Evaluation, Measurement and Verification Report for SBW Consulting Inc.'s 2002-03 Compressed Air Management Program

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Submitted to

The California Public Utilities Commission
Energy Analysis Division

Submitted by

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1 Executive Summary

Ridge & Associates, in association with the Draw Group and Equipoise Consulting Inc., evaluated the PY 2003-04 Compressed Air Management Program (CAMP). We begin with a brief description of CAMP, the methods used to evaluate CAMP's performance, and the results of our evaluation.

1.1 CAMP

The PY 2002-2003 CAMP provided a free measurement-based performance assessment of compressed air systems. The CAMP Program was designed to address several market barriers identified by the Compressed Air Challenge and SBW through the provision of information coupled with financial incentives.

The assessment provided specific recommendations to plant operators and SBW offered technical follow-up support to help motivate adoption of these recommendations. These recommendations showed plant operators how they can achieve and sustain large improvements in the efficiency of their compressed air systems through a combination of capital improvements and better operating and maintenance practices.

CAMP also offered a two-part financial incentive to participants. One incentive was designed to encourage customers to participate in the program by implementing the recommended efficiency improvements. CAMP provided a one-time incentive of two cents per annual kWh saved with a cap of 60 percent of the implementation costs. CAMP also offered an incentive to establish a three-year maintenance agreement to ensure a continuation of the savings in future years. The total Maintenance Incentive could not exceed 100 percent of the cost of the three-year maintenance program.

The goal for CAMP (2002-03) was to meet or exceed the target for verified gross savings of 12,218,451 kWh. Note that these goals were originally based on an overall target of 35 performance assessments. Through an agreement between SBW and the Energy Division of the California Utilities Commission, the goal of 35 performance assessments was reduced to 27, while keeping the original kWh and kW goals. Note that SBW defined a participant installer as a customer who received a performance assessment and management presentation and who subsequently installed at least some of the recommended measures. A participant non-installer was defined as a customer who received a performance assessment and management presentation but who did not install any of the recommended measures. A nonparticipant was defined as a customer who qualified for participation but who never agreed to have a performance assessment conducted.

As part of the implementation of CAMP, SBW conducted M&V activities that were consistent with options B and D of the International Performance Measurement and Verification Protocols (IPMVP). In the verification of savings, SBW's use of isolated end use metering (power and pressure for the affected compressed air system) was consistent with IPMVP option B. Annual *baseline* energy consumption for each participating CAMP site's compressed air system was determined from kW measurements taken before any changes were made to the system. The resulting data were processed using LogTool to identify typical daily kW profiles. If seasonal variations were known to exist, adjustments were made to the kW profiles to account for these variations based on information provided by site personnel. For each daytype, the modeler specified the number of such days expected to occur in a year.

Following project implementation, SBW again measured power draw (kW) for the affected system and determined the post-implementation demand profiles in the same manner as was used to establish the baseline demand profiles, i.e. by processing the measured data using LogTool. Because the energy-savings measures were highly interactive, it was not practical to quantify energy savings on a measure-by-measure basis. Therefore, if there were no significant post-installation changes to the air demands at the site, the analyst entered the post-implementation profiles into the CAMP database using "cut-and-paste". Savings were determined by taking the differences between the baseline and post-implementation profiles on an hour-by-hour basis.[1]

IPMVP Option D was used to estimate the initial savings that appeared in SBW's Assessment Reports. Once the baseline data from LogTool are entered into AIRMaster+, it was then used to estimate the *baseline* kWh and kW use. A *second* AirMaster+ case was then prepared that incorporated the recommended changes. The difference in kWh and kW represents the estimated gross impacts that are presented to the customer in the Assessment Report. SBW's use of a calibrated the AIRMaster+ model to model baseline energy use for impact for a full year and as a design simulation tool to estimate the post-installation energy use assuming all recommended measures were adopted is consistent with IPMVP option D.

1.2 Evaluation Methods

The evaluation consisted of a process evaluation and an impact evaluation. The process evaluation involved telephone interviews with 10 customers who qualified for the CAMP but who chose not to participate, a sample of participant installers who installed at least some of the recommended measures, and CAMP staff. Due to budget constraints the impact evaluation did not collect any additional metering and monitoring data beyond what SBW had collected in a manner consistent with the IPMVP. Rather, R&A conducted on-site inspections of a random sample of 11 of the 16 participant installer sites to verify installations, the adoption of maintenance programs, and pre- and post-installation conditions. We also reviewed the metering and monitoring data collected and the completed AIRMaster$^+$ mdb files submitted by SBW for each site. Using this information, we adjusted, either up or down, the savings reported by SBW. Final adjustments were made based on an agreed upon net-to-gross ratio of 0.80.

