel	Warehouse	Personal Service	Community Service	Misc.	Total
Retrofit Express Program													
Compact Fluorescent	1.00	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	
Incandescent to Fluorescent	1.00	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	
Efficient Ballast	1.00	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	
T8 Lamps and Electronic Ballasts	1.00	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	
Optical Reflectors w/ Fluor. Delamp	1.00	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	
High Intensity Discharge	1.26	1.26	1.26	0.00	1.26	1.26	1.26	1.26	0.00	1.26	1.26	1.26	
Halogen	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	
Exit Signs	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	
Controls	1.38	1.38	1.38	1.38	1.38	1.38	1.38	1.38	1.38	1.38	1.38	1.38	
Retrofit Express Total													
Customized Incentives Program													
Compact Fluorescent	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	
Standard Fluorescent	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	
High Intensity Discharge	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	
Halogen	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	
Exit Signs	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	
Controls	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	
Other	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	
Customized Incentives Total													
Total													

Exhibit C-18
Commercial HVAC Gross Energy Impact SAE Coefficients
By Business Type and Technology Group

Business Type / Program and Technology Group	SAE Coefficients											
	Office	Retail	College/ University	School	Grocery	Restaurant	Health Care	Hotel/Motel	Warehouse	Personal Service	Community Service	Misc.	Total
Retrofit Express Program													
Central A/C	2.069	2.069	2.069	2.069	2.069	2.069	2.069	2.069	2.069	2.069	2.069	2.069	
Variable Speed Drive HVAC Fan	1.901	1.901	1.901	1.901	1.901	1.901	1.901	1.901	1.901	1.901	1.901	1.901	
Package Terminal A/C	0.898	0.898	0.898	0.898	0.898	0.898	0.898	0.898	0.898	0.898	0.898	0.898	
Programmable Thermostat	0.000	0.898	0.898	0.898	0.898	0.898	0.898	0.898	0.898	0.898	0.898	0.898	
Reflective Window Film	0.898	0.898	0.898	0.898	0.898	0.898	0.898	0.898	0.898	0.898	0.898	0.898	
Water Chiller	1.582	1.582	1.582	1.582	1.582	1.582	1.582	1.582	1.582	1.582	1.582	1.582	
Other Measures	0.898	0.898	0.898	0.898	0.898	0.898	0.898	0.898	0.898	0.898	0.898	0.898	
Retrofit Express Total													
Retrofit Efficiency Options Program													
Variable Frequency Drive	1.901	1.901	1.901	1.901	1.901	1.901	1.901	1.901	1.901	1.901	1.901	1.901	
Water Chiller	1.582	1.582	1.582	1.582	1.582	1.582	1.582	1.582	1.582	1.582	1.582	1.582	
CAV to VAV	0.653	0.653	0.653	0.653	0.653	0.653	0.653	0.653	0.653	0.653	0.653	0.653	
Cooling Tower	0.898	0.898	0.898	0.898	0.898	0.898	0.898	0.898	0.898	0.898	0.898	0.898	
Retrofit Efficiency Options Total													
Customized Incentives Program													
HVAC Variable Speed Drive	1.901	1.901	1.901	1.901	1.901	1.901	1.901	1.901	1.901	1.901	1.901	1.901	
High Efficiency Chiller	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
Energy Management System	1.026	1.026	1.026	1.026	1.026	1.026	1.026	1.026	1.026	1.026	1.026	1.026	
Other Measures	0.653	0.653	0.653	0.653	0.653	0.653	0.653	0.653	0.653	0.653	0.653	0.653	
Customized Incentives Total													
Total													

Exhibit C-19
Commercial Refrigeration Gross Energy Impact SAE Coefficients
By Business Type and Technology Group

Business Type / Program and Technology	SAE Coefficients												
	Office	Retail	College/ University	School	Grocery	Restaurant	Health Care	Hotel/Motel	Warehouse	Personal Service	Community Service	Misc.	Total
Retrofit Express Program													
Refrigeration Load Reduction													
Low Temperature Glass/Acrylic Door	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	
Heatless Door	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	
Cooler/Freezer Door Gaskets	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	
Auto Closer for Cooler/Freezer	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	
Medium Temperature Case w/ Door	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	
Strip Curtains for Walk-in	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	
Low Temperature Case w/ Door	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	
Night Covers for Display Cases	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	
Compressor Upgrades													
Mechanical Subcooler	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	
Multiplex Comprssor System	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	
Adjustable Speed Drive	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	
Floating Head Pressure Controls	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	
Condenser Upgrades													
Oversized Air-Cooled Condenser	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	
Oversized Evaporative Condenser	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	
Evaporator Upgrades													
Walk-in Cooler PSC Evaporator Motor	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	
Display PSC Evaporator Motor	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	
Other													
Anti-Sweat Heater Control	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	
Suction Line Insulation	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	
Display Case Electronic Ballast	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	
Non-Electric Condensate Evaporator	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	
Retrofit Express Total													
Customized Incentives Program													
Compressor Upgrades													
Floating Head Pressure Controls	0.753	0.753	0.753	0.753	0.753	0.753	0.753	0.753	0.753	0.753	0.753	0.753	
Booster Desuperheaters	0.753	0.753	0.753	0.753	0.753	0.753	0.753	0.753	0.753	0.753	0.753	0.753	
Condenser Upgrades													
Oversized Condensers	0.753	0.753	0.753	0.753	0.753	0.753	0.753	0.753	0.753	0.753	0.753	0.753	
Other													
Refrigeration EMS	0.753	0.753	0.753	0.753	0.753	0.753	0.753	0.753	0.753	0.753	0.753	0.753	
Refrigeration Add/Change	0.753	0.753	0.753	0.753	0.753	0.753	0.753	0.753	0.753	0.753	0.753	0.753	
Refrigeration Other	0.753	0.753	0.753	0.753	0.753	0.753	0.753	0.753	0.753	0.753	0.753	0.753	
Customized Incentives Total													
Total													

C.7.1 Relative Precision Calculation

Relative precision at 90 percent and 80 percent confidence levels for the adjusted gross energy impact estimates are calculated for each of the SAE analysis segments. As mentioned above, there are a total of sixteen analysis segments that were explicitly modeled, and the relative precision estimates based upon the model output are presented in Exhibit C-20 below. In order to calculate the total program level adjusted gross impact and relative precision, the segment-level results were weighted by their unadjusted engineering energy impact estimates in the following equations.

$$\text{Total Adjusted Energy Impact} = \sum_i \beta_i Eng_i$$

Where β_i and Eng_i are the SAE coefficients and unadjusted engineering impact estimates for segment i, respectively. The program level standard error can be estimated as:[2]

$$StdErr = \sqrt{\sum_i (CV_i * \beta_i * Eng_i)^2}$$

Where $CVi = (std(\beta i)/\beta i)$ is the coefficient of variation in segment i, estimated in the billing regression model. Finally, the relative precision at 90 percent and 80 percent confidence levels were calculated as

$$RP = \frac{t * StdErr}{\text{Total Adj. Energy Impact}}$$

Where t equals 1.645 and 1.282 for the 90 percent and 80 percent confidence levels, respectively.

[2] This procedure assumes that the samples in different segments are independent and can be treated as strata in a stratified sampling.

Exhibit C-20
Relative Precision Calculation

SAE Analysis Level	Engineering Gross Energy Impact Estimate (MWh)	SAE Coefficient	t-Statistic	Relative Precision at 80%	Relative Precision at 90%
Lighting End Use					
Office Flourescents	51,455	1.00	14.67	9%	11%
Other Flourescents	76,591	0.68	7.41	17%	22%
Controls	5,318	1.38	2.09	61%	79%
Warehouse HIDs	4,306	0.00	-	-	-
School HIDS	815	0.00	-	-	-
Other RE Lighting	17,534	1.26	2.15	60%	77%
Customized Incentives Lighting	10,242	0.51	3.07	42%	54%
Total	166,261	0.83		13%	16%
HVAC End Use					
Central A/Cs	878	2.07	3.67	35%	45%
ASDs	8,971	1.90	6.75	19%	24%
Chillers	2,966	1.58	2.39	54%	69%
EMS	10,290	1.03	8.38	15%	20%
Other Customized Incentives HVAC	18,668	0.65	4.76	27%	35%
Office Thermostats	1,332	0.00	-	-	-
Other RE/REO HVAC	6,087	0.90	2.89	44%	57%
Total	49,192	1.03		12%	15%
Refrigeration					
Customized Incentives Refrigeration	18,206	0.75	2.00	64%	82%
RE/REO Refrigeration	8,566	0.53	1.98	65%	83%
Total	26,772	0.68		51%	65%

C.8 NET BILLING ANALYSIS

In addition to conducting a billing analysis to estimate gross energy impacts, a net billing analysis was performed, with the objective of estimating SAE coefficients that could be applied to gross engineering estimates to calculate net energy impact. The net billing analysis model specification differs from the gross billing analysis model, which used two different multivariate regression models (a baseline model using a control group and an SAE model using participants). Instead, the net billing analysis model runs one integrated model combining both the participants and nonparticipants.

A disadvantage of combining both participants and nonparticipants into one model of net energy savings is that the resulting sample is not random. In particular, participants self-select into the program and therefore may not be randomly distributed. As a result, there are certain unobserved characteristics that influence the decision to participate. If these characteristics are not accounted for in the model, the net savings model could produce biased coefficient estimates.

One solution to this problem is to include an Inverse Mills Ratio in the model to correct for self-selection. This method was developed by Heckman (1976, 1979[3]) and is used by others (Goldberg and Train, 1996[4]) to address the problem of self-selection into energy retrofit programs. The Mills Ratio technique assumes that the unobserved factors that are influencing participation are distributed normally. The influence of these unobserved factors on participation can be approximated by a Mills Ratio which itself is distributed normally. Using the Mills Ratio corrects for the self-selection bias in the net savings regression as the unobserved factors affecting participation are now controlled for in the model. As a result, standard regression techniques should produce unbiased coefficient estimates.

Goldberg and Train (1996) develop the technique of using an additional Mills Ratio in the savings regression to account for the possibility that participation is correlated with the size of energy savings. The second Mills Ratio is interacted with a measure of energy savings, which allows the amount of net savings to vary with participation. The rationale for the second term is that those customers who have potentially large savings are more likely to participate in the program. Consequently, the unobserved factors that are influencing participation are also affecting the amount of savings. The additional Mills Ratio accounts for the fact that amount of savings will be correlated with participation.

To correct for self-selection, a probit model of program participation is estimated separately for each of the Lighting, HVAC, and Refrigeration retrofit programs. Upon estimation, the parameters of the participation model are then used to calculate an Inverse Mills Ratio for both participants and nonparticipants. This Mills Ratio is then included in the net savings regression that combines both participants and nonparticipants. If the Mills Ratio controls for those unobserved factors that determine participation, and the other model assumptions are met, then the net savings model can then be estimated as if participation in the program is randomly determined.

Using the Inverse Mills Ratio to correct for selection relies on several assumptions. First, the net savings due to the program, whether expressed as naturally occurring savings or a net-to-gross ratio, must be normally distributed. In addition, the Mills Ratio must not be highly correlated with the other independent variables used in the net billing regression. In this application, both of these assumptions are found to be violated. Net savings due to the program is biased upward toward large customers and is not distributed normally. The Mills Ratio term used in the net savings regression is also found to be highly correlated with other independent variables, which introduces multi-collinearity into the model. As a result of these violations, the regression analysis using the Mills Ratio technique does not yield reliable estimates in this application. A description of the methods used for this application are given in the following sections. *Section C.8.1* describes the data and variables used for the probit participation model and *Section C.8.2* gives the estimation results. *Section C.8.3* describes how the Inverse Mills Ratio is used in the Net Billing Model and *Section C.8.4* gives the estimation results from the Net Billing Model.

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[3] Heckman, J. 'The Common Structure of Statistical Models of Truncation, Sample Selection and Limited Dependent Variables and a Simple Estimator for Such Models.". Annals of Economic and Social Measurement, Vol. 5, pp. 475-492, 1976.

Heckman, J. "Sample Selection Bias as a Specification Error." Econometrica, Vol. 47, pp. 153-161, 1979.

[4] Goldberg, Miriam and Kenneth Train. 'Net Savings Estimation: An analysis of Regression and Discrete Choice Approaches', prepared for the CADMAC Subcommittee on Base Efficiency by Xenergy, Inc. Madison, WI, March 1996.

C.8.1 Probit Model of Participation

The first stage of calculating the Mills Ratio is to develop a probit model of program participation. The probit model is a discrete choice model with a dependent variable of either zero or one reflecting whether or not an event occurred. In this case, individuals received a value of one if they participated in the retrofit program and a zero otherwise. The sample includes all 1,217 participants and 652 nonparticipants, and includes information obtained from the telephone surveys as well as billing data. All of these 1,869 survey respondents were used to estimate the participation probit for each program. Of the 1,869, 614 are participants in the Lighting program, 487 are participants in the HVAC program, and 241 are participants in the Refrigeration program. For those customers with missing information, an average value is assigned based on both building type and program participation.

For each of the three retrofit programs, the participation model specification is the same:

$$\text{Participation} = \alpha + \beta'X + \gamma Y + \vartheta' Z + \varepsilon$$

A description of the explanatory variables is given in Exhibit C-21. The dependent variable PARTICIPATION has a value of one if the customer participated in the 1995 Retrofit program and a zero if they did not participate. The independent variables used are those characteristics that are likely to influence program participation. The first set of variables (X) used in the participation probit describe the customer's business activity. These consist of indicator variables for various building types. The second group of variables (Y) reflect the building characteristics. These include customer size and energy use as well as recent changes in high energy equipment. The third group of variables (Z) contain information on participation in other PG&E programs. Finally, the error term (ε) is assumed to be normally distributed for the probit specification.

Exhibit C-21
Explanatory Variables Description

Variable Name	Units	Variable Type	Description
ADDLIGHT	0,1	Y	Customer added light equipment since 1/93
AVGUSE	Kwh	Y	Average monthly electricity use over 1992-1994
ADDCOOL	0,1	Y	Customer added cooling equipment since 1/93
ADDREF	0,1	Y	Customer added refrigeration equipment since 1/93
ARCOOL	0,1	Y	Cooling equipment was added and removed since 1/93
ARLIGHT	0,1	Y	Lighting equipment was added and removed since 1/93
ARREF	0,1	Y	Refrigeration equipment was added and removed since 1/93
CCHGPGE	0,1	Y	Cooling change was part of a PG&E program
LCHGPGE	0,1	Y	Lighting change was part of a PG&E program
COLLEGE	0,1	X	College
COMMSERV	0,1	X	Community service building
GROCERY	0,1	X	Grocery
HEALTH	0,1	X	Health Care Building
HOTEL	0,1	X	Hotel
MISCCOM	0,1	X	Miscellanious commercial building
OFFICE	0,1	X	Office building
PERSONAL	0,1	X	Personal service building
RESTRNT	0,1	X	Restaurant
SCHOOL	0,1	X	School
RETAIL	0,1	X	Retail Building
WAREHSE	0,1	X	Warehouse
MEDCUST	0,1	Y	Medium sized customer, based on electricty use
LARGCUST	0,1	Y	Large sized customer, based on electricity use
LIGHT95	0,1	Y	Lighting change done in 1995 or later
COOL95	0,1	Y	Cooling change done in 1995 or later
HEAT95	0,1	Y	Heating change done in 1995 or later
OTHER95	0,1	Y	Other equipment change done in 1995 or later
GASHEAT	0,1	Y	Customer has gas heating
ELECHEAT	0,1	Y	Customer has electric heating
DUALHEAT	0,1	Y	Customer has dual heating
HAWARE	0,1	Z	Customer is an HVAC part and became aware of the PG&E program either before or at the same time the new equipment was selected
LAWARE	0,1	Z	Customer is an lighting part and became aware of the PG&E program either before or at the same time the new equipment was selected

C.8.2 Probit Estimation Results

The results of the probit estimation for each program are given in Exhibits C-22, C-23, and C-24.

Exhibit C-22
Lighting Program Probit Estimation Results

Variable Name	Coefficient Estimate	Standard Error	Significance Level
ADDLIGHT	-0.21	0.17	22%
AVGUSE	0.00	0.00	1%
ADDCOOL	0.02	0.17	91%
ADDREF	-0.25	0.26	34%
ARCOOL	0.08	0.15	58%
ARLIGHT	-1.02	0.17	1%
ARREF	-0.34	0.27	22%
CCHGPGE	0.47	0.28	10%
LCHGPGE	-0.13	0.20	51%
COLLEGE	-0.36	0.31	24%
COMMSERV	-0.10	0.14	50%
GROCERY	-1.51	0.13	10%
HEALTH	-0.65	0.17	16%
HOTEL	-0.29	0.21	1%
MISCCOM	-1.17	0.15	8%
OFFICE	-0.22	0.12	2%
PERSONAL	-0.45	0.20	1%
RESTRNT	-1.17	0.14	1%
SCHOOL	-0.52	0.13	1%
RETAIL	-0.66	0.13	2%
WAREHSE	-0.39	0.17	2%
MEDCUST	0.41	0.08	1%
LARGCUST	0.58	0.10	1%
LIGHT95	-0.11	0.24	66%
COOL95	0.10	0.27	70%
HEAT95	0.34	0.27	21%
OTHER95	-0.36	0.25	14%
GASHEAT	0.18	0.10	6%
ELECHEAT	-0.06	0.11	60%
DUALHEAT	0.14	0.29	63%
HAWARE	-0.65	0.09	1%

Exhibit C-23
HVAC Program Probit Estimation Results

Variable Name	Coefficient Estimate	Standard Error	Significance Level
ADDLIGHT	0.13	0.24	59%
AVGUSE	0.00	0.00	3%
ADDCOOL	-0.33	0.26	20%
ADDREF	-0.09	0.46	84%
ARCOOL	-0.71	0.26	1%
ARLIGHT	0.07	0.20	73%
ARREF	-0.30	0.53	58%
CCHGPGE	1.33	0.44	1%
LCHGPGE	0.56	0.24	2%
COLLEGE	-1.12	0.48	2%
COMMSERV	-0.50	0.23	3%
GROCERY	-2.16	0.24	1%
HEALTH	-0.37	0.24	11%
HOTEL	-0.39	0.3	19%
MISCCOM	-1.74	0.26	1%
OFFICE	-0.24	0.19	20%
PERSONAL	-0.70	0.29	2%
RESTRNT	-1.43	0.22	1%
SCHOOL	-0.70	0.20	1%
RETAIL	-1.07	0.21	1%
WAREHSE	-0.81	0.26	1%
MEDCUST	-0.13	0.12	25%
LARGCUST	-0.11	0.15	46%
LIGHT95	0.31	0.28	26%
COOL95	-0.63	0.55	25%
HEAT95	-0.26	0.44	56%
OTHER95	-0.11	0.36	75%
GASHEAT	0.62	0.16	1%
ELECHEAT	0.40	0.18	3%
DUALHEAT	0.33	0.43	45%
LAWARE	-0.79	0.12	1%

Exhibit C-24
Refrigeration Program Probit Estimation Results

Variable Name	Coefficient Estimate	Standard Error	Significance Level
ADDLIGHT	-0.08	0.32	80%
AVGUSE	0.00	0.00	62%
ADDCOOL	-0.06	0.33	86%
ADDREF	-0.16	0.27	56%
ARCOOL	-0.51	0.34	13%
ARLIGHT	-0.29	0.26	27%
ARREF	0.44	0.24	7%
CCHGPGE	0.66	0.62	29%
LCHGPGE	0.39	0.30	20%
COLLEGE	-0.66	0.60	23%
COMMSERV	-1.52	0.42	1%
GROCERY	-0.38	0.14	1%
HEALTH	-6.56	0.83	99%
HOTEL	-1.00	0.44	2%
MISCCOM	-1.00	0.23	1%
OFFICE	-1.09	0.24	1%
PERSONAL	-1.81	0.67	1%
RESTRNT	0.80	0.16	1%
SCHOOL	-0.85	0.23	1%
RETAIL	-0.90	0.21	1%
WAREHSE	-0.50	0.27	7%
MEDCUST	-0.33	0.14	2%
LARGCUST	-0.35	0.15	2%
LIGHT95	0.77	0.30	1%
COOL95	0.81	0.40	4%
HEAT95	0.21	0.41	60%
OTHER95	-0.32	0.52	54%
GASHEAT	-0.28	0.13	4%
ELECHEAT	-0.33	0.16	4%
DUALHEAT	0.16	0.46	73%
LAWARE	-0.86	0.21	1%
HAWARE	-1.48	0.36	1%

In general, the estimation results conform to expectations. For the Lighting probit, customer size as reflected by energy use has a positive impact on program participation. In addition, those customers with gas heating and with a recent cooling equipment change are also more likely to participate. All of the building type variables have negative coefficient estimates, which reflects the fact that each building type has more nonparticipants than participants included in the sample. Finally, recent additions and removals in lighting equipment as well as changes in HVAC equipment have a negative effect on program participation.

For the HVAC probit, large customers based on average monthly electricity use tend to participate in the program. Recent changes in lighting and cooling due to PG&E programs also have a positive impact on program participation. As with the lighting model, all of the building types have negative coefficient estimates.

For the Refrigeration model, smaller customers tend to participate more relative to the medium- and large-sized customers. In addition, restaurants are more likely to participate in the program while other business types are less likely to participate. Recent changes in cooling and lighting equipment also tend to increase participation.

Upon estimation, the coefficient estimates are used to calculate the Inverse Mills Ratio for use in the net savings regression. The product of all of the independent variables and respective coefficient estimates are used in the following calculation

Mills Ratio = $= \phi(Q)/\Phi(Q)$ (for participants)

$= -\phi(Q)/\Phi(-Q)$ (for nonparticipants)

$$Q = \alpha + \beta' X + \gamma Y + \vartheta' Z$$

where ϕ is the standard normal probability density function and Φ is the standard normal cumulative density function. Again, this Mills Ratio is used as a measure of the influence that unobserved factors have on program participation. In the following sections, the Mills Ratio is included in the net billing regression as an additional explanatory variable to correct for the problem of self-selection into the Lighting program.

C.8.3 Net Billing Model

The net billing regression analysis for the Commercial Program Evaluation uses a model specification similar to the baseline model used in the gross billing analysis, with three significant differences.

- Both participants and nonparticipants are used in the model.
- The engineering impact estimates are included as independent variables in the model. For nonparticipants, these values are all zero.
- The Mills Ratio is entered into the model in two ways. First, the three Mills Ratios, corresponding to each end use, are included as independent variables. Second, the three Mills Ratios are interacted with the total engineering impact estimate for each corresponding end use.

The resulting SAE coefficients on the energy impacts are then used to adjust the engineering estimates of expected annual energy impacts for the entire participant population to estimate the net ex post energy impacts. The net billing analysis model has the following functional form:

$$kWh_{post,i} = \sum_j (\alpha_j + \beta_j kWh_{pre,i}) + \gamma(\Delta CDD_i) * kWh_{pre,i} + \phi(\Delta HDD_i) * Elec_i * kWh_{pre,i} + \sum_k \eta_k Chg_{i,k}$$
$$+ \sum_m (\rho_m Eng_{m,i}) + \delta_1 Mills_{light,i} + \delta_2 Mills_{HVAC,i} + \delta_3 Mills_{refrig,i} + \delta_4 Mills_{light,i} * Eng_{light,i} + \delta_5 Mills_{HVAC,i} Eng_{HVAC,i}$$
$$+ \delta_6 Mills_{refrig,i} Eng_{refrig,i} + \varepsilon$$

Where

$kWh_{post,i}$ and $kWh_{pre,i}$ are customer i's annualized energy usage for the post- and pre-installation periods, respectively;

ΔCDD_i and ΔHDD_i are the annual change of cooling and heating degree days (base 65°F) between the post-installation year and pre-installation year;

$Elec_i$ is an indicator variable (0/1) for the ith customer, which equals 1 if the customer has electric heating;

$Chg_{i,k}$ are the customer self-reported change variables from the survey data, including adding, replacing, or removing equipment associated with major end uses, changes in number of employees and square footage;

$Eng_{m,i}$ are the engineering impact estimates for technology m, customer i;

$Mills_{light,i}$ is the Mills Ratio for the Lighting end use for customer i;

$Mills_{HVAC,i}$ is the Mills Ratio for the HVAC end use for customer i;

$Mills_{refrig,i}$ is the Mills Ratio for the Refrigeration end use for customer I;

$Eng_{light,i}$ is the engineering estimate for all Lighting technologies for customer i;

$Eng_{HVAC,i}$ is the engineering estimate for all HVAC technologies for customer i;

$Eng_{refrig,i}$ is the engineering estimate for all Refrigeration technologies for customer i;

α_j is the indicator variable (0/1) for the jth business type, which equals 1 if the customer is in that business type and 0 otherwise;

β, γ and ϕ are the estimated slopes on their respective independent variables. Separate slopes on pre-usage are estimated by business type; and,

ρ_m are the SAE coefficients for the engineering impact estimates for technology m;

δ are the coefficients on the individual Mills ratios, and on the Mills ratios interacted with the engineering energy impacts;

ε is the random error term of the model.

This model was run with the same set of 620 nonparticipants and 935 participants that were used in the gross billing analysis model. The results of the model are presented below. The parameter estimates, t-statistics and sample sizes are presented for all of the SAE coefficients and Mills ratios.

Exhibit C-25
Net Billing Regression Analysis Final Model Outputs

Parameter Descriptions	Units	Parameter Estimate	t-Statistic	Sample Size
SAE Coefficients				
Lighting End Use				
Office Flourescents	kWh	-0.35	0.75	116
Other Flourescents	kWh	-0.70	1.40	261
Controls	kWh	-0.60	0.83	57
Warehouse HIDs	kWh	0.08	0.14	10
School HIDS	kWh	0.13	0.23	10
Other RE Lighting	kWh	-0.05	0.07	119
Customized Incentives Lighting	kWh	-0.47	0.92	15
HVAC End Use				
Central A/Cs	kWh	-3.64	3.41	184
ASDs	kWh	-2.53	2.40	27
Chillers	kWh	-1.85	1.76	5
EMS	kWh	-2.20	3.17	20
Other Customized Incentives HVAC	kWh	-1.31	1.60	5
Office Thermostats	kWh	-0.83	0.85	36
Other RE/REO HVAC	kWh	-1.70	1.75	153
Refrigeration				
Customized Incentives Refrigeration	kWh	5.78	2.08	3
RE/REO Refrigeration	kWh	4.72	2.02	181
Other End Uses	kWh			
Other	kWh	-2.18	3.94	62
Mills Ratios				
Single Mills				
Lighting	unitless	-3083	1.18	1555
HVAC	unitless	2980	1.08	1555
Refrigeration	unitless	4051	1.00	1555
Double Mills, Interacted with Impact				
Lighting	kWh	0.07	0.33	464
HVAC	kWh	0.54	1.56	368
Refrigeration	kWh	-1.92	2.21	183

It was found that there was a significant problem of multi-collinearity with the net billing model. The double Mills ratios (the Mills ratio interacted with the engineering energy impacts) were found to be extremely highly correlated with the corresponding engineering energy impacts. Exhibit C-26 below presents the correlation of estimates between the double Mills and the engineering energy impacts.

Exhibit C-26
Correlation Between Double Mills Ratios and Energy Impact Estimates

Parameter Descriptions	Double Mills Ratios		
	Lighting	**HVAC**	**Refrigeration**
Engineering Energy Impact Estimates			
Lighting End Use			
Office Flourescents	-0.99	-0.06	-0.014
Other Flourescents	-0.98	-0.11	-0.0132
Controls	-0.50	-0.04	-0.0121
Warehouse HIDs	-0.91	-0.07	-0.0137
School HIDS	-0.78	-0.06	-0.0109
Other RE Lighting	-0.65	-0.09	-0.01
Customized Incentives Lighting	-0.95	-0.06	-0.0061
HVAC End Use			
Central A/Cs	-0.06	-0.85	-0.0035
ASDs	-0.12	-0.96	-0.008
Chillers	-0.05	-0.81	-0.004
EMS	-0.08	-0.98	-0.008
Other Customized Incentives HVAC	-0.10	-0.99	-0.0075
Office Thermostats	-0.05	-0.87	-0.0054
Other RE/REO HVAC	-0.09	-0.95	-0.0066
Refrigeration			
Customized Incentives Refrigeration	-0.01	0.00	-0.9916
RE/REO Refrigeration	-0.01	-0.01	-0.9936
Other End Uses			
Other	0.07	-0.02	-0.003

As a result of the multi-collinearity problem, the majority of the SAE coefficients in the net billing model are insignificant at the 95 percent confidence level. In addition, the high correlation between the double Mills Ratios and the engineering impact estimates results in relatively meaningless parameter estimates. For example, because the HVAC double Mills Ratio is 99 percent negatively correlated with the "other Custom HVAC" energy impact estimate, the SAE coefficient on the energy impact will tend to become more negative as the parameter estimate on the Mills Ratio becomes more positive. Therefore, because of the positive parameter estimate of 0.54 on the HVAC double Mills Ratio, we see the SAE coefficient on the "other Custom HVAC" energy impact being driven down to a value of -1.31 (from -.65 in the gross billing analysis). This would indicate a net ex post impact estimate that is twice as large as the gross ex post impact estimate. Conversely, the negative parameter on the Refrigeration double Mills Ratio is causing the SAE coefficient on the refrigeration energy impacts to become positive.

A number of alternative model specifications were implemented, however all suffered from the problem of multi-collinearity. Therefore, the results of the net billing analysis were not incorporated into the final net ex post energy impact estimates. *Appendix D* discusses the results of the net to gross analysis that was conducted to estimate the final net ex post energy impact estimates.

Appendix D
Net-to-Gross Analysis

D. NET-TO-GROSS METHOD

In this appendix, the methods used to derive net-to-gross (NTG) results for the evaluation of PG&E's 1995 Commercial RE and Customized Incentives Programs are presented. After a brief discussion of data sources, estimates of free-ridership and spillover from participant self-reports are discussed.

D.1 DATA SOURCES

Data used in the NTG analysis include 236 telephone surveys from refrigeration end use participants and 201 telephone surveys from refrigeration end use nonparticipants surveyed in October 1996.

D.2 SELF-REPORT-BASED ESTIMATES OF FREE-RIDERSHIP

The RE and Customized Incentives participants surveyed installed or adopted the following measures. (Some participants installed more than one measure.)

Measure	N
Cooler or Freezer with Non-Electric Condensate Evaporator	165
Night Covers for Display Case	23
Strip Curtains for Walk-in Boxes	21
New Refrigeration Case with Glass or Acrylic Doors	10
Cooler or Freezer Door Gasket	16
Auto-Closer for Cooler or Freezer	6
Other Measures	13
Custom	6

Because free-ridership often varies by technology, results were calculated for each technology group. However, caution should be employed in interpreting the analysis results, given the small group sizes for some technology groups.

D.2.1 Methods for Scoring Free-Ridership

Multiple methods were used in scoring free-ridership. The methods used vary slightly from each other and elaborate on the technique described in the work plan. All of them use participant responses to survey questions regarding the timing of and reasons for equipment replacement actions. The complete text of the participant surveys may be found in *Appendix S-1*.

Six methods were used in this analysis. Each is described below.

Method 1 is the method described in the work plan. If the customer indicated that he had not been shopping for new refrigeration equipment before becoming aware of the program, he was scored initially as a net participant. A customer was then classified as a free-rider if he met the following two conditions: (1) stated that he would have installed high-efficiency equipment within the year and had already selected the equipment; and (2) stated that he would have purchased high-efficiency equipment if the program had not existed.

To be classified as a free-rider under *Method 2*; a customer must have: (1) stated that he became aware of the program *after* making an equipment selection; (2) stated that he had already decided to purchase high-efficiency equipment before becoming aware of the program; and (3) stated that he would have purchased high-efficiency equipment if the program had not existed. As a consistency check, if a customer indicated that he would not have replaced the equipment (an unprompted response), free-ridership was scored as "0" for the site. This method generates high NTG ratios because of the final condition that must be met in order to be scored as a free-rider. Most customers reported that they would not have replaced equipment and hence were scored as net participants.

With *Method 3,* if the customer stated that he would have purchased high-efficiency equipment if the program had not existed, he was scored as a free-rider. Additional questions were used to "override" this preliminary assignment. If he answered that he hadn't considered purchasing new equipment before becoming aware of the program or hadn't yet decided on equipment, then the site was rescored as a net participant. If the customer indicated that he had not been shopping but had been approached by a vendor/contractor, then free-ridership was set at "0." As a last check, information volunteered by customers was used to revert the customer back to free-ridership status, if appropriate.

Method 4 is identical to Method 3 except deferred free-riders[1] (PD500 = 3) are assigned a NTG ratio of "0.5."

Method 5 is similar to the method described in the work plan except additional questions are used to validate results. If the customer indicated that he had not been shopping for new refrigeration equipment before becoming aware of the program, he was scored initially as a net participant. A customer was then classified as a free-rider if he met the two conditions stated in Method 1. If the customer stated that the most important factor in his decision to install the equipment was the rebate, free-ridership was set to "0." However, if, when asked why he hadn't installed the equipment prior to participating, the customer stated that he was planning to, the site was scored as a free-rider.

Method 6 is similar to Methods 1 and 5, except that customers citing information and referral services associated with the program as the most important factor in deciding to install the equipment were scored as net participants. An opportunity to revert to free-ridership status was also allowed with this method.

D.2.2 Free-Ridership Results

NTG results weighted by avoided cost (AC) and calculated by subtracting the free-ridership rates obtained through each of the methods described above are presented in Exhibit D-1. Results are presented overall and by segment. Measures classified as "other" include glass or acrylic doors for low-temperature case, low-heat/no-heat refrigeration case doors, humidistat control, case lighting

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[1] Deferred free-riders are those who were planning on installing energy-efficient equipment prior to becoming aware of the program but whose purchase was accelerated by the program.

electronic ballast, insulate bare suction line, multiplex compressor system, subcooler, and floating head pressure controller.

Exhibit D-1
NTG Weighted by Avoided Cost

	RE Measures								
	New Cases	Nonelectric Condensate Evaporator	Auto-Closers	Night Covers	Strip Curtains	Gaskets	Other	Custom	Overall
N	10	165	6	23	21	16	13	6	260
% Avoided Cost	2.4%	1.6%	0.5%	0.5%	0.4%	0.2%	5.5%	85.8%	91.3%
Method 1	1.00	0.753	0.880	0.699	0.871	0.434	0.983	0.385	0.508
Method 2	1.00	0.806	1.00	0.753	0.893	0.703	0.995	0.719	0.782
Method 3	0.687	0.717	0.961	0.868	0.439	0.717	0.831	0.333	0.455
Method 4	0.687	0.687	0.927	0.771	0.646	0.661	0.822	0.359	0.471
Method 5	1.00	0.784	0.880	0.721	0.852	0.434	0.983	0.385	0.509
Method 6	1.00	0.737	0.880	0.691	0.852	0.434	0.983	0.385	0.507

Overall, weighted NTG results range from a low of 0.455 for Method 3 to a high of 0.782 for Method 2. Results obtained using Method 1 (initially proposed in the workplan) were consistent with those from the other methods, and the Method 1 result of 0.508 overall NTG was used as the basis for subsequent adjustment for spillover.

D.3 SELF-REPORT-BASED ESTIMATES OF SPILLOVER

Refrigeration spillover can be defined as refrigeration efficiency improvements implemented outside the program but influenced by the program. Preliminary estimates of refrigeration spillover rates were generated by analyzing responses to a combination of questions asked of 236 participants and 201 nonparticipants.

D.3.1 Methods for Scoring Spillover

The integrated approach to estimating refrigeration spillover is summarized below.

All survey respondents were asked if they had installed refrigeration equipment outside the program since January 1993. Participants who answered "yes" to the first question were asked if these changes were made after participating in the program. Nonparticipants, and participants who said the changes were made after participation, were asked if they made the equipment changes through a PG&E program.

Participants who passed the first two screening questions and had not changed out refrigeration equipment through a PG&E program, and nonparticipants who passed the first two screening questions and were aware of the program at the time of equipment purchase, were asked how influential the program was in their decision. Those who said that the program had influenced their decision2 were included in the preliminary estimate of program spillover.

[2] "To what extent did participating in the program influence your additional equipment selection?" Values of 2, 3, 4, and 5 (slightly influential to very influential) were considered to demonstrate program influence on the purchase.

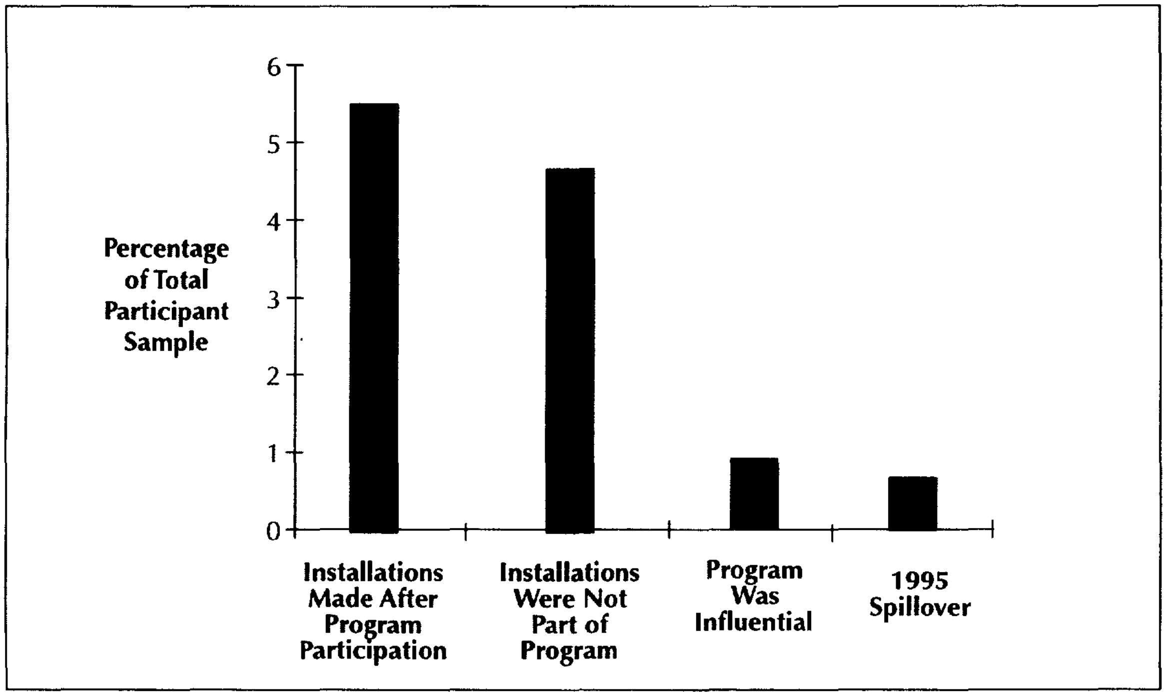
Survey-based estimates were applied to the refrigeration participant population and the refrigeration nonparticipant population along with estimates of impact per site, resulting in a final spillover impact.