[1] In a few cases, there were significant changes in the post-installation period at the site that affected energy use, e.g., elimination of a compressor or the addition of a new shift. In these cases, the pre-metering data were adjusted on a case-by-case basis to reflect post-installation conditions. Once these adjustments were made, gross savings were estimated as the difference between the pre- and post-period energy use.

1.3 Results

Below are the key results of the process and impact evaluations.

1.3.1 Process Evaluation

- The marketing outreach effort represented a good faith effort to reach customers and inform them about the benefits of addressing compressed air issues.
- Participants were very satisfied with CAMP.
- CAMP appears to have had a moderate impact on the organizational practices barrier among participants by making energy efficiency a higher priority.
- While there is some evidence that objective third-party advice has reduced asymmetric information barrier among participants, nonparticipants still face this barrier with 80 percent stating that firms that offer energy efficiency services are tied to companies that are trying to sell them equipment.
- The information/search cost barrier, while appearing to be low among nonparticipants, may be understated. While over half of the participants stated they were aware of ways to reduce energy consumption, many were surprised at the cost of operating their compressed air systems. In addition, it appears that metered data provided by CAMP about the kW and kWh used by their compressed air systems were both new and useful.
- The Assessment Report and the Verification Report appear to have reduced somewhat any performance uncertainty participants might have had about savings.
- Those who work in the targeted market appear to be very busy and have little time for what they believe in many cases are sales calls.
- Most of the participants (64 percent) have not shared the benefits of making improvements to their compressed air systems with other colleagues in other businesses. Diffusion of information may be slow in this sector.
- There was no central theme as to why the participant installers chose not to adopt some of the recommended measures. Reasons given include safety, regulatory hassle, and the lack of technology needed for the upgrade.
- Eight of the 16 participants chose to participate in the maintenance agreement. The simplification of the maintenance agreement appears to be the main reason why these 50 percent chose to participate in the maintenance agreement.
- Regardless of whether a company signed the maintenance agreement, 86 percent indicated that they were implementing the O&M changes recommended by SBW, at least to some degree.

1.3.2 Impact Evaluation

The key results of the impact evaluation are:

- SBW met its goals of conducting 27 assessments at 26 participant sites for a total gross estimate of 15,545,619 kWh.
- However, for only 16 of these sites, representing 17 assessments, did SBW conduct a verification study. These 16 are referred to as participant installers. The remaining 10 sites are referred to as participant non-installers.

- The Evaluation Team was able to verify 100 percent of the savings claimed in the SBW Verification Reports for these 16 participant installers. Because the realization rate is 1.0, no adjustments were made to the SBW's estimates of kWh or kW impacts.
- The gross energy impact for these 16 participant installers is 5,280,000 kWh, which is 43 percent of the goal of 12,218,451 kWh and 56.3 percent of the savings in the assessment reports for these 16 participant installers.
- The gross demand impact is 625.9 kW.
- For 21 percent of the participants, there appears to be some spillover. However, spillover savings were not calculated and are not counted toward the CAMP goal.
- Using the net-to-gross ratio of 0.80, the net energy and demand impacts are 4,224,000 kWh and 500.7 kW.

1.3.3 Benefit/Cost Ratios

- Both the participant cost (PC) and the total resource cost (TRC) benefit/cost ratios were calculated. The PC ratio is 8.8 while the TRC ratio is 1.27.

1.3.4 Continuing Need for the Program

- Based on previous reports on compressed air potential and our analysis of participant and nonparticipant interview data, much cost-effective energy efficiency potential remains for compressed air systems in the industrial sector but significant market barriers persist.
- General uncertainty in the economy might have made both participants and nonparticipants reluctant to make any investments, even for measures with relatively short paybacks. Such market conditions and uncertainty require a continued effort to intervene in the marketplace to lower barriers and reduce first costs.

2 Introduction

In this report, Ridge & Associates, in association with the Draw Group and Equipoise Consulting Inc., will address each of the components of an EM&V plan that are listed in Table 6.1 of the Energy Efficiency Policy Manual (EEPM) prepared by the Energy Division of the California Public Utilities Commission (CPUC) in 2001. These are:

1. Energy Efficiency Measure Information
2. Evaluation Approach