It should be noted that this analysis provides a preliminary indication of spillover rates and more in-depth analysis is required to quantify spillover impacts.

D.3.2 Spillover Result— Participants

Results of the sequential analysis of survey responses to estimate a participant spillover rate of 0.42 percent are illustrated in Exhibit D-2.

Exhibit D-2
Refrigeration Spillover Indicators
Program Participants

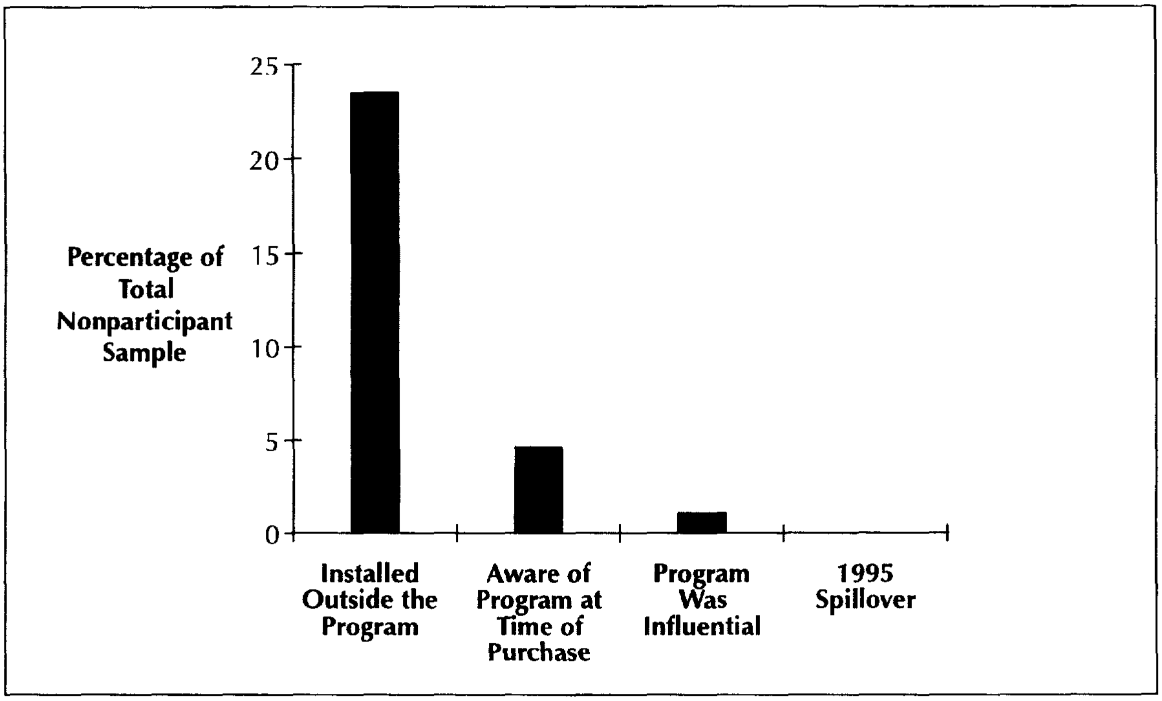


Twenty-nine surveyed participants (12 percent of the total participant sample) reported that since January 1993 they had added refrigeration equipment. Forty-five percent of those participants who added equipment (6 percent of the total participant sample) added the equipment after participating in the program. Thirty-eight percent (5 percent of the total participant sample) did not install the equipment through the program. Two of these respondents (0.85 percent of the total participant sample) reported the program influenced their additional refrigeration equipment installations. Of these two, one installed additional refrigeration in 1995. One of 236 participants yields an initial unweighted spillover rate of 0.42 percent for 1995.

D.3.3 Spillover Results—Nonparticipants

Results of the sequential analysis of survey responses to estimate nonparticipant spillover are illustrated in Exhibit D-3.

Exhibit D-3
Refrigeration Spillover Indicators
Program Nonparticipants



Fifty of 201 program nonparticipants reported making refrigeration changes outside the program, of which 47 respondents confirmed their installations were not done through the program. Nine respondents (4 percent of the total nonparticipant sample) reported they were aware of the program before they purchased the equipment. Of these 9, 2 respondents reported their knowledge of the program was influential on their equipment selection. Neither of these 2 respondents installed their refrigeration equipment in 1995, indicating there was no 1995 program spillover within the nonparticipant sample, according to our definition.

Because the levels of self-reported spillover were low for participants and nonexistent for nonparticipants, it was decided not to apply a correction for spillover. One minus the self-reported rate of free-ridership (0.508) was therefore used as the self-reported NTG ratio for Refrigeration overall, with the corresponding measure-specific NTG ratios used for individual technologies.

Appendix E
Results Tables

Commercial Refrigeration Ex Ante Gross Energy Impacts
By Business Type and Technology Group

Business Type / Program and Technology	MDSS Gross Energy Impacts (kWh)												
	Office	Retail	College/ University	School	Grocery	Restaurant	Health Care	Hotel/Motel	Warehouse	Personal Service	Community Service	Misc.	Total
Retrofit Express Program													
Refrigeration Load Reduction													
Low Temperature Glass/Acrylic Door	-	-	-	-	44,521	-	-	-	-	-	-	-	44,521
Heatless Door	-	-	-	-	55,595	-	-	-	-	-	-	-	55,595
Cooler/Freezer Door Gaskets	-	23,194	-	-	66,147	30,926	-	-	-	-	-	-	120,267
Auto Closer for Cooler/Freezer	-	55,457	-	-	70,756	1,912	-	1,912	-	-	-	-	130,038
Medium Temperature Case w/ Door	1,718	8,018	-	-	144,378	4,582	-	-	-	-	-	-	158,695
Strip Curtains for Walk-in	531	983	-	1,781	34,162	2,954	-	-	18,272	-	-	215,799	274,483
Low Temperature Case w/ Door	-	-	-	-	354,537	-	-	-	8,904	-	-	-	363,441
Night Covers for Display Cases	-	10,916	-	-	369,671	3,184	-	-	-	-	-	-	383,771
Compressor Upgrades													
Mechanical Subcooler	-	-	-	-	8,570	-	-	-	-	-	-	-	8,570
Multiplex Compressor System	-	-	-	-	180,060	-	-	-	-	-	-	7,550	187,610
Adjustable Speed Drive	-	-	-	-	-	-	-	-	5,764	-	-	-	5,764
Floating Head Pressure Controls	-	-	-	-	-	-	-	-	-	-	-	863,286	863,286
Condenser Upgrades													
Oversized Air-Cooled Condenser	-	-	-	-	34,551	-	-	-	-	-	-	-	34,551
Oversized Evaporative Condenser	-	-	-	-	-	-	-	-	-	-	-	542,614	542,614
Evaporator Upgrades													
Walk-in Cooler PSC Evaporator Motor	-	-	-	-	12,482	-	-	-	-	-	-	13,869	26,352
Display PSC Evaporator Motor	-	-	-	-	28,723	-	-	-	-	-	-	-	28,723
Other													
Anti-Sweat Heater Control	-	-	-	-	31,020	-	-	-	-	-	-	-	31,020
Suction Line Insulation	-	-	-	-	50,331	239	-	-	8,313	-	-	3,001	61,885
Display Case Electronic Ballast	8,546	37,835	-	-	66,832	-	-	-	4,236	-	-	-	117,448
Non-Electric Condensate Evaporator	22,324	12,557	4,186	4,186	111,618	389,269	2,790	8,371	8,371	1,395	30,695	4,004	599,768
Retrofit Express Total	33,119	148,960	4,186	5,967	1,663,953	433,066	2,790	10,284	53,862	1,395	30,695	1,650,125	4,038,402
Customized Incentives Program													
Compressor Upgrades													
Floating Head Pressure Controls	-	-	-	-	85,673	-	-	-	-	-	-	-	85,673
Booster Desuperheaters	-	-	-	-	107,048	-	-	-	-	-	-	-	107,048
Condenser Upgrades													
Oversized Condensers	-	-	-	-	244,994	-	-	-	-	-	-	-	244,994
Other													
Refrigeration EMS	-	-	-	-	3,551,579	-	-	-	-	-	-	1,427,795	4,979,374
Refrigeration Add/Change	484,156	-	-	-	-	-	-	-	213,119	-	-	1,272,871	1,970,146
Refrigeration Other	-	-	-	-	11,021,897	-	-	-	-	-	-	165,042	11,186,939
Customized Incentives Total	484,156	-	-	-	15,011,191	-	-	-	213,119	-	-	2,865,708	18,574,174
Total	517,275	148,960	4,186	5,967	16,675,144	433,066	2,790	10,284	266,981	1,395	30,695	4,515,833	22,612,576

Commercial Refrigeration Ex Ante Net Energy Impacts
By Business Type and Technology Group

Business Type / Program and Technology	MDSS Net Energy Impacts (kWh)												
	Office	Retail	College/ University	School	Grocery	Restaurant	Health Care	Hotel/Motel	Warehouse	Personal Service	Community Service	Misc.	Total
Retrofit Express Program													
Refrigeration Load Reduction													
Low Temperature Glass/Acrylic Door	-	-	-	-	28,939	-	-	-	-	-	-	-	28,939
Heatless Door	-	-	-	-	36,137	-	-	-	-	-	-	-	36,137
Cooler/Freezer Door Gaskets	-	17,396	-	-	47,033	21,476	-	-	-	-	-	-	85,905
Auto Closer for Cooler/Freezer	-	41,593	-	-	47,712	1,434	-	1,434	-	-	-	-	92,174
Medium Temperature Case w/ Door	1,117	5,212	-	-	93,845	2,978	-	-	-	-	-	-	103,152
Strip Curtains for Walk-in	345	639	-	1,158	22,205	1,920	-	-	11,877	-	-	140,269	178,414
Low Temperature Case w/ Door	-	-	-	-	230,449	-	-	-	5,788	-	-	-	236,237
Night Covers for Display Cases	-	7,096	-	-	240,286	2,070	-	-	-	-	-	-	249,451
Compressor Upgrades													
Mechanical Subcooler	-	-	-	-	5,570	-	-	-	-	-	-	-	5,570
Multiplex Compressor System	-	-	-	-	117,039	-	-	-	-	-	-	4,907	121,946
Adjustable Speed Drive	-	-	-	-	-	-	-	-	3,747	-	-	-	3,747
Floating Head Pressure Controls	-	-	-	-	-	-	-	-	-	-	-	561,136	561,136
Condenser Upgrades													
Oversized Air-Cooled Condenser	-	-	-	-	22,458	-	-	-	-	-	-	-	22,458
Oversized Evaporative Condenser	-	-	-	-	-	-	-	-	-	-	-	352,699	352,699
Evaporator Upgrades													
Walk-in Cooler PSC Evaporator Motor	-	-	-	-	8,114	-	-	-	-	-	-	9,015	17,129
Display PSC Evaporator Motor	-	-	-	-	18,670	-	-	-	-	-	-	-	18,670
Other													
Anti-Sweat Heater Control	-	-	-	-	20,163	-	-	-	-	-	-	-	20,163
Suction Line Insulation	-	-	-	-	32,715	155	-	-	5,404	-	-	1,951	40,225
Display Case Electronic Ballast	5,555	24,593	-	-	43,441	-	-	-	2,754	-	-	-	76,341
Non-Electric Condensate Evaporator	16,185	9,418	3,139	3,139	78,691	275,767	1,953	5,999	5,581	1,046	21,905	2,742	425,567
Retrofit Express Total	23,201	105,945	3,139	4,297	1,093,467	305,801	1,953	7,434	35,150	1,046	21,905	1,072,720	2,676,059
Customized Incentives Program													
Compressor Upgrades													
Floating Head Pressure Controls	-	-	-	-	64,255	-	-	-	-	-	-	-	64,255
Booster Desuperheaters	-	-	-	-	80,286	-	-	-	-	-	-	-	80,286
Condenser Upgrades													
Oversized Condensers	-	-	-	-	183,746	-	-	-	-	-	-	-	183,746
Other													
Refrigeration EMS	-	-	-	-	2,663,684	-	-	-	-	-	-	1,070,846	3,734,531
Refrigeration Add/Change	363,117	-	-	-	-	-	-	-	159,839	-	-	954,653	1,477,610
Refrigeration Other	-	-	-	-	8,266,423	-	-	-	-	-	-	123,782	8,390,205
Customized Incentives Total	363,117	-	-	-	11,258,394	-	-	-	159,839	-	-	2,149,281	13,930,632
Total	386,318	105,945	3,139	4,297	12,351,861	305,801	1,953	7,434	194,989	1,046	21,905	3,222,001	16,606,690

Commercial Refrigeration Unadjusted Engineering Gross Energy Impacts By Business Type and Technology Group

Program and Technology \ Business Type	First-Year Unadjusted Gross Energy Impacts (kWh)												
	Office	Retail	College/ University	School	Grocery	Restaurant	Health Care	Hotel/Motel	Warehouse	Personal Service	Community Service	Misc.	Total
Retrofit Express Program													
Refrigeration Load Reduction													
Low Temperature Glass/Acrylic Door	-	-	-	-	88,380	-	-	-	-	-	-	-	88,380
Heatless Door	-	-	-	-	38,734	-	-	-	-	-	-	-	38,734
Cooler/Freezer Door Gaskets	-	56,457	-	-	161,007	75,276	-	-	-	-	-	-	292,740
Auto Closer for Cooler/Freezer	-	102,515	-	-	130,795	3,535	-	3,535	-	-	-	-	240,380
Medium Temperature Case w/ Door	2,418	11,284	-	-	203,193	6,448	-	-	-	-	-	-	223,343
Strip Curtains for Walk-in	6,678	12,352	-	22,388	429,386	37,133	-	-	229,670	-	-	2,712,422	3,450,029
Low Temperature Case w/ Door	-	-	-	-	703,799	-	-	-	17,676	-	-	-	721,475
Night Covers for Display Cases	-	13,114	-	-	444,087	3,825	-	-	-	-	-	-	461,025
Compressor Upgrades													
Mechanical Subcooler	-	-	-	-	10,320	-	-	-	-	-	-	-	10,320
Multiplex Compressor System	-	-	-	-	200,912	-	-	-	-	-	-	8,424	209,336
Adjustable Speed Drive	-	-	-	-	-	-	-	-	7,710	-	-	-	7,710
Floating Head Pressure Controls	-	-	-	-	-	-	-	-	-	-	-	1,040,522	1,040,522
Condenser Upgrades													
Oversized Air-Cooled Condenser	-	-	-	-	41,850	-	-	-	-	-	-	-	41,850
Oversized Evaporative Condenser	-	-	-	-	-	-	-	-	-	-	-	659,123	659,123
Evaporator Upgrades													
Walk-in Cooler PSC Evaporator Motor	-	-	-	-	15,039	-	-	-	-	-	-	16,710	31,749
Display PSC Evaporator Motor	-	-	-	-	34,669	-	-	-	-	-	-	-	34,669
Other													
Anti-Sweat Heater Control	-	-	-	-	51,737	-	-	-	-	-	-	-	51,737
Suction Line Insulation	-	-	-	-	61,815	294	-	-	10,210	-	-	3,686	76,005
Display Case Electronic Ballast	11,934	52,836	-	-	93,330	-	-	-	5,916	-	-	-	164,016
Non-Electric Condensate Evaporator	26,896	15,129	5,043	5,043	134,480	468,999	3,362	10,086	10,086	1,681	36,982	5,043	722,830
Retrofit Express Total	47,926	263,687	5,043	27,431	2,843,533	595,510	3,362	13,621	281,268	1,681	36,982	4,445,929	8,565,972
Customized Incentives Program													
Compressor Upgrades													
Floating Head Pressure Controls	-	-	-	-	85,673	-	-	-	-	-	-	-	85,673
Booster Desuperheaters	-	-	-	-	147,887	-	-	-	-	-	-	-	147,887
Condenser Upgrades													
Oversized Condensers	-	-	-	-	244,994	-	-	-	-	-	-	-	244,994
Other													
Refrigeration EMS	-	-	-	-	3,742,294	-	-	-	-	-	-	527,473	4,269,767
Refrigeration Add/Change	484,156	-	-	-	-	-	-	-	175,202	-	-	903,671	1,563,029
Refrigeration Other	-	-	-	-	11,729,547	-	-	-	-	-	-	165,042	11,894,589
Customized Incentives Total	484,156	0	0	0	15,950,395	0	0	0	175,202	0	0	1,596,186	18,205,939
Total	532,082	263,687	5,043	27,431	18,793,928	595,510	3,362	13,621	456,470	1,681	36,982	6,042,115	26,771,911

Commercial Refrigeration Gross Energy Impact SAE Coefficients
By Business Type and Technology Group

Business Type / Program and Technology	SAE Coefficients												
	Office	Retail	College/ University	School	Grocery	Restaurant	Health Care	Hotel/Motel	Warehouse	Personal Service	Community Service	Misc.	Total
Retrofit Express Program													
Refrigeration Load Reduction													
Low Temperature Glass/Acrylic Door	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	
Heatless Door	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	
Cooler/Freezer Door Gaskets	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	
Auto Closer for Cooler/Freezer	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	
Medium Temperature Case w/ Door	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	
Strip Curtains for Walk-in	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	
Low Temperature Case w/ Door	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	
Night Covers for Display Cases	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	
Compressor Upgrades													
Mechanical Subcooler	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	
Multiplex Compressor System	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	
Adjustable Speed Drive	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	
Floating Head Pressure Controls	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	
Condenser Upgrades													
Oversized Air-Cooled Condenser	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	
Oversized Evaporative Condenser	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	
Evaporator Upgrades													
Walk-in Cooler PSC Evaporator Motor	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	
Display PSC Evaporator Motor	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	
Other													
Anti-Sweat Heater Control	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	
Suction Line Insulation	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	
Display Case Electronic Ballast	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	
Non-Electric Condensate Evaporator	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	
Retrofit Express Total													
Customized Incentives Program													
Compressor Upgrades													
Floating Head Pressure Controls	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	
Booster Desuperheaters	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	
Condenser Upgrades													
Oversized Condensers	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	
Other													
Refrigeration EMS	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	
Refrigeration Add/Change	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	
Refrigeration Other	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	
Customized Incentives Total													
Total													

Commercial Refrigeration Ex Post Gross Energy Impacts
By Business Type and Technology Group

Program and Technology / Business Type	First-Year Gross Energy Impacts (kWh)												
	Office	Retail	College/ University	School	Grocery	Restaurant	Health Care	Hotel/Motel	Warehouse	Personal Service	Community Service	Misc.	Total
Retrofit Express Program													
Refrigeration Load Reduction													
Low Temperature Glass/Acrylic Door	-	-	-	-	46,454	-	-	-	-	-	-	-	46,454
Heatless Door	-	-	-	-	20,359	-	-	-	-	-	-	-	20,359
Cooler/Freezer Door Gaskets	-	29,675	-	-	84,628	39,566	-	-	-	-	-	-	153,869
Auto Closer for Cooler/Freezer	-	53,883	-	-	68,748	1,858	-	1,858	-	-	-	-	126,347
Medium Temperature Case w/ Door	1,271	5,931	-	-	106,801	3,389	-	-	-	-	-	-	117,392
Strip Curtains for Walk-in	3,510	6,492	-	11,767	225,692	19,518	-	-	120,718	-	-	1,425,690	1,813,387
Low Temperature Case w/ Door	-	-	-	-	369,928	-	-	-	9,291	-	-	-	379,218
Night Covers for Display Cases	-	6,893	-	-	233,419	2,010	-	-	-	-	-	-	242,322
Compressor Upgrades													
Mechanical Subcooler	-	-	-	-	5,424	-	-	-	-	-	-	-	5,424
Multiplex Compressor System	-	-	-	-	105,603	-	-	-	-	-	-	4,428	110,030
Adjustable Speed Drive	-	-	-	-	-	-	-	-	4,052	-	-	-	4,052
Floating Head Pressure Controls	-	-	-	-	-	-	-	-	-	-	-	546,914	546,914
Condenser Upgrades													
Oversized Air-Cooled Condenser	-	-	-	-	21,997	-	-	-	-	-	-	-	21,997
Oversized Evaporative Condenser	-	-	-	-	-	-	-	-	-	-	-	346,445	346,445
Evaporator Upgrades													
Walk-in Cooler PSC Evaporator Motor	-	-	-	-	7,905	-	-	-	-	-	-	8,783	16,688
Display PSC Evaporator Motor	-	-	-	-	18,223	-	-	-	-	-	-	-	18,223
Other													
Anti-Sweat Heater Control	-	-	-	-	27,194	-	-	-	-	-	-	-	27,194
Suction Line Insulation	-	-	-	-	32,491	154	-	-	5,367	-	-	1,937	39,949
Display Case Electronic Ballast	6,273	27,771	-	-	49,056	-	-	-	3,110	-	-	-	86,209
Non-Electric Condensate Evaporator	14,137	7,952	2,651	2,651	70,685	246,513	1,767	5,301	5,301	884	19,438	2,651	379,930
Retrofit Express Total	25,191	138,598	2,651	14,418	1,494,604	313,009	1,767	7,159	147,839	884	19,438	2,336,847	4,502,403
Customized Incentives Program													
Compressor Upgrades													
Floating Head Pressure Controls	-	-	-	-	64,488	-	-	-	-	-	-	-	64,488
Booster Desuperheaters	-	-	-	-	111,318	-	-	-	-	-	-	-	111,318
Condenser Upgrades													
Oversized Condensers	-	-	-	-	184,412	-	-	-	-	-	-	-	184,412
Other													
Refrigeration EMS	-	-	-	-	2,816,899	-	-	-	-	-	-	397,039	3,213,939
Refrigeration Add/Change	364,434	-	-	-	-	-	-	-	131,878	-	-	680,211	1,176,523
Refrigeration Other	-	-	-	-	8,829,065	-	-	-	-	-	-	124,230	8,953,295
Customized Incentives Total	364,434	0	0	0	12,006,181	0	0	0	131,878	0	0	1,201,481	13,703,974
Total	389,624	138,598	2,651	14,418	13,500,785	313,009	1,767	7,159	279,717	884	19,438	3,538,328	18,206,378

Commercial Refrigeration Net-to-Gross Adjustments By Business Type and Technology Group

Program and Technology \ Business Type	Net-to-Gross Adjustments											
	Office	Retail	College/ University	School	Grocery	Restaurant	Health Care	Hotel/Motel	Warehouse	Personal Service	Community Service	Misc.	Total
Retrofit Express Program													
Refrigeration Load Reduction													
Low Temperature Glass/Acrylic Door	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	
Heatless Door	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	
Cooler/Freezer Door Gaskets	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	
Auto Closer for Cooler/Freezer	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	
Medium Temperature Case w/ Door	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Strip Curtains for Walk-in	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	
Low Temperature Case w/ Door	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Night Covers for Display Cases	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	
Compressor Upgrades													
Mechanical Subcooler	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	
Multiplex Compressor System	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	
Adjustable Speed Drive	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	
Floating Head Pressure Controls	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	
Condenser Upgrades													
Oversized Air-Cooled Condenser	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	
Oversized Evaporative Condenser	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	
Evaporator Upgrades													
Walk-in Cooler PSC Evaporator Motor	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	
Display PSC Evaporator Motor	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	
Other													
Anti-Sweat Heater Control	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	
Suction Line Insulation	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	
Display Case Electronic Ballast	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	
Non-Electric Condensate Evaporator	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	
Retrofit Express Total													
Customized Incentives Program													
Compressor Upgrades													
Floating Head Pressure Controls	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	
Booster Desuperheaters	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	
Condenser Upgrades													
Oversized Condensers	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	
Other													
Refrigeration EMS	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	
Refrigeration Add/Change	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	
Refrigeration Other	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	
Customized Incentives Total													
Total													

Commercial Refrigeration Ex Post Net Energy Impacts
By Business Type and Technology Group

Business Type / Program and Technology	First-Year Net Energy Impacts (kWh)												
	Office	Retail	College/ University	School	Grocery	Restaurant	Health Care	Hotel/Motel	Warehouse	Personal Service	Community Service	Misc.	Total
Retrofit Express Program													
Refrigeration Load Reduction													
Low Temperature Glass/Acrylic Door	-	-	-	-	45,664	-	-	-	-	-	-	-	45,664
Heatless Door	-	-	-	-	20,013	-	-	-	-	-	-	-	20,013
Cooler/Freezer Door Gaskets	-	12,879	-	-	36,728	17,172	-	-	-	-	-	-	66,779
Auto Closer for Cooler/Freezer	-	47,417	-	-	60,498	1,635	-	1,635	-	-	-	-	111,186
Medium Temperature Case w/ Door	1,271	5,931	-	-	106,801	3,389	-	-	-	-	-	-	117,392
Strip Curtains for Walk-in	3,057	5,655	-	10,249	196,578	17,000	-	-	105,145	-	-	1,241,776	1,579,460
Low Temperature Case w/ Door	-	-	-	-	369,928	-	-	-	9,291	-	-	-	379,218
Night Covers for Display Cases	-	4,818	-	-	163,160	1,405	-	-	-	-	-	-	169,383
Compressor Upgrades													
Mechanical Subcooler	-	-	-	-	5,332	-	-	-	-	-	-	-	5,332
Multiplex Compressor System	-	-	-	-	103,807	-	-	-	-	-	-	4,353	108,160
Adjustable Speed Drive	-	-	-	-	-	-	-	-	3,984	-	-	-	3,984
Floating Head Pressure Controls	-	-	-	-	-	-	-	-	-	-	-	537,616	537,616
Condenser Upgrades													
Oversized Air-Cooled Condenser	-	-	-	-	21,623	-	-	-	-	-	-	-	21,623
Oversized Evaporative Condenser	-	-	-	-	-	-	-	-	-	-	-	340,555	340,555
Evaporator Upgrades													
Walk-in Cooler PSC Evaporator Motor	-	-	-	-	7,770	-	-	-	-	-	-	8,634	16,404
Display PSC Evaporator Motor	-	-	-	-	17,913	-	-	-	-	-	-	-	17,913
Other													
Anti-Sweat Heater Control	-	-	-	-	26,731	-	-	-	-	-	-	-	26,731
Suction Line Insulation	-	-	-	-	31,938	152	-	-	5,275	-	-	1,905	39,270
Display Case Electronic Ballast	6,166	27,299	-	-	48,222	-	-	-	3,057	-	-	-	84,744
Non-Electric Condensate Evaporator	10,645	5,988	1,996	1,996	53,226	185,624	1,331	3,992	3,992	665	14,637	1,996	286,088
Retrofit Express Total	21,139	109,987	1,996	12,245	1,315,932	226,377	1,331	5,627	130,744	665	14,637	2,136,834	3,977,515
Customized Incentives Program													
Compressor Upgrades													
Floating Head Pressure Controls	-	-	-	-	24,828	-	-	-	-	-	-	-	24,828
Booster Desuperheaters	-	-	-	-	42,857	-	-	-	-	-	-	-	42,857
Condenser Upgrades													
Oversized Condensers	-	-	-	-	70,999	-	-	-	-	-	-	-	70,999
Other													
Refrigeration EMS	-	-	-	-	1,084,506	-	-	-	-	-	-	152,860	1,237,366
Refrigeration Add/Change	140,307	-	-	-	-	-	-	-	50,773	-	-	261,881	452,961
Refrigeration Other	-	-	-	-	3,399,190	-	-	-	-	-	-	47,829	3,447,019
Customized Incentives Total	140,307	0	0	0	4,622,380	0	0	0	50,773	0	0	462,570	5,276,030
Total	161,446	109,987	1,996	12,245	5,938,312	226,377	1,331	5,627	181,517	665	14,637	2,599,404	9,253,545

Commercial Refrigeration Gross Energy Impact Realization Rates
By Business Type and Technology Group

Program and Technology \ Business Type	Gross Energy Impact Realization Rates												
	Office	Retail	College/ University	School	Grocery	Restaurant	Health Care	Hotel/Motel	Warehouse	Personal Service	Community Service	Misc.	Total
Retrofit Express Program													
Refrigeration Load Reduction													
Low Temperature Glass/Acrylic Door	-	-	-	-	1.04	-	-	-	-	-	-	-	1.04
Heatless Door	-	-	-	-	0.37	-	-	-	-	-	-	-	0.37
Cooler/Freezer Door Gaskets	-	1.28	-	-	1.28	1.28	-	-	-	-	-	-	1.28
Auto Closer for Cooler/Freezer	-	0.97	-	-	0.97	0.97	-	0.97	-	-	-	-	0.97
Medium Temperature Case w/ Door	0.74	0.74	-	-	0.74	0.74	-	-	-	-	-	-	0.74
Strip Curtains for Walk-in	6.61	6.61	-	6.61	6.61	6.61	-	-	6.61	-	-	6.61	6.61
Low Temperature Case w/ Door	-	-	-	-	1.04	-	-	-	1.04	-	-	-	1.04
Night Covers for Display Cases	-	0.63	-	-	0.63	0.63	-	-	-	-	-	-	0.63
Compressor Upgrades													
Mechanical Subcooler	-	-	-	-	0.63	-	-	-	-	-	-	-	0.63
Multiplex Compressor System	-	-	-	-	0.59	-	-	-	-	-	-	0.59	0.59
Adjustable Speed Drive	-	-	-	-	-	-	-	-	0.70	-	-	-	0.70
Floating Head Pressure Controls	-	-	-	-	-	-	-	-	-	-	-	0.63	0.63
Condenser Upgrades													
Oversized Air-Cooled Condenser	-	-	-	-	0.64	-	-	-	-	-	-	-	0.64
Oversized Evaporative Condenser	-	-	-	-	-	-	-	-	-	-	-	0.64	0.64
Evaporator Upgrades													
Walk-in Cooler PSC Evaporator Motor	-	-	-	-	0.63	-	-	-	-	-	-	0.63	0.63
Display PSC Evaporator Motor	-	-	-	-	0.63	-	-	-	-	-	-	-	0.63
Other													
Anti-Sweat Heater Control	-	-	-	-	0.88	-	-	-	-	-	-	-	0.88
Suction Line Insulation	-	-	-	-	0.65	0.65	-	-	0.65	-	-	0.65	0.65
Display Case Electronic Ballast	0.73	0.73	-	-	0.73	-	-	-	0.73	-	-	-	0.73
Non-Electric Condensate Evaporator	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.66	0.63
Retrofit Express Total	0.76	0.93	0.63	2.42	0.90	0.72	0.63	0.70	2.74	0.63	0.63	1.42	1.11
Customized Incentives Program													
Compressor Upgrades													
Floating Head Pressure Controls	-	-	-	-	0.75	-	-	-	-	-	-	-	0.75
Booster Desuperheaters	-	-	-	-	1.04	-	-	-	-	-	-	-	1.04
Condenser Upgrades													
Oversized Condensers	-	-	-	-	0.75	-	-	-	-	-	-	-	0.75
Other													
Refrigeration EMS	-	-	-	-	0.79	-	-	-	-	-	-	0.28	0.65
Refrigeration Add/Change	0.75	-	-	-	-	-	-	-	0.62	-	-	0.53	0.60
Refrigeration Other	-	-	-	-	0.80	-	-	-	-	-	-	0.75	0.80
Customized Incentives Total	0.75	-	-	-	0.80	-	-	-	0.62	-	-	0.42	0.74
Total	0.75	0.93	0.63	2.42	0.81	0.72	0.63	0.70	1.05	0.63	0.63	0.78	0.81

Commercial Refrigeration Net Energy Impact Realization Rates
By Business Type and Technology Group

Program and Technology \ Business Type	Net Energy Impact Realization Rates												
	Office	Retail	College/ University	School	Grocery	Restaurant	Health Care	Hotel/Motel	Warehouse	Personal Service	Community Service	Misc.	Total
Retrofit Express Program													
Refrigeration Load Reduction													
Low Temperature Glass/Acrylic Door	-	-	-	-	1.58	-	-	-	-	-	-	-	1.58
Heatless Door	-	-	-	-	0.55	-	-	-	-	-	-	-	0.55
Cooler/Freezer Door Gaskets	-	0.74	-	-	0.78	0.80	-	-	-	-	-	-	0.78
Auto Closer for Cooler/Freezer	-	1.14	-	-	1.27	1.14	-	1.14	-	-	-	-	1.21
Medium Temperature Case w/ Door	1.14	1.14	-	-	1.14	1.14	-	-	-	-	-	-	1.14
Strip Curtains for Walk-in	8.85	8.85	-	8.85	8.85	8.85	-	-	8.85	-	-	8.85	8.85
Low Temperature Case w/ Door	-	-	-	-	1.61	-	-	-	1.61	-	-	-	1.61
Night Covers for Display Cases	-	0.68	-	-	0.68	0.68	-	-	-	-	-	-	0.68
Compressor Upgrades													
Mechanical Subcooler	-	-	-	-	0.96	-	-	-	-	-	-	-	0.96
Multiplex Compressor System	-	-	-	-	0.89	-	-	-	-	-	-	0.89	0.89
Adjustable Speed Drive	-	-	-	-	-	-	-	-	1.06	-	-	-	1.06
Floating Head Pressure Controls	-	-	-	-	-	-	-	-	-	-	-	0.96	0.96
Condenser Upgrades													
Oversized Air-Cooled Condenser	-	-	-	-	0.96	-	-	-	-	-	-	-	0.96
Oversized Evaporative Condenser	-	-	-	-	-	-	-	-	-	-	-	0.97	0.97
Evaporator Upgrades													
Walk-in Cooler PSC Evaporator Motor	-	-	-	-	0.96	-	-	-	-	-	-	0.96	0.96
Display PSC Evaporator Motor	-	-	-	-	0.96	-	-	-	-	-	-	-	0.96
Other													
Anti-Sweat Heater Control	-	-	-	-	1.33	-	-	-	-	-	-	-	1.33
Suction Line Insulation	-	-	-	-	0.98	0.98	-	-	0.98	-	-	0.98	0.98
Display Case Electronic Ballast	1.11	1.11	-	-	1.11	-	-	-	1.11	-	-	-	1.11
Non-Electric Condensate Evaporator	0.66	0.64	0.64	0.64	0.68	0.67	0.68	0.67	0.72	0.64	0.67	0.73	0.67
Retrofit Express Total	0.91	1.04	0.64	2.85	1.20	0.74	0.68	0.76	3.72	0.64	0.67	1.99	1.49
Customized Incentives Program													
Compressor Upgrades													
Floating Head Pressure Controls	-	-	-	-	0.39	-	-	-	-	-	-	-	0.39
Booster Desuperheaters	-	-	-	-	0.53	-	-	-	-	-	-	-	0.53
Condenser Upgrades													
Oversized Condensers	-	-	-	-	0.39	-	-	-	-	-	-	-	0.39
Other													
Refrigeration EMS	-	-	-	-	0.41	-	-	-	-	-	-	0.14	0.33
Refrigeration Add/Change	0.39	-	-	-	-	-	-	-	0.32	-	-	0.27	0.31
Refrigeration Other	-	-	-	-	0.41	-	-	-	-	-	-	0.39	0.41
Customized Incentives Total	0.39	-	-	-	0.41	-	-	-	0.32	-	-	0.22	0.38
Total	0.42	1.04	0.64	2.85	0.48	0.74	0.68	0.76	0.93	0.64	0.67	0.81	0.56

Commercial Refrigeration Ex Ante Gross Demand Impacts
By Business Type and Technology Group

Program and Technology \ Business Type	First-Year Gross Demand Impacts (kW)												
	Office	Retail	College/ University	School	Grocery	Restaurant	Health Care	Hotel/Motel	Warehouse	Personal Service	Community Service	Misc.	Total
Retrofit Express Program													
Refrigeration Load Reduction													
Low Temperature Glass/Acrylic Door	-	-	-	-	5	-	-	-	-	-	-	-	5
Heatless Door	-	-	-	-	3	-	-	-	-	-	-	-	3
Cooler/Freezer Door Gaskets	-	3	-	-	7	3	-	-	-	-	-	-	14
Auto Closer for Cooler/Freezer	-	19	-	-	24	1	-	1	-	-	-	-	44
Medium Temperature Case w/ Door	0	1	-	-	17	1	-	-	-	-	-	-	18
Strip Curtains for Walk-in	0	0	-	0	4	0	-	-	2	-	-	28	36
Low Temperature Case w/ Door	-	-	-	-	41	-	-	-	1	-	-	-	42
Night Covers for Display Cases	-	-	-	-	-	-	-	-	-	-	-	-	0
Compressor Upgrades													
Mechanical Subcooler	-	-	-	-	6	-	-	-	-	-	-	-	6
Multiplex Compressor System	-	-	-	-	54	-	-	-	-	-	-	2	56
Adjustable Speed Drive	-	-	-	-	-	-	-	-	-	-	-	-	0
Floating Head Pressure Controls	-	-	-	-	-	-	-	-	-	-	-	-	0
Condenser Upgrades													
Oversized Air-Cooled Condenser	-	-	-	-	5	-	-	-	-	-	-	-	5
Oversized Evaporative Condenser	-	-	-	-	-	-	-	-	-	-	-	117	117
Evaporator Upgrades													
Walk-in Cooler PSC Evaporator Motor	-	-	-	-	1	-	-	-	-	-	-	1	1
Display PSC Evaporator Motor	-	-	-	-	1	-	-	-	-	-	-	-	1
Other													
Anti-Sweat Heater Control	-	-	-	-	2	-	-	-	-	-	-	-	2
Suction Line Insulation	-	-	-	-	-	-	-	-	-	-	-	-	0
Display Case Electronic Ballast	1	4	-	-	6	-	-	-	0	-	-	-	11
Non-Electric Condensate Evaporator	2	1	0	0	8	28	0	1	1	0	2	0	44
Retrofit Express Total	3	27	0	1	185	34	0	1	4	0	2	148	405
Customized Incentives Program													
Compressor Upgrades													
Floating Head Pressure Controls	-	-	-	-	-	-	-	-	-	-	-	-	0
Booster Desuperheaters	-	-	-	-	-	-	-	-	-	-	-	-	0
Condenser Upgrades													
Oversized Condensers	-	-	-	-	30	-	-	-	-	-	-	-	30
Other													
Refrigeration EMS	-	-	-	-	85	-	-	-	-	-	-	85	170
Refrigeration Add/Change	-	-	-	-	-	-	-	-	9	-	-	369	378
Refrigeration Other	-	-	-	-	532	-	-	-	-	-	-	-	532
Customized Incentives Total	0	0	0	0	647	0	0	0	9	0	0	454	1,110
Total	3	27	0	1	832	34	0	1	14	0	2	602	1,515

Commercial Refrigeration Ex Ante Net Demand Impacts
By Business Type and Technology Group

Program and Technology / Business Type	First -Year Demand Impacts (kW)												
	Office	Retail	College/ University	School	Grocery	Restaurant	Health Care	Hotel/Motel	Warehouse	Personal Service	Community Service	Misc.	Total
Retrofit Express Program													
Refrigeration Load Reduction													
Low Temperature Glass/Acrylic Door	-	-	-	-	3	-	-	-	-	-	-	-	3
Heatless Door	-	-	-	-	2	-	-	-	-	-	-	-	2
Cooler/Freezer Door Gaskets	-	2	-	-	5	2	-	-	-	-	-	-	10
Auto Closer for Cooler/Freezer	-	14	-	-	16	0	-	0	-	-	-	-	31
Medium Temperature Case w/ Door	0	1	-	-	11	0	-	-	-	-	-	-	12
Strip Curtains for Walk-in	0	0	-	0	3	0	-	-	2	-	-	18	23
Low Temperature Case w/ Door	-	-	-	-	26	-	-	-	1	-	-	-	27
Night Covers for Display Cases	-	-	-	-	-	-	-	-	-	-	-	-	-
Compressor Upgrades													
Mechanical Subcooler	-	-	-	-	4	-	-	-	-	-	-	-	4
Multiplex Compressor System	-	-	-	-	35	-	-	-	-	-	-	1	36
Adjustable Speed Drive	-	-	-	-	-	-	-	-	-	-	-	-	-
Floating Head Pressure Controls	-	-	-	-	-	-	-	-	-	-	-	-	-
Condenser Upgrades													
Oversized Air-Cooled Condenser	-	-	-	-	3	-	-	-	-	-	-	-	3
Oversized Evaporative Condenser	-	-	-	-	-	-	-	-	-	-	-	76	76
Evaporator Upgrades													
Walk-in Cooler PSC Evaporator Motor	-	-	-	-	0	-	-	-	-	-	-	0	1
Display PSC Evaporator Motor	-	-	-	-	1	-	-	-	-	-	-	-	1
Other													
Anti-Sweat Heater Control	-	-	-	-	2	-	-	-	-	-	-	-	2
Suction Line Insulation	-	-	-	-	-	-	-	-	-	-	-	-	-
Display Case Electronic Ballast	1	2	-	-	4	-	-	-	0	-	-	-	7
Non-Electric Condensate Evaporator	1	1	0	0	6	20	0	0	0	0	2	0	31
Retrofit Express Total	2	20	0	0	122	24	0	1	3	0	2	96	269
Customized Incentives Program													
Compressor Upgrades													
Floating Head Pressure Controls	-	-	-	-	-	-	-	-	-	-	-	-	-
Booster Desuperheaters	-	-	-	-	-	-	-	-	-	-	-	-	-
Condenser Upgrades													
Oversized Condensers	-	-	-	-	22	-	-	-	-	-	-	-	22
Other													
Refrigeration EMS	-	-	-	-	64	-	-	-	-	-	-	64	128
Refrigeration Add/Change	-	-	-	-	-	-	-	-	7	-	-	277	284
Refrigeration Other	-	-	-	-	399	-	-	-	-	-	-	-	399
Customized Incentives Total	-	-	-	-	485	-	-	-	7	-	-	341	833
Total	2	20	0	0	607	24	0	1	10	0	2	437	1,102

Commercial Refrigeration Ex Post Gross Demand Impacts
By Business Type and Technology Group

Program and Technology \ Business Type	First-Year Unadjusted Gross Demand Impacts (kW)												
	Office	Retail	College/ University	School	Grocery	Restaurant	Health Care	Hotel/Motel	Warehouse	Personal Service	Community Service	Misc.	Total
Retrofit Express Program													
Refrigeration Load Reduction													
Low Temperature Glass/Acrylic Door	-	-	-	-	10	-	-	-	-	-	-	-	10
Heatless Door	-	-	-	-	4	-	-	-	-	-	-	-	4
Cooler/Freezer Door Gaskets	-	6	-	-	18	9	-	-	-	-	-	-	33
Auto Closer for Cooler/Freezer	-	17	-	-	21	1	-	1	-	-	-	-	39
Medium Temperature Case w/ Door	0	1	-	-	23	1	-	-	-	-	-	-	25
Strip Curtains for Walk-in	1	1	-	3	49	4	-	-	26	-	-	310	394
Low Temperature Case w/ Door	-	-	-	-	80	-	-	-	2	-	-	-	82
Night Covers for Display Cases	-	-	-	-	-	-	-	-	-	-	-	-	0
Compressor Upgrades													
Mechanical Subcooler	-	-	-	-	6	-	-	-	-	-	-	-	6
Multiplex Compressor System	-	-	-	-	23	-	-	-	-	-	-	1	24
Adjustable Speed Drive	-	-	-	-	-	-	-	-	1	-	-	-	1
Floating Head Pressure Controls	-	-	-	-	-	-	-	-	-	-	-	-	0
Condenser Upgrades													
Oversized Air-Cooled Condenser	-	-	-	-	5	-	-	-	-	-	-	-	5
Oversized Evaporative Condenser	-	-	-	-	-	-	-	-	-	-	-	75	75
Evaporator Upgrades													
Walk-in Cooler PSC Evaporator Motor	-	-	-	-	2	-	-	-	-	-	-	2	4
Display PSC Evaporator Motor	-	-	-	-	4	-	-	-	-	-	-	-	4
Other													
Anti-Sweat Heater Control	-	-	-	-	6	-	-	-	-	-	-	-	6
Suction Line Insulation	-	-	-	-	7	0	-	-	1	-	-	0	9
Display Case Electronic Ballast	1	6	-	-	11	-	-	-	1	-	-	-	20
Non-Electric Condensate Evaporator	3	2	1	1	15	52	0	1	1	0	4	1	81
Retrofit Express Total	6	34	1	3	285	67	0	2	32	0	4	388	822
Customized Incentives Program													
Compressor Upgrades													
Floating Head Pressure Controls	-	-	-	-	-	-	-	-	-	-	-	-	0
Booster Desuperheaters	-	-	-	-	-	-	-	-	-	-	-	-	0
Condenser Upgrades													
Oversized Condensers	-	-	-	-	25	-	-	-	-	-	-	-	25
Other													
Refrigeration EMS	-	-	-	-	138	-	-	-	-	-	-	61	199
Refrigeration Add/Change	-	-	-	-	-	-	-	-	80	-	-	186	266
Refrigeration Other	-	-	-	-	397	-	-	-	-	-	-	-	397
Customized Incentives Total	0	0	0	0	559	0	0	0	80	0	0	247	886
Total	6	34	1	3	844	67	0	2	112	0	4	635	1,708

Commercial Refrigeration Ex Post Net Demand Impacts By Business Type and Technology Group

Business Type / Program and Technology	First -Year Net Demand Impacts (kW)												
	Office	Retail	College/ University	School	Grocery	Restaurant	Health Care	Hotel/Motel	Warehouse	Personal Service	Community Service	Misc.	Total
Retrofit Express Program													
Refrigeration Load Reduction													
Low Temperature Glass/Acrylic Door	-	-	-	-	10	-	-	-	-	-	-	-	10
Heatless Door	-	-	-	-	4	-	-	-	-	-	-	-	4
Cooler/Freezer Door Gaskets	-	3	-	-	8	4	-	-	-	-	-	-	15
Auto Closer for Cooler/Freezer	-	15	-	-	19	1	-	1	-	-	-	-	34
Medium Temperature Case w/ Door	0	1	-	-	23	1	-	-	-	-	-	-	25
Strip Curtains for Walk-in	1	1	-	2	43	4	-	-	23	-	-	270	343
Low Temperature Case w/ Door	-	-	-	-	80	-	-	-	2	-	-	-	82
Night Covers for Display Cases	-	-	-	-	-	-	-	-	-	-	-	-	0
Compressor Upgrades													
Mechanical Subcooler	-	-	-	-	6	-	-	-	-	-	-	-	6
Multiplex Compressor System	-	-	-	-	23	-	-	-	-	-	-	1	23
Adjustable Speed Drive	-	-	-	-	-	-	-	-	1	-	-	-	1
Floating Head Pressure Controls	-	-	-	-	-	-	-	-	-	-	-	-	0
Condenser Upgrades													
Oversized Air-Cooled Condenser	-	-	-	-	5	-	-	-	-	-	-	-	5
Oversized Evaporative Condenser	-	-	-	-	-	-	-	-	-	-	-	73	73
Evaporator Upgrades													
Walk-in Cooler PSC Evaporator Motor	-	-	-	-	2	-	-	-	-	-	-	2	4
Display PSC Evaporator Motor	-	-	-	-	4	-	-	-	-	-	-	-	4
Other													
Anti-Sweat Heater Control	-	-	-	-	6	-	-	-	-	-	-	-	6
Suction Line Insulation	-	-	-	-	7	0	-	-	1	-	-	0	9
Display Case Electronic Ballast	1	6	-	-	11	-	-	-	1	-	-	-	20
Non-Electric Condensate Evaporator	2	1	0	0	11	39	0	1	1	0	3	0	61
Retrofit Express Total	5	28	0	3	261	48	0	1	28	0	3	347	725
Customized Incentives Program													
Compressor Upgrades													
Floating Head Pressure Controls	-	-	-	-	-	-	-	-	-	-	-	-	0
Booster Desuperheaters	-	-	-	-	-	-	-	-	-	-	-	-	0
Condenser Upgrades													
Oversized Condensers	-	-	-	-	10	-	-	-	-	-	-	-	10
Other													
Refrigeration EMS	-	-	-	-	53	-	-	-	-	-	-	23	76
Refrigeration Add/Change	-	-	-	-	-	-	-	-	31	-	-	72	102
Refrigeration Other	-	-	-	-	153	-	-	-	-	-	-	-	153
Customized Incentives Total	0	0	0	0	215	0	0	0	31	0	0	95	341
Total	5	28	0	3	476	48	0	1	59	0	3	442	1,066

Commercial Refrigeration Gross Demand Impact Realization Rates
By Business Type and Technology Group

Program and Technology \ Business Type	Gross Demand Impact Realization Rates												
	Office	Retail	College/ University	School	Grocery	Restaurant	Health Care	Hotel/Motel	Warehouse	Personal Service	Community Service	Misc.	Total
Retrofit Express Program													
Refrigeration Load Reduction													
Low Temperature Glass/Acrylic Door	-	-	-	-	1.98	-	-	-	-	-	-	-	1.98
Heatless Door	-	-	-	-	1.37	-	-	-	-	-	-	-	1.37
Cooler/Freezer Door Gaskets	-	2.46	-	-	2.46	2.46	-	-	-	-	-	-	2.46
Auto Closer for Cooler/Freezer	-	0.88	-	-	0.88	0.88	-	0.88	-	-	-	-	0.88
Medium Temperature Case w/ Door	1.39	1.39	-	-	1.39	1.39	-	-	-	-	-	-	1.39
Strip Curtains for Walk-in	11.03	11.03	-	11.03	11.03	11.03	-	-	11.03	-	-	11.03	11.03
Low Temperature Case w/ Door	-	-	-	-	1.98	-	-	-	1.98	-	-	-	1.98
Night Covers for Display Cases	-	-	-	-	-	-	-	-	-	-	-	-	-
Compressor Upgrades													
Mechanical Subcooler	-	-	-	-	1.00	-	-	-	-	-	-	-	1.00
Multiplex Compressor System	-	-	-	-	0.43	-	-	-	-	-	-	0.43	0.43
Adjustable Speed Drive	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Floating Head Pressure Controls	-	-	-	-	-	-	-	-	-	-	-	-	-
Condenser Upgrades													
Oversized Air-Cooled Condenser	-	-	-	-	1.01	-	-	-	-	-	-	-	1.01
Oversized Evaporative Condenser	-	-	-	-	-	-	-	-	-	-	-	0.64	0.64
Evaporator Upgrades													
Walk-in Cooler PSC Evaporator Motor	-	-	-	-	2.59	-	-	-	-	-	-	2.59	2.59
Display PSC Evaporator Motor	-	-	-	-	2.76	-	-	-	-	-	-	-	2.76
Other													
Anti-Sweat Heater Control	-	-	-	-	2.49	-	-	-	-	-	-	-	2.49
Suction Line Insulation	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Display Case Electronic Ballast	1.79	1.79	-	-	1.79	-	-	-	1.79	-	-	-	1.79
Non-Electric Condensate Evaporator	1.84	1.84	1.84	1.84	1.84	1.84	1.84	1.84	1.84	1.84	1.84	1.93	1.84
Retrofit Express Total	2.03	1.25	1.84	5.80	1.54	1.99	1.84	1.35	7.28	1.84	1.84	2.62	2.03
Customized Incentives Program													
Compressor Upgrades													
Floating Head Pressure Controls	-	-	-	-	-	-	-	-	-	-	-	-	-
Booster Desuperheaters	-	-	-	-	-	-	-	-	-	-	-	-	-
Condenser Upgrades													
Oversized Condensers	-	-	-	-	0.82	-	-	-	-	-	-	-	0.82
Other													
Refrigeration EMS	-	-	-	-	1.61	-	-	-	-	-	-	0.72	1.17
Refrigeration Add/Change	-	-	-	-	-	-	-	-	8.69	-	-	0.50	0.70
Refrigeration Other	-	-	-	-	0.75	-	-	-	-	-	-	-	0.75
Customized Incentives Total	-	-	-	-	0.86	-	-	-	8.69	-	-	0.54	0.80
Total	2.03	1.25	1.84	5.80	1.02	1.99	1.84	1.35	8.23	1.84	1.84	1.06	1.13

Commercial Refrigeration Net Demand Impact Realization Rates
By Business Type and Technology Group

Program and Technology \ Business Type	Net Demand Impact Realization Rates												
	Office	Retail	College/ University	School	Grocery	Restaurant	Health Care	Hotel/Motel	Warehouse	Personal Service	Community Service	Misc.	Total
Retrofit Express Program													
Refrigeration Load Reduction													
Low Temperature Glass/Acrylic Door	-	-	-	-	2.99	-	-	-	-	-	-	-	2.99
Heatless Door	-	-	-	-	2.08	-	-	-	-	-	-	-	2.08
Cooler/Freezer Door Gaskets	-	1.43	-	-	1.50	1.54	-	-	-	-	-	-	1.50
Auto Closer for Cooler/Freezer	-	1.03	-	-	1.14	1.03	-	1.03	-	-	-	-	1.09
Medium Temperature Case w/ Door	2.14	2.14	-	-	2.14	2.14	-	-	-	-	-	-	2.14
Strip Curtains for Walk-in	14.77	14.77	-	14.77	14.77	14.77	-	-	14.77	-	-	14.77	14.77
Low Temperature Case w/ Door	-	-	-	-	3.04	-	-	-	3.04	-	-	-	3.04
Night Covers for Display Cases	-	-	-	-	-	-	-	-	-	-	-	-	-
Compressor Upgrades													
Mechanical Subcooler	-	-	-	-	1.51	-	-	-	-	-	-	-	1.51
Multiplex Compressor System	-	-	-	-	0.65	-	-	-	-	-	-	0.65	0.65
Adjustable Speed Drive	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Floating Head Pressure Controls	-	-	-	-	-	-	-	-	-	-	-	-	-
Condenser Upgrades													
Oversized Air-Cooled Condenser	-	-	-	-	1.53	-	-	-	-	-	-	-	1.53
Oversized Evaporative Condenser	-	-	-	-	-	-	-	-	-	-	-	0.97	0.97
Evaporator Upgrades													
Walk-in Cooler PSC Evaporator Motor	-	-	-	-	3.92	-	-	-	-	-	-	3.92	3.92
Display PSC Evaporator Motor	-	-	-	-	4.17	-	-	-	-	-	-	-	4.17
Other													-
Anti-Sweat Heater Control	-	-	-	-	3.77	-	-	-	-	-	-	-	3.77
Suction Line Insulation	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Display Case Electronic Ballast	2.70	2.70	-	-	2.70	-	-	-	2.70	-	-	-	2.70
Non-Electric Condensate Evaporator	1.91	1.85	1.85	1.85	1.97	1.96	1.98	1.94	2.08	1.85	1.94	2.12	1.96
Retrofit Express Total	2.46	1.39	1.85	6.97	2.15	2.04	1.98	1.46	9.87	1.85	1.94	3.60	2.69
Customized Incentives Program													
Compressor Upgrades													
Floating Head Pressure Controls	-	-	-	-	-	-	-	-	-	-	-	-	-
Booster Desuperheaters	-	-	-	-	-	-	-	-	-	-	-	-	-
Condenser Upgrades													
Oversized Condensers	-	-	-	-	0.42	-	-	-	-	-	-	-	0.42
Other													
Refrigeration EMS	-	-	-	-	0.83	-	-	-	-	-	-	0.37	0.60
Refrigeration Add/Change	-	-	-	-	-	-	-	-	4.46	-	-	0.26	0.36
Refrigeration Other	-	-	-	-	0.38	-	-	-	-	-	-	-	0.38
Customized Incentives Total	-	-	-	-	0.44	-	-	-	4.46	-	-	0.28	0.41
Total	2.46	1.39	1.85	6.97	0.78	2.04	1.98	1.46	6.05	1.85	1.94	1.01	0.97

Appendix F
Summary of Gross Program Impacts by Costing Period

F. SUMMARY OF GROSS PROGRAM IMPACTS BY COSTING PERIOD

Ex post program gross demand and energy impacts are summarized by time-of-use (TOU) costing periods in Exhibit F-1, in order to support Pacific Gas and Electric Company's (PG&E's) cost-effectiveness calculations. The adjustment factors presented in Exhibit F-1 were obtained from Tables 3-7 and 3-8 of PG&E's Advice Filing 1978-G/1608-D, dated October 1, 1996. The gross demand and energy impacts by costing period reported in Exhibit F-1 are calculated by multiplying the program's ex post gross demand and energy impact by the corresponding adjustment factor.

Exhibit F-1
Ex Post Gross Demand and Energy Savings by Costing Period
For Commercial Refrigeration Technologies

PG&E Cost Period	Time-of-Use Impact Distribution			
	Program kW Savings Coincident with System Max in Period	kW Adjustment Factor	kWh Savings	kWh Adjustment Factor
Summer On-Peak: May 1 to Oct. 31 12:00 PM - 6:00 PM Weekdays	1,708	1.00	1,820,638	0.10
Summer Partial Peak: May 1 to Oct. 31 8:30 AM - 12:00 PM & 6:00 PM - 9:30 PM Weekdays	1,161	0.68	1,638,574	0.09
Summer Off-Peak: May to Oct. 31 9:30 PM - 8:30 AM	2,357	1.38	6,190,168	0.34
Winter Partial Peak: Nov. 1 to April 31 8:30 AM - 9:30 PM Weekdays	1,264	0.74	2,548,893	0.14
Winter Off-Peak: Nov. 1 to April 31 9:30 PM - 8:30 AM Other	1,144	0.67	6,008,105	0.33

Appendix G
Final Refrigeration Waiver

PACIFIC GAS & ELECTRIC COMPANY REQUEST FOR RETROACTIVE WAIVER FOR 1995 COMMERCIAL EEI RETROFIT PROGRAMS, REFRIGERATION END USE

Program Background

Pacific Gas & Electric Company (PG&E) fielded DSM programs to the Commercial sector (among others) during 1995. The primary purpose of the 1995 Commercial Program (Programs) was to promote the installation of energy efficient equipment retrofits. The Programs offered a variety of energy efficient refrigeration measures from prescriptive freezer curtains and doors to custom non- prescriptive refrigeration measures[1]. The impact evaluation associated with this waiver is designed to assess the actual load impacts resulting from the refrigeration measures rebated during 1995[2].

Summary of PG&E Request

This waiver requests two deviations from the Protocols[3] for PG&E's 1995 Commercial Sector Evaluation, refrigeration end use. PG&E seeks approval to: (1) use self-report analysis results to estimate net-to-gross effects if the regression model yields statistically insignificant results; and (2) specify the Designated Unit of Measure (DUOM) for refrigeration.

Proposed Waiver

PG&E seeks CADMAC approval to:

(1) Allow the use of self-report survey analysis results to estimate net-to-gross effects (adjusted for free-ridership and spillover) for measures where the regression-based end use load impact savings for refrigeration measure estimates are not significant at the 90 percent confidence level[4]. PG&E will use the self-report method in addition to the Protocols-accepted method. We will compare and report the results of both methods in the impact report, clearly indicating which method we choose to assess our actual net load impacts.

PG&E will ask a series of sequentially-ordered questions in the participant and nonparticipant telephone surveys to probe for customers' likely actions in the absence of the program. Several recent studies[5] have demonstrated the feasibility of using an ordered set of questions to determine

[1] For 1995, refrigeration measures were rebated under the 1994-95 Retrofit Express, the 1994-95 Retrofit Efficiency Options, and the 1993-94 Customized Incentive Programs.
[2] PG&E is claiming Shareholder Incentives in the amount of $1,907,739 for the Refrigeration end-use. This end-use represents approximately 6% of the commercial sector and 3% of the entire nonresidential sector.
[3] Protocols and Procedures for the Verification of Costs, Benefits, and Shareholder Earnings for Demand-Side Management Programs
[4] If the gross LIRM fails to identify significant results, the NTG LIRM is even less likely to yield statistically significant results.
[5] For example: Northeast Utilities Conservation and Load Management Department, *Energy Action Program Report on 1994 Measure Installations Impact Evaluation - Final Report*, June 1996, Prepared by RLW Analytics, Inc. and The Nicholas Group; New England Power Service Company, *1995 Commercial Industrial Free Rider Study*, July 1996, Prepared by Hagler Bailly Consulting, Inc.; and Baltimore Gas and Electric Company, *Evaluation of the Commercial Efficient HVAC Rebate Program*, June 1996, Prepared by Quantum Consulting, Inc. All of these studies discuss the use of self reports to estimate free-ridership. In addition, last year's PG&E *1994 Commercial HVAC Impact Evaluation*; (Report #CIA-96-SB01, CEC#312) March 1996; Prepared by SBW Consulting and Ridge & Associates also discussed methodologies for self report analysis of NTG ratios.

probable customer activity. Our goal is to remove as much subjectivity from the scoring as possible in order to approximate a quantifiable estimate of net-to-gross effects. Tabulated results will be used to present point and interval estimates of free ridership.

Parameters and Protocol Requirements

The Protocols Table 5 defines net load impacts as the difference between the participant load impacts and the comparison group load impacts. Table C-4 for Commercial end uses states that the End Use Consumption or Load Impact Model will be either a LIRM or CE model. Both models require statistical based modeling.

Rationale

Commercial refrigeration is a small end use (598 unique participants) where much of the impact comes from custom measures (84% from 54 participants). It cannot support the large samples needed for multivariate modeling approaches. The low levels of participation together with the diversity of measures increases the statistical "noise" in the LIRMs to a point where gross impacts are anticipated to be statistically undetectable.

Furthermore, PG&E's commercial customers are constantly surveyed. While it would be hypothetically possible to do a canvass survey to identify nonparticipants that installed program qualifying measures outside of the program, such a survey of the nonparticipant population for this small end use would place an unreasonable burden on PG&E customers and could adversely affect customer relations.

(2) Use the DUOM of "load impact per project" for the refrigeration end use.

Parameters and Protocol Requirements

Table C-6 does not specify a DUOM for refrigeration measures since refrigeration was not specified as an end use.

Rationale

No DUOM has been designated for refrigeration in Table C-4 of the Protocols because refrigeration was not included as an end use. The use of the "load impact per project" DUOM is the same DUOM used for the Gas Cooking end use in Table C-4. In addition, the PG&E tracking system tracks the measure installation on a per project basis, where per project represents all refrigeration measures per customer per application.

Although the DUOM is on a "per project (per customer per application)" basis, our analysis will capture the diversity of program participation by stratifying the sample by size of expected savings. Per unit savings derived from each strata will be reconstructed in the final analysis to get an estimate of overall savings.

Conclusion

PG&E is seeking a retroactive waiver to clearly define, in advance, acceptable methods for performing the 1995 Commercial refrigeration impact evaluation. Recommendations in this waiver are designed to maximize the quality and value of evaluation results. The proposed waiver allowing the use of self-report analysis reflects a realization that commercial sector refrigeration variability and sample sizes do not support other proposed approaches. The waiver concerning the refrigeration end use DUOM attempts to supply a useful unit for comparison where none exists in the Protocols.

Appendix H
Protocol Tables 6 & 7

H. PROTOCOL TABLES 6 AND 7

1995 COMMERCIAL ENERGY EFFICIENCY INCENTIVES PROGRAM EVALUATION OF REFRIGERATION TECHNOLOGIES

PG&E STUDY ID #330

This Appendix presents Tables 6 and 7 for the above referenced study as required under the "Protocols and Procedures for the Verification of Cost, Benefits, and Shareholder Earnings from Demand Side Management Programs" (the Protocols), as adopted by the California Public Utility Commission (CPUC) Decision 93-05-063, Revised January 1996 Pursuant to Decisions 94-05-063, 94-10-059, 94-12-021, and 95-12-054.

Table 6 Assumptions

In some instances, interpretation of the Protocols allows for a variety of results to be presented. For the refrigeration technologies, the interpretation of these terms are:

- Items 1.A, 1.B, 2.C, 3.C: The change model of estimates did not require an evaluation of base usage for these technologies.
- Item 2.B: The per-unit gross and net impacts required by the Protocols specify a constant term in the denominator. This value was taken directly from Table E-3 of the Technical Appendix of the Annual Summary Report on Demand Side Management Programs in 1995 and 1996, revised in December 1996.
- Items 6 and 7: The number of measures reported are the purchased number in the MDSS. As such, they reflect a variety of units of measure, including square feet, horsepower, tons, linear feet, lamps, total heat rejected, gaskets, etc.

The Table 7 synopsis of analytical methods applied follows Items 1 through 7 of Protocol Table 6.

During the process of obtaining approval for the Request for Waiver, a Draft Request for Waiver proposed reverting to calibrated engineering estimates of impact if the SAE billing regression analysis resulted in statistically insignificant SAE coefficients. In addition, in this Draft Request for Waiver, it was proposed to present two Table 6 exhibits, one based on calibrated engineering estimates, and another based on SAE adjusted estimates of impact. Although this Draft Request for Waiver was not approved, and even though the SAE analysis resulted in statistically significant SAE coefficients, a second Table 6 is provided for Items 1 through 5 (items 6 and 7 do not change) based on calibrated engineering estimates for impact. This second Table 6 is referenced as Table 6-2 below.

Protocol Table 6
Items 1-5
PG&E Refrigeration Study ID #330

Table Item			Relative Precision	
Item Number	**Description**	**Estimate**	**90% Confidence**	**80% Confidence**
1.A†	Pre-installation usage, Base usage, and Base usage per designated unit* of measurement.	N/A	N/A	N/A
1.B†	Impact Year usage, Impact year usage per designated unit* of measurement.	N/A	N/A	N/A
2.A	Gross Peak kW (Demand) Impacts	1,708	76%	59%
	Gross kWh (Energy) Impacts	18,206,378	65%	51%
	Gross thm (Therm) Impacts	N/A	N/A	N/A
	Net Peak kw (Demand) Impacts	1,066	77%	60%
	Net kWh (Energy) Impacts	9,253,545	66%	52%
	Net thm (Therm) Impacts	N/A	N/A	N/A
2.B	Per designated unit* Gross Demand Impacts	2.41	76%	59%
	Per designated unit* Gross Energy Impacts	25,643	65%	51%
	Per designated unit Gross Therm¥ Impacts	N/A	N/A	N/A
	Per designated unit* Net Demand Impacts	1.50	77%	60%
	Per designated unit* Net Energy Impacts	13,033	66%	52%
	Per designated unit Net Therm¥ Impacts	N/A	N/A	N/A
2.C†	Percent change in usage (relative to base usage) of the participant group and comparison group.	N/A	N/A	N/A
2.D	Gross Demand Realization Rate	1.13	76%	59%
	Gross Energy Realization Rate	0.81	65%	51%
	Gross Therm¥ Realization Rate	N/A	N/A	N/A
	Net Demand Realization Rate	0.97	77%	60%
	Net Energy Realization Rate	0.56	66%	52%
	Net Therm¥ Realization Rate	N/A	N/A	N/A
3.A	Net-to-Gross ratio based on Avg. Load Impacts	0.51	10%	8%
3.B	Net-to-Gross ratio based on Avg. Load Impacts per designated unit* of measurement.	0.51	10%	8%
3.C†	Net-to-Gross ratio based on Avg. Load Impacts as a percent change from base usage	N/A	N/A	N/A
4.A	Pre-installation Avg. (mean) Sq. Foot (participant group)			
	Pre-installation Avg. (mean) Sq. Foot (comparison group)			
	Pre-installation Avg. Hours of Operation (participant group)			
	Pre-installation Avg. Hours of Operation (comparison group)			
4.B	Post-installation Avg. (mean) Sq. Foot (participant group)			
	Post-installation Avg. (mean) Sq. Foot (comparison group)			
	Post-installation Avg. Hours of Operation (participant group)			
	Post-installation Avg. Hours of Operation (comparison group)			

† The change model estimates of impact did not require an evaluation of base usage
¥ There were no estimated therm impacts for this end use.
* The per designated unit used was refrigeration measures installed.
▒ Shaded cells were not evaluated because per designated unit calculations did not use these estimates.

Protocol Table 6-2
Based on Calibrated Engineering Estimates
Items 1-5
PG&E Refrigeration Study ID #330

Table Item			Relative Precision	
Item Number	**Description**	**Estimate**	**90% Confidence**	**80% Confidence**
1.A†	Pre-installation usage, Base usage, and Base usage per designated unit* of measurement.	N/A	N/A	N/A
1.B†	Impact Year usage, Impact year usage per designated unit* of measurement.	N/A	N/A	N/A
2.A	Gross Peak kW (Demand) Impacts	1,708	76%	59%
	Gross kWh (Energy) Impacts	26,771,911	76%	59%
	Gross thm (Therm) Impacts	N/A	N/A	N/A
	Net Peak kw (Demand) Impacts	1,066	77%	60%
	Net kWh (Energy) Impacts	14,576,640	77%	60%
	Net thm (Therm) Impacts	N/A	N/A	N/A
2.B	Per designated unit* Gross Demand Impacts	2.41	76%	59%
	Per designated unit* Gross Energy Impacts	37,707	76%	59%
	Per designated unit Gross Therm¥ Impacts	N/A	N/A	N/A
	Per designated unit* Net Demand Impacts	1.50	77%	60%
	Per designated unit* Net Energy Impacts	20,530	77%	60%
	Per designated unit Net Therm¥ Impacts	N/A	N/A	N/A
2.C†	Percent change in usage (relative to base usage) of the participant group and comparison group.	N/A	N/A	N/A
2.D	Gross Demand Realization Rate	1.13	76%	59%
	Gross Energy Realization Rate	1.18	76%	59%
	Gross Therm¥ Realization Rate	N/A	N/A	N/A
	Net Demand Realization Rate	0.97	77%	60%
	Net Energy Realization Rate	0.88	77%	60%
	Net Therm¥ Realization Rate	N/A	N/A	N/A
3.A	Net-to-Gross ratio based on Avg. Load Impacts	0.54	10%	8%
3.B	Net-to-Gross ratio based on Avg. Load Impacts per designated unit* of measurement.	0.54	10%	8%
3.C†	Net-to-Gross ratio based on Avg. Load Impacts as a percent change from base usage	N/A	N/A	N/A
4.A	Pre-installation Avg. (mean) Sq. Foot (participant group)			
	Pre-installation Avg. (mean) Sq. Foot (comparison group)			
	Pre-installation Avg. Hours of Operation (participant group)			
	Pre-installation Avg. Hours of Operation (comparison group)			
4.B	Post-installation Avg. (mean) Sq. Foot (participant group)			
	Post-installation Avg. (mean) Sq. Foot (comparison group)			
	Post-installation Avg. Hours of Operation (participant group)			
	Post-installation Avg. Hours of Operation (comparison group)			

† The change model estimates of impact did not require an evaluation of base usage
¥ There were no estimated therm impacts for this end use.
* The per designated unit used was refrigeration measures installed.
■ Shaded cells were not evaluated because per designated unit calculations did not use these estimates.

Protocol Table 6
Item 6: Refrigeration Measure Count Data
PG&E Study ID #330

Program and Technology Group Description	Number of Measures Paid in 1995		
	All Participants (Item 6.B)	**Participant Sample (Item 6.A)**	**Comparison Group (Item 6.C)**
Retrofit Express Program			
Refrigeration Load Reduction			
Low Temperature Glass/Acrylic Door	60	0	0
Heatless Door	214	140	32
Cooler/Freezer Door Gaskets	140	102	7
Auto Closer for Cooler/Freezer	68	26	7
Medium Temperature Case w/ Door	554	210	33
Strip Curtains for Walk-in	8,938	3,645	0
Low Temperature Case w/ Door	490	257	1
Night Covers for Display Cases	3,375	1,412	0
Compressor Upgrades			
Mechanical Subcooler	18	2	0
Multiplex Compressor System	149	10	0
Adjustable Speed Driver	15	15	2
Floating Head Pressure Controls	1,898	-	500
Condenser Upgrades			
Oversized Air-Cooled Condenser	45	45	0
Oversized Evaporative Condenser	4,043	1,756	6
Evaporator Upgrades			
Walk-in Cooler PSC Evaporator Motor	4	-	0
Display PSC Evaporator Motor	286	238	0
Other			
Anti-Sweat Heater Control	133	133	0
Suction Line Insulation	4,660	1,152	2,000
Display Case Electronic Ballast	1,608	258	0
Non-Electric Condensate Evaporator	430	227	0
Total for Retrofit Express:	**27,127**	**9,627**	**2,588**
Customized Incentives Program			
Compressor Upgrades			
Floating Head Pressure Controls	1	-	[redacted]
Booster Desuperheaters	1	1	
Condenser Upgrades			
Oversized Condensers	1	1	[redacted]
Other			
Refrigeration EMS	18	6	[redacted]
Refrigeration Add/Change	4	4	
Refrigeration Other	39	1	
Total for Customized Incentives:	**64**	**13**	**0**
TOTAL:	**27,191**	**9,640**	**2,588**

Protocol Table 6
Item 7.A: Refrigeration Market Segment Data by Business Type
PG&E Study ID # 330

Business Type	Refrigeration	
	# of Part.	**% of Part.**
Office	14	2%
Retail	75	13%
Col/Univ	3	1%
School	4	1%
Grocery	239	40%
Restaurant	208	35%
Health Care/Hospital	2	0%
Hotel/Motel	6	1%
Warehouse	11	2%
Personal Service	1	0%
Community Service	18	3%
Misc. Commercial	17	3%
TOTAL:	**598**	**100%**

Protocol Table 6
Item 7.B: Refrigeration Market Segment Data by 3-Digit SIC Code
PG&E Study ID # 330

	Refrigeration	
Industry (3-Digit SIC Code)	# of Part.	% of Part.
581	208	35%
541	186	31%
554	63	11%
546	26	4%
866	13	2%
422	12	2%
549	11	2%
592	10	2%
652	10	2%
701	6	1%
072	5	1%
514	5	1%
594	5	1%
821	4	1%
542	3	1%
543	3	1%
832	3	1%
799	2	0%
805	2	0%
829	2	0%
864	2	0%
498	1	0%
504	1	0%
518	1	0%
519	1	0%
531	1	0%
533	1	0%
553	1	0%
562	1	0%
571	1	0%
599	1	0%
650	1	0%
752	1	0%
782	1	0%
783	1	0%
784	1	0%
824	1	0%
835	1	0%
002	0	0%
074	0	0%
075	0	0%
076	0	0%
078	0	0%
411	0	0%
413	0	0%
415	0	0%

Protocol Table 6
Item 7.B: Refrigeration Market Segment Data by 3-Digit SIC Code
PG&E Study ID # 330

	Refrigeration	
Industry (3-Digit SIC Code)	# of Part.	% of Part.
417	0	0%
421	0	0%
423	0	0%
431	0	0%
449	0	0%
451	0	0%
458	0	0%
472	0	0%
473	0	0%
478	0	0%
481	0	0%
483	0	0%
484	0	0%
492	0	0%
493	0	0%
495	0	0%
501	0	0%
502	0	0%
503	0	0%
505	0	0%
506	0	0%
507	0	0%
508	0	0%
509	0	0%
511	0	0%
512	0	0%
516	0	0%
517	0	0%
521	0	0%
523	0	0%
525	0	0%
526	0	0%
539	0	0%
540	0	0%
544	0	0%
551	0	0%
552	0	0%
555	0	0%
556	0	0%
557	0	0%
559	0	0%
560	0	0%
561	0	0%
563	0	0%
564	0	0%
565	0	0%

Protocol Table 6
Item 7.B: Refrigeration Market Segment Data by 3-Digit SIC Code
PG&E Study ID # 330

Industry (3-Digit SIC Code)	Refrigeration	
	# of Part.	% of Part.
566	0	0%
569	0	0%
572	0	0%
573	0	0%
591	0	0%
593	0	0%
596	0	0%
598	0	0%
602	0	0%
603	0	0%
606	0	0%
609	0	0%
614	0	0%
615	0	0%
616	0	0%
621	0	0%
631	0	0%
632	0	0%
633	0	0%
636	0	0%
641	0	0%
651	0	0%
653	0	0%
655	0	0%
662	0	0%
672	0	0%
702	0	0%
703	0	0%
704	0	0%
721	0	0%
722	0	0%
723	0	0%
724	0	0%
725	0	0%
726	0	0%
729	0	0%
731	0	0%
732	0	0%
733	0	0%
734	0	0%
735	0	0%
736	0	0%
737	0	0%
738	0	0%
751	0	0%
753	0	0%

Protocol Table 6
Item 7.B: Refrigeration Market Segment Data by 3-Digit SIC Code PG&E Study ID # 330

	Refrigeration	
Industry (3-Digit SIC Code)	# of Part.	% of Part.
754	0	0%
762	0	0%
769	0	0%
781	0	0%
791	0	0%
792	0	0%
793	0	0%
794	0	0%
801	0	0%
802	0	0%
804	0	0%
806	0	0%
807	0	0%
808	0	0%
809	0	0%
811	0	0%
822	0	0%
823	0	0%
830	0	0%
833	0	0%
836	0	0%
839	0	0%
841	0	0%
842	0	0%
861	0	0%
862	0	0%
863	0	0%
869	0	0%
871	0	0%
872	0	0%
873	0	0%
874	0	0%
913	0	0%
919	0	0%
921	0	0%
922	0	0%
931	0	0%
941	0	0%
943	0	0%
944	0	0%
951	0	0%
953	0	0%
962	0	0%
964	0	0%
971	0	0%
TOTAL:	**598**	**100%**

PROTOCOL TABLE 7

1995 COMMERCIAL ENERGY EFFICIENCY INCENTIVES PROGRAM EVALUATION OF REFRIGERATION TECHNOLOGIES PG&E STUDY ID #330

The purpose of this section is to provide the documentation for data quality and processing as required in Table 7 of the California Public Utility Commission (CPUC) Evaluation and Measurement Protocols (the Protocols). Although other important considerations are addressed throughout this section, major topics are organized and presented in the same order as they are listed in Table 7 for ease of reference and review. When responses to the items are discussed in detail elsewhere in the report, only a brief summary will be given in this section to avoid redundancy.

A. OVERVIEW INFORMATION

1. Study Title and Study ID Number

Study Title: Evaluation of PG&E's 1995 Nonresidential Energy Efficiency Incentives (EEI) Program for Commercial Sector Refrigeration Technologies.

Study ID Number: 330

2. Program, Program Year and Program Description

Program: PG&E Nonresidential EEI Program, Commercial Sector.

Program Year: Rebates Received in the 1995 Calendar Year.

Program Description:

The Nonresidential EEI Program offered by PG&E has two components: the Retrofit Express (RE) Program and the Customized Incentive Program.

The RE Program offers fixed rebates to PG&E's customers that install specific gas or electric energy-efficient equipment in their facilities. The RE Program covers most common energy-saving measures: lighting, air conditioning, refrigeration/food service, and motors. To receive a rebate, the customer is required to submit proof of purchase along with the application. This Program is primarily marketed to small and medium commercial, industrial, and agricultural customers. The maximum total rebate amount of the RE Program is $300,000 per account. This includes participation in any combination of the lighting, air conditioning, refrigeration/food service, and motor program options.

The Customized Incentives Program offers financial incentives to customers who undertake large or complex projects that save gas or electricity. These customers must submit calculations for the projected first year energy savings, along with an application, prior to the start of the customers' installation of high-efficiency equipment. The maximum total incentive amount for the Customized Program is $500,000 per account. The minimum qualifying incentive amount is $2,500 per project.

3. End Uses and/or Measures Covered

End Use Covered: Refrigeration Technologies.

Measures Covered: For the list of RE and Customized Incentives Program measures covered in this evaluation, refer to the report *Sections 2.1 and 2.2,* and more specifically in Exhibit 4-1. The measure classification provided is consistent with PG&E program tracking recrods strored in the Management Decision Support System (MDSS).

4. Methods and Models Used

The PG&E Commercial Refrigeration Technologies consisted of three key analysis components: engineering analysis, billing data regression analysis, and net-to-gross analysis. This integrated approach reduces a complicated problem to manageable components, while incorporating the comparative advantages of each analysis method. This approach describes per-unit net impacts as follows:

Net Impact = (Gross Impact) x (SAE Realization Rate) x (Net-to-Gross)

Gross impact -- The gross impact estiamtes were modeled using distinct approaches for the RE and Customized Incentives Programs. However, both approaches yielded energy impacts based on an entire year of refrigeration end-use consumption, and a separate demand impact that represents end-use consumption during the summer on-peak period.

RE impacts were estimated based on a review and subsequent revisions to the engineering algorithms used by PG&E to develop ex ante impacts (algorithms were taken from the 1995 Advice Filing[1]). A detailed discussion of the RE gross impact approach is provided in the *Section 3.2.2,* and presentation of each measure-specific algorithm assessment is found in *Appendix B, Section B.5.*

Customized Incentives impacts were estimated based on a thorough review and subsequent update of each refrigeration application that was submitted and paid in 1995. A detailed discussion of the Customized Incentives gross impact approach is provided in the *Section 3.2.3,* and presentation of each application-specific assessment is found in *Appendix B, Sections B.4 and B.6.*

SAE Realization Rates -- The SAE Realization Rates were estimated based on a Statistically Adjusted Engineering (SAE) analysis using cross-sectional time series data and incorporating prior engineering estimates. As a result, the SAE realization rates could be defined as the percentage of a savings estimate that is detected or realized in the statistical analysis of actual changes in energy usage. The SAE realization rates were then applied to an impact estimate based upon the program baseline, equipment purchased under the program, and typical weather. A detailed discussion of the final SAE model specification can be found in *Section 3.3.*

Net-to-Gross -- The net-to-gross (NTG) ratio adjusts the program baseline, derived using estimates of free-ridership and spillover (associated with the program). The refrigeration end-use NTG

[1] PG&E 1995 Customer Energy Efficiency Programs Advice Letter No. 1867-G/1481-E, filed October 1994.

ratio's were calculated based on survey self-report using a representative nonparticipant sample to account for naturally occurring conservation. The NTG analysis approach is presented in detail in *Section-3.4,* and a thorough discussion surrounding the methods used to score those results is provided in *Appendix D.*

5. Participant and Comparison Group Definition

Participant

Participants are defined as those PG&E commercial customers who received PG&E rebates in the 1995 calendar year for installing at least one refrigeration measure under the Nonresidential EEI Program.

Comparison Group

The comparison group for this study is defined as a group of PG&E commercial customers who did not receive any refrigeration end-use rebates in the 1995 calendar year under the Nonresidential EEI Program, and who share as many characteristics as possible with the commercial sector participant group in terms of annual usage and business type distribution. Customers who participated in the previous years or those who simply participated by installing a non-refrigeration end-use measure, are eligible for the comparison group.

6. Analysis Sample Size

The final analysis dataset has 2,025 observations based upon 2,025 telephone survey completes (of which 241 were refrigeration end-use participants, and the remaining 1,784 served as a comparison group for that sample). In addition, 18 on-site audits were conducted at refrigeration end-use participant sites, 13 of which were conducted at Customized Incentives sites (for use in application review/analysis). The distribution of the sample by business type and technology is presented in *Appendix A.*

B. DATABASE MANAGEMENT

1. Data Description and Flow Chart

The Evaluation of PG&E Commercial Refrigeration Technologies was based on a telephone survey sample dataset, that was derived using a census to achieve a representative customer profile. On-site audit data were collected primarily within the Customized Incentives Program, providing a basis for revisions to the application-based estimates of savings.

All data elements mentioned above were linked to the final analysis database through the unique customer identifier -- the evaluation 'site_id' variable. For this evaluation, the analysis database served as a centralized tracking system for each customers' billing history, program participation, and sampling status, which helped to reduce data problems such as account mis-match, double counting, or repeated customer contacts. Exhibit A illustrates how each key data element was used to create the final analysis database for the Evaluation.

2. Key Data Elements and Sources

A complete list of data elements and their sources can be found in *Section 3.1.1* and *Appendix C.* The key analysis data elements and their sources are listed below:

Program Participant Tracking System. The participant tracking system for the RE and Customized Incentives programs was maintained as part of the PG&E MDSS. It contains program application, rebate, and technical information about installed measures, including measure description, quantity, rebate amount, and ex ante demand, energy, and therm saving estimates.

PG&E Billing Data. Initially, the PG&E billing data were obtained from two PG&E data sources. The original nonresidential billing dataset contains monthly energy usage for all nonresidential accounts in PG&E's service territory, and was used in the sample design as described in *Appendix A*. The billing histories contained in this database only run through September 1995.

The second billing dataset, which consists only of customer accounts in the surveyed dataset, was later obtained from PG&E's Load Data Services.[2] This billing dataset contains bill readings that run through September 1996, and was therefore used in the billing regression analysis. In addition, the billing series from this database is the PG&E pro-rated monthly usage data, a series calculated by PG&E for each calendar month, from January 1992 to September 1996.

Telephone Survey Data. Two telephone survey samples (241 participants and 1,784 comparison group customers) were collected as part of this evaluation. They were designed to be representative of the population of each business type. The telephone survey supplies information on customer decision-making, equipment operating characteristics, equipment stocks, and energy-related changes at each site for the billing period covered by the statistical billing analysis.

On-Site Audit Data. On-site audit data were specifically collected (as part of the refrigeration end-use evaluation) for the Customized Incentives participant group only. This sample contributes site-specific equipment details, and better estimates of operating schedules and equipment profiles (than are provided in the application records). There were a total of 18 participant on-site audits conducted for this refrigeration end-use evaluation, 13 of which were used to evaluate Customized Incentives applications.

Weather Data. The hourly dry bulb temperature collected for 25 PG&E load research weather sites is used in the billing regression analysis to calculate total monthly cooling and heating degree days for each month in the analysis period. For each customer in the analysis dataset, the appropriate weather site is linked to that customer by using the PG&E-defined weather site to PG&E's local office mapping.

Other data elements include PG&E program marketing data, PG&E internal SIC code mapping/segmentation scheme, program procedural manuals and other industry standard data sources.

3. Data Attrition Process

All data elements mentioned above were first validated and then merged together to form the final analysis dataset. Records with out-of-range or questionable data were either deleted or flagged to ensure that only those records with sufficient data, both in terms of data quality and representativeness, were used in the analysis. The key data attrition decisions are summarized in *Appendix C, Section 5.*

4. Internal Data Quality Procedures

The Evaluation contractor for this project, Quantum Consulting Inc. (QC), has performed extensive data quality control on all categories of program data, including utility billing data, program

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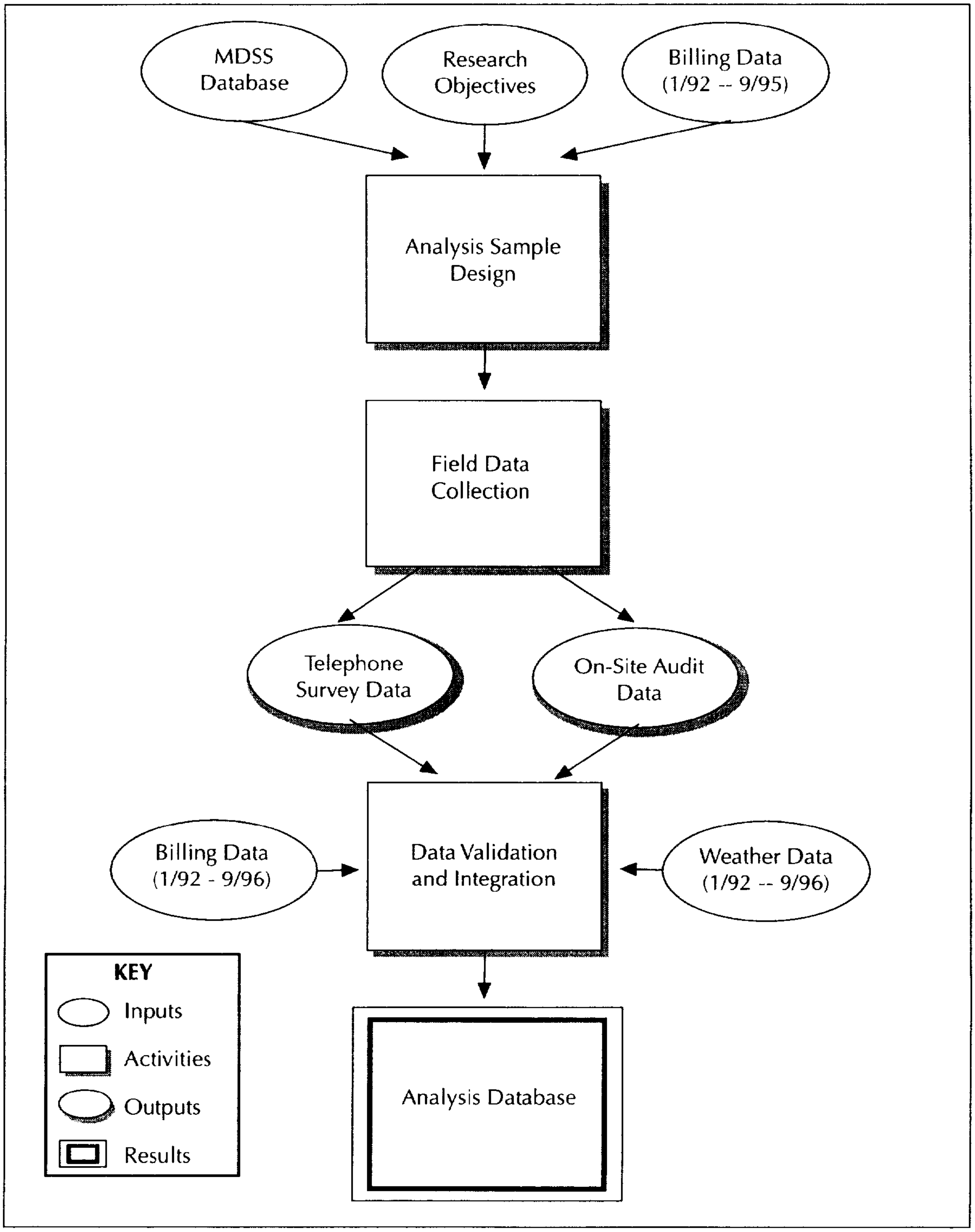
[2] A preliminary analysis has concluded that the monthly usage and bill read date information in these two datasets is consistent.

tracking data, telephone survey data, and on-site audit data. QC's data quality procedures are consistent with PG&E's internal database guidelines and the guidelines established in the Protocols.

Exhibit A
Analysis Database Development



Throughout the course of sample design and creation, survey data collection, and data analysis, several data quality assurance procedures were in place to insure that all energy usage data used in analysis and all telephone survey data collected was of high quality and would prove useful in later analysis. The stages of data validation undertaken and the methods employed are detailed below:

Pre-Survey Usage and Account Characteristic Data Validation. The goal of this stage of data validation was to screen out customers who had unreasonable or unreliable usage data, or who had changes in key elements of their billing data over the 1992 to 1995 period. Accounts for which changes were observed in account numbers, service addresses, SIC codes, electric rate schedules, electric meter numbers, or corporation and premise identification variables, were excluded from sample eligibility. Usage data reliability screening first eliminated from sample accounts which experienced service interruptions, exhibited inconsistent read dates, or for which bills were estimated. Additionally, based on comparisons of account usage between years, and between different months in the same year, customers with unusual usage patterns such as unusually high variation in monthly or yearly usage were given special attention and, in some cases, excluded from the sample frame. A more detailed discussion of the steps undertaken in the pre-survey usage and account characteristics data validation, is provided in the discussion of survey sample creation in *Appendix A*.

Real Time Survey Data Validation. Survey data collection was performed using QC's 24 station Computer Aided Telephone Interviewing (CATI) center. Data entry applications, programmed using SAS/AF software, employed logical branching routines and real-time data validation procedures to insure that survey questions were appropriate for each customer's situation and that recorded responses were reasonable and logical. Data entry applications also performed real time range checks and field protection for out of range values during the data collection process thereby affording an additional means of ongoing data validation. Finally, because SAS/AF was used to program the data collection software, the survey data was on-line in the form of a SAS dataset continuously throughout the course of data collection. This allowed for the generation of frequency distributions and cross-tabs on data at regular stages throughout the survey fielding to facilitate QC's internal early detection and correction of data entry errors.

Final Survey Data Validation. Following the completion of survey data collection, all data was subjected to a final stage of validation and cleaning during which illogical responses were identified and corrected or flagged, and corrections were made to any mis-coding of data not detected in earlier stages of cleaning and validation. All activities undertaken in the course of survey were documented in accordance with QC's Enumerated Quality Assurance Logs and Standards (EQUALS) survey data collection documentation protocols.

5. Unused Data Elements

Without exception, all data collected specifically for the Evaluation were utilized in the analysis.

C. SAMPLING

1. Sampling Procedures and Protocols

The sample design for the Commercial Refrigeration Evaluation was based upon analysis of 1995 program participation data and PG&E billing data. The goal of the sample design was to achieve the most efficient utilization of project resources in order to estimate the first-year gross and net impacts in a manner that met the sample size and evaluation accuracy requirements defined by the Protocols.

The telephone survey sample was selected based upon a census of the program participants, while the comparison group was drawn in a stratified fashion, in an attempt to achieve a customer profile similar to the participant sample. For example, the comparison group sample frame included business types and usage strata that were similar to the participant population.

The customer segment is defined primarily by the business types, which were determined based upon the MDSS database (for participants), and the Second Standard Industrial Classification (SIC2) code—which represents building activity—from the billing dataset (for the comparison group). Within each business type, the annual energy consumption is used as a proxy to group customers into usage bins, and sample points are selected to reflect the underlying distribution of the participant population.

The sampling unit for both participant and comparison groups was defined as customer premise. A premise is defined as all billing accounts that correspond to the same location and customer. The final participant sample frame consists of 2,560 premises drawn from the eligible population of 5,694 program participants who were paid in 1995 from both the RE and Customized Incentives programs.

The comparison group sample frame consists of 4,153 customers drawn from the eligible population of 172,354 commercial customers that satisfied all of the screening criteria used in construction of the sample frame. In drawing the sample frame, targets are established for each business type and usage segment, so that the sample frame distribution, by business type and usage segment, is the same as that of the participant population.

The process of reduction to the eligible sample involved the elimination of customers that had 1) moved during the period of interest; or 2) had billing records with significant missing data. Customers were further screened to identify those who had high-quality data for each month, for all three years of the analysis window.

Finally, the achieved samples and their distributions can be found in *Appendix A*. Based on the total energy usage, the samples relative precision was estimated to be 6 percent at the 90 percent level. The procedures used in the relative precision calculation and a summary of how the Evaluation sample design meets the Protocols' requirement in terms of sample size and relative precision are presented in *Appendix A*.

2. Survey Information

Telephone survey instruments are presented in the *Survey Appendix , Section S-1* (for participants) and *Section S-2* (for comparison group customers). Participant and comparison group customer's survey response frequencies are presented in *Section S-9*. Finally, reasons for refusals are presented in *Section S-10*.

3. Statistical Descriptions

As mentioned above, a complete set of participant and comparison group customer response frequencies are presented in *Survey Appendix S-9*. In addition, statistics on usage and engineering impact variables that were used in the billing data regression models are also presented in *Appendix C*.

D. DATA SCREENING AND ANALYSIS

A detailed discussion of the billing data regression data analysis is presented in *Appendix C*. The statistical billing model described in this section incorporates analysis for three distinct end uses, lighting, HVAC and refrigeration (for Study ID's 324, 326 and 330, respectively). Specific procedures and modeling issues are discussed below.

1. Outliers, Missing Data and Weather Adjustment

Three types of data censoring screens were applied to the billing analysis sample frame to remove customers that have invalid billing data, that may not have had their bill properly aggregated to the Site ID level, or that were extremely large users.

Invalid Usage

For customers to be included in the final billing analysis, customers had to have billing data that met the following three criteria.

The pre- and post-installation annual bills had to have been comprised of at least six non-zero monthly bills. If there were seven or more monthly bills with zero energy, the customer was removed from the analysis. If there were between one and six monthly bills with zero energy, the remaining months were prorated to an annual estimate.

The pre-installation annual bill could not be more than three times or less than one third of the post-installation bill. If this occurred, the customer was removed from the analysis.

The pre-installation annual bill could not be more than twice or less than one half the post-installation bill, unless the telephone survey responses indicated that the customer had a change at the site that may have caused an increase or decrease in usage, respectively. For example, if a customer doubled their usage and reported an increase in square footage, or an increase in employees, or an additional measure installed, the customer remained in the sample. However, if the customer reported no changes, or only changes that would indicate a decrease in usage, such as a removal of a measure, then the customer was removed from the analysis.

Appendix C presents the number of participants and nonparticipants that were deleted for each of the above criteria. Note that only 22 nonparticipants were deleted, whereas 123 participants were deleted. This is due to the fact that the nonparticipants were pre-screened to have relatively valid billing data prior to being selected into the nonparticipant survey sample frame. The participants, however, were often a census and no pre-screening was done on their billing data prior to being selected into the participant survey sample frame. Of the 123 participants, 87 were deleted due to the zero bill criteria.

Large Customers

Customers whose annual post-installation energy consumption exceeded three million kWh were excluded from the billing analysis. Customers of this size were deleted for a number of reasons. First, there were 98 participants dropped for this reason, compared to only 10 nonparticipants. This indicated that the nonparticipants would not provide a good control for this group of participants. Very large customers are more likely to participate because they are more aware of the program, since they have more contact with PG&E representatives. Therefore, it is difficult to find a sample of nonparticipants that adequately represents these customers.

Large customers installing measures that provide relatively low levels of savings are particularly problematic in billing analyses of this type. It is very difficult to detect an annual impact even as large as 10,000 kWh in a customer's bill which exceeds 10 million kWh, for example. In addition, large customers are more likely to have made changes at the site, which could significantly affect their energy usage. If the model does not adequately capture all of these changes (possibly due to the unique nature of the change, or an error in the self-reported survey responses) it is likely that the coefficient on the program *energy* impact may reflect the change. While this is true of all customers, regardless of size, it is more of a concern for larger customers because the magnitude of their changes can have significant influence over the results of the model.

Aggregation to Site ID Level

As mentioned above, one concern with aggregating to the Site ID level is that there may be control numbers associated with a different premise number, service address, or corporation number that are in the same physical site and are being affected by the installed measures. If this is the case, the billing analysis will have the effect of underestimating the impacts. Therefore, a comparison was made between the engineering energy impact and the pre- and post-installation bills to identify any customers where this problem of bill aggregation may exist.

There were 148 participants that were identified as having total Commercial Sector Program energy impacts that were either more than 50 percent of their pre-installation usage or more than 100 percent of their post-installation usage. These 148 participants were further analyzed to determine whether the impact was large relative to usage because of a problem in aggregating the bill, or if the engineering estimates were just over-estimated, in which case the customer would not be removed from the billing analysis.

Three criteria were used to determine if there was a problem with aggregating the bill for these 148 participants. If a participant failed any of these criteria, the customer was removed from the analysis on the basis that the bills were not properly aggregated and the entire impact would not be detected in an analysis of the customer's billing data.

If the customer's annual kWh per square foot was in the bottom tenth percentile of all participants, the customer was removed.

If the customer's annual kWh per employee was in the bottom tenth percentile of all participants, the customer was removed.

The first billing data pull, which consisted of every nonresidential customer in PG&E's service territory over the period of January 1992 to September 1995, was compared to the second data pull, which is being used for the billing analysis. Customer bills from the first billing data pull were aggregated to the Site ID level in the same way described above. These annual aggregated bills were compared to the aggregated bills used in the analysis. If the aggregated bills from the first data pull were more than 50 percent larger than the bills being used in the billing analysis, the customer was removed. This would indicate that either not all of the control numbers that link to a site were provided in the second data pull or, more likely, since 1995 (when the first billing data was pulled and when the customer participated) there has been customer turnover at the site, and there are now additional premise numbers that no longer link to one unique site.

As a results of these three criteria, 102 of the 148 premises were removed. Of the 102 removed customers, 45 failed the invalid usage data screening checks as well. Therefore, only 57 premises were removed solely on these data screening criteria alone.

Appendix C presents the number of participants that were removed from the analysis for each of the above criteria.

Other Censoring

In addition to all of the above censoring, three other participants were removed from the analysis for the following reasons:

One customer was removed from the analysis because the customer was noted as a "Z-Customer" in the MDSS. PG&E does not claim impacts on "Z-Coded" customers.

Another site had a retrofit performed that will affect a neighboring customer's utility bill. The refrigeration equipment (compressors and condensers) serving the participant are maintained and operated by a nonparticipant. The participant buys liquid ammonia from the nonparticipant via lines running under an adjacent road (driveway) and suction gas is returned to the nonparticipant following use. The impacts of this retrofit (which affect ice production) will be realized by the manufacturer of the liquid ammonia product, a nonparticipant. Therefore, the participating customer was removed from the analysis.

Finally, two other customers were identified as having added the rebated measure installed under the Commercial Program, causing a net increase in energy from the pre- to post-installation period. One of these customers was previously identified as being a large customer and deleted. Therefore, only one extra customer was removed.

Appendix C summarizes all of these data screening criteria and provides the pre- and post-censoring sample sizes by technology and business type.

2. *Background Variables*

Background variables, such as interest rates, unemployment rates and other economic factors, were not explicitly modeled in the final model. However, the effect of these factors was explicitly accounted for when a cross-sectional time series model was used with a comparison group. This is based on the assumption that the comparison group was equally impacted by the same set of background variables.

3. *Data Screen Process*

As explained in *Appendix C*, the final model was fitted in two steps. The first step is to estimate a baseline model to develop the relationship between the pre-installation year usage and the post-installation year usage, followed by an SAE model to estimate the SAE realization rates based on the engineering estimates of program impacts. Section 1 above describes in detail all of the data screening criteria. *Appendix C* also details the number of customers that were screened for each criteria.

4. *Regression Statistics*

The billing regression analysis for the lighting program uses two different multivariate regression models under an integrated framework of providing unbiased and robust model estimates in the commercial sector. The key feature of our approach is that it employs a simultaneous equation approach to account for both the year-to-year and cross-sectional variations in a manner that consistently and efficiently isolates program impacts.

A baseline model is initially estimated using only the comparison group sample. This model estimates a relationship that is then used to forecast the post-installation-year energy consumption for both participants and the comparison group, as a function of pre-installation-year usage. In this way, baseline energy usage is forecasted for participants by assuming that their usage will change, on average, in the same way that usage did for the comparison group. The outputs of the baseline model are presented in *Appendix C*.

The estimated SAE realization rates are used to adjust the engineering estimates of expected annual energy impacts for the entire participant population. The regression statistics for the final SAE model are presented in the following exhibits and a more detailed discussion can be found in *Appendix C*.

Exhibit B
Final SAE Model Output

Parameter Descriptions	Units	Parameter Estimate	t-Statistic	Sample Size
SAE Coefficients				
Lighting End Use				
Office Flourescents	kWh	-1.00	14.67	116
Other Flourescents	kWh	-0.68	7.41	261
Controls	kWh	-1.38	2.09	57
Warehouse HIDs	kWh	0.02	0.07	10
School HIDS	kWh	0.11	0.30	10
Other RE Lighting	kWh	-1.26	2.15	119
Custom Lighting	kWh	-0.51	3.07	15
HVAC End Use				
Central A/Cs	kWh	-2.07	3.67	184
ASDs	kWh	-1.90	6.75	27
Chillers	kWh	-1.58	2.39	5
EMS	kWh	-1.03	8.38	20
Other Custom HVAC	kWh	-0.65	4.76	5
Office Thermostats	kWh	0.05	1.06	36
Other RE/REO HVAC	kWh	-0.90	2.89	153
Refrigeration				
Custom Refrigeration	kWh	-0.75	2.00	3
RE/REO Refrigeration	kWh	-0.53	1.98	181
Other End Uses	kWh			
Other	kWh	-1.71	2.90	62
Change Variables	kWh			
Cooling System Replacement	(0,1)*kWh	-0.03	0.70	10
Lighting System Replacement	(0,1)*kWh	-0.08	4.17	48
Change in Employees	(±1,0)*kWh	0.01	0.64	57
Square Foot Change	± sqft	4.42	2.37	27
Heating System Replacement	(0,1)*kWh	-0.07	0.04	4
Other Equipment Change	(0,1)*kWh	0.03	1.17	42
Remove Equipment	(0,1)*kWh	0.08	0.64	2
Refrigeration Replacement	(0,1)*kWh	0.00	0.01	3
Add Equipement	(0,1)*kWh	0.11	0.49	11
Other Additions	(0,1)*kWh	0.14	12.41	375

The dependent variable is the difference between the actual and predicted 1996 usage using the 1994 baseline model.

SAE coefficients were calculated for 16 different combinations of business type and measure. Primarily those measures that have broad participation and relatively high expected impacts were supported by separate SAE coefficients. In addition, a separate SAE coefficient was calculated for other Commercial Program measures outside Lighting, HVAC, and Refrigeration.

Attempts were made to estimate the SAE coefficients at a finer level of segmentation, but generally either one of two problems were encountered. First, available sample sizes were too small to support a finer level of segmentation. Second, certain parameters were correlated with each other and needed to be combined into a single parameter (a standard econometric solution to solving the problem of colinearity). For example, it was determined that there was a high incidence of compact and standard fluorescent installations at the same site in office buildings. Therefore, there was enough correlation between the compact and fluorescent engineering estimates to warrant combining the two estimates into a single fluorescent estimate in the model.

All but three of the SAE coefficients are significant at the 95 percent confidence level (t-statistics greater than 1.96). In addition, all of the statistically significant SAE coefficients were the correct sign, and therefore were used in the calculation of the final ex post energy calculations. The three SAE coefficients that were not significant at the 95 percent confidence interval (HIDs in warehouses and schools, and thermostats in offices) were not used in the final ex post energy calculations. Because each of the insignificant SAE coefficients were also the wrong sign, they were set to zero. Therefore, no energy impacts are being claimed for these three segments.

All of the HVAC technologies are represented in the SAE billing analysis, except for REO Variable Frequency Drives (VFD), REO CAV to VAV, and Customized Incentive Chillers. Although these measures represent only ten percent of the energy impact, an approach needed to be developed for adjusting the engineering energy impact estimate for these measures.

- The REO VFD measure is very similar to those installed under the RE and Customized Incentive programs, and the engineering estimate is calculated using the same approach. Therefore, engineering energy impact estimate for the REO VFD measure was adjusted by the SAE coefficient estimated for the RE and Customized Incentive measures.

- Three approaches were considered for adjusting the engineering energy impact estimate for the REO CAV to VAV measure: (1) applying the Other RE HVAC SAE coefficient, (2) applying the Other Custom HVAC SAE coefficient, or (3) leaving the engineering estimate unadjusted. Because the REO CAV to VAV measure is usually installed in large businesses, typical of those installing Customized Incentive measures, the Other Custom HVAC SAE coefficient was used to adjust the engineering energy impact estimate for the REO CAV to VAV measure. This is also the most conservative approach since the SAE coefficient is only 0.65.

- The engineering energy impact for Chillers was estimated differently for Customized Incentive applications than for RE and REO applications, due to the different types of businesses that install these measures. Therefore, the engineering energy impact estimate for Customized Incentive Chillers was left unadjusted, which is conservative compared to the alternative approach of applying the 1.58 SAE coefficient estimated for the RE and REO applications.

The SAE coefficient of 0.65 for Other Custom HVAC measures is based on a sample size of only five sites, compared to the 43 unique sites that installed "Other" Customized Incentive HVAC measures in 1995. In addition, these five sites represent only seven percent of the total ex ante energy impact contributed by these 43 sites. Also, one third of the customers installing "Other" Customized Incentive HVAC measures have usage over 3 million kWh per year, which are not represented in the SAE analysis.

The larger customers (usage over 3 million kWh per year), however, are very well represented in the on-site audit sample, for which calibrated engineering energy impacts were estimated. Sixteen sites, which represent 53 percent of the total ex ante energy impact, were on-site audited, one of which was included in the SAE billing analysis. The ratio of the engineering energy impact estimate to the ex ante estimate is 0.79 for the on-site audit sample. This can be directly compared to the SAE coefficient, because ex ante estimates were used as the engineering energy impact estimates for the billing analysis, as mentioned above.

Three approaches were considered for estimating the ex post gross energy impact for the "Other" Customized Incentive HVAC measures:

- The SAE coefficient of 0.65 could be applied to the ex ante estimate of gross energy impact for the population.
- The 0.79 ratio of engineering energy engineering energy impact estimate to the ex ante estimate from the on-site audit sample could be applied to the ex ante estimate of gross energy impact for the population.
- The SAE coefficient of 0.65 could be applied to the ex ante estimate of gross energy impact for the population that is most similar to the SAE sample, and the 0.79 ratio of engineering energy engineering energy impact estimate to the ex ante estimate could be applied to the population most similar to the on-site audit sample.

The approach of applying the SAE coefficient to the ex ante estimate of gross energy impact for the population, which is the most conservative method, was chosen for two reasons. First, the SAE coefficient provides a statistically adjusted result that is significant at the 95 percent confidence level. Second, the 0.79 ratio based on the on-site audit is very sensitive to a few individual on-site results. For example, the ratio of the engineering to ex ante estimate is 1.51 for the site with the largest energy impact. If the engineering estimate was set equal to the ex ante estimate for this customer, the overall ratio for all on-sites would be 0.64. Conversely, if the site with the second largest energy impact, which has a ratio of 0.41, had an engineering estimate set equal to the ex ant estimate, the overall ratio would be 0.95.

The SAE coefficient of 0.75 for Customized Incentive Refrigeration measures is based on a sample size of only three sites, compared to the 53 unique sites that installed Customized Incentive Refrigeration measures in 1995. Adjusting the engineering estimates of energy impact by 0.75 for all Customized Incentive measures should be considered conservative because it is likely that a sample size of three may not be representative of the population. An alternative approach would be to adjust only those measures that are similar to the three represented in the billing analysis, and leave the remaining measures unadjusted. It was found that the ratio of the engineering energy to the ex ante gross energy estimate was 98 percent over all 53 unique sites, and 94 percent for the three sites used in the SAE analysis. Because the ratio for the SAE sample is similar to the population's ratio and because the SAE coefficient was statistically significant at the 95 percent confidence level, the conservative approach of adjusting all Customized Incentive Refrigeration measures by 0.75 was chosen.

Impact estimates from the MDSS for other end uses were included in the model for customers that installed measures outside the Lighting, HVAC, and Refrigeration end uses. Although this result is statistically significant and the correct sign, it is not recommended that this value be used because the sample may not be representative of the population of participants installing these measures.

The majority of the change variables that were included in the model were not statistically significant at the 95 percent confidence level. Most of the parameter estimates are the correct sign, and those that are not have very low t-statistics. All but one variable, was determined solely on telephone survey responses. The change variable termed "other additions" was determined by comparing the predicted estimate of post-installation usage, based on the baseline model, to the actual post-installation usage. If the predicted usage is less than the actual post-installation usage, it is likely that some change occurred at the premise that would cause the usage to increase. An analysis of these customers revealed that two thirds of them indicated through the telephone survey that some change did occur at the premise. However, almost half of these customers did not provide a date for when the change occurred. Therefore, the "other additions" variable was created in an attempt to capture other changes that would cause usage to increase, which were not explained by the other independent variables in the model.

5. Model Specification

The model specifications are presented in *Appendix C*. Specific model specification issues are further discussed below:

Cross-sectional Variation. The final model specification recognizes the potential heterogeneity problem in the model and uses the following procedures to eliminate the impacts of the cross-sectional variation: (1) observations with highest usage values were removed in the model to reduce the overall variance of the sample in terms of usage and size; and (2) independent variables were all intercepted with the pre-installation usage to ensure that change of independent variable will be proportional to the usage value.

Time Series Variation. The key factors to control for the time series variation in the final model are: (1) use of the comparison group to define the relationship of the energy consumption between two different time periods and (2) eliminate the multiple time period interactions by only one yearly pre-installation period and one yearly post-installation period for each stage.

Self-selection. Self-selection is not treated explicitly in the billing regression analysis. The reasons for excluding such a correction is based on the following considerations: (1) the objective of the billing regression analysis is to estimate the program gross energy impacts, where self-selection bias is believed to have a limited effect on the regression result (when both cross-sectional and time series data are used), and (2) the existing self-selection correction procedures all have serious flaws in their underlying assumptions. For example, the Mills ratio approach was attempted, but resulted in serious multi-collinearity problems between the double inverse Mills ratio variable and the engineering estimates of impact.

Collinearity. Various statistical tests (such as COLLIN and VIF options in SAS) were used to check multiple collinearity problem among independent variables in the model to ensure that the final parameter estimates are robust.

Net Impact. As mentioned in the Self-selection section, a net billing model was implemented using the double inverse Mills ratio approach, but resulted in problems with multi-colinearity that were uncorrectable. Therefore, a gross billing analysis model was used and adjusted by a net-to-gross ratio using discrete choice and self report methods.

6. Measurement Errors

For the billing data regression analysis, the main source of measurement errors is the telephone survey. Our approach has been to proactively stop the problem before it happens so that statistical corrections are kept to a minimum.

Measurement errors are a combination of random and non-random error components that plague all survey data. The non-random error frequently takes the form of systematic bias, which includes, but is not limited to, ill-formed or misleading questions and mis-coded study variables. In this project, we have implemented several controls to reduce the systematic bias in the data. These steps included (1) thorough auditor/coder training; (2) instrument pretest; and (3) cross-validation between on-site audit data and telephone survey responses.

The random measurement error, such as data entry error, has no impact on estimating mean values because the errors are typically unbiased. For the measures that were modeled in the billing regression analysis, the impact of random unbiased measurement errors was accounted for as part of the overall standard variance in the parameter estimate.

7. Autocorrelation

The autocorrelation problem exists if the residuals in one time period are correlated with the residuals in the previous time period. Since the final model is based on a yearly pre- and post-installation period comparison with only one year in each period, the autocorrelation problem was unlikely to occur under this scenario, as was confirmed by examining the Durbin-Watson statistic for these models.

8. Heteroskdasticity

See discussion above.

9. Collinearity

See discussion above.

10. Influential Data Points

See discussion above.

11. Missing Data

See discussion above.

12. Precision

The precision calculation for the gross SAE realization rates are presented in *Section 3.* Relative precision's for net estimates were calculated using the following procedure:

- First, NTG ratios, N_i, were computed for all technology groups that were represented in the telephone survey.
- Then, the program level NTG and program level standard error for the NTG were calculated using the classic stratified sample techniques. The program level NTG was a weighted average of technology level NTG values with adjusted gross impacts per technology group providing the weights.[3] The functional relation can be best described in the following equations:

$$\overline{N} = \Sigma_i w_i * \overline{N}_i \text{ with } w_i = MWh_i$$

$$StdErr_{NTG} = \sqrt{\Sigma_1\left((w_i)^2 * StdErr_i^2\right)}$$

[3] Technology groups with no standard errors were excluded from this calculation.

where

N = Net-to-Gross Value

i = Technology Group

w = Weight

- Then, the relative precision[4] for the program NTG value for energy was calculated and combined with the relative precision of the gross energy impact to yield an overall relative precision for the net energy impacts:

$$RP_{NTG\_Energy} = \frac{t_{\alpha=10} * StdErr}{NetMWH}$$

$$RP_{NetEnergy} = \sqrt{RP^2{}_{NTG\_Energy} + RP^2{}_{GrossEnergy}}$$

- Finally, the relative precision net demand impacts was calculated using a scaled version of the relative precision for the net energy impact. The sample sizes of the on-site audits and telephone surveys served as the scalars:

$$RP_{NetDemand} = RP_{NetEnergy} * \sqrt{\frac{N_{OnSite}}{N_{Telephone}}}$$

- Per-unit NTG relative precision's appearing in Table 6 (Items 1-5) were calculated in a similar fashion.

E. DATA INTERPRETATION AND APPLICATION

The program net-to-gross analysis was conducted based on a survey self-report analysis. For a detailed NTG analysis discussion, see *Appendix D.*

Self Report Method

The self-report method used to score free-ridership uses participant responses to survey questions regarding the timing of and reasons for equipment replacement actions. The complete text of the participant surveys may be found in *Survey Appendix S-1.* Questions used for the self-report analysis are summarized in *Appendix D.*

As described in *Appendix D,* a series of questions was posed to program participants. If the customer indicated that he had not been shopping for new refrigeration equipment before becoming aware of the program, he was scored initially as a net participant. A customer was then classified as a free-rider if he (1) stated that he would have installed high-efficiency refrigeration within the year and had already selected the refrigeraton equipment; and (2) stated that he would have purchased high-efficiency refrigeration equipment if the program had not existed.

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[4] The example shown is for the 90 percent confidence level. Relative precision was also calculated at the 80 percent confidence level.

The net-to-gross ratio using the self-report method relied only on free ridership and did not include any estimate of spillover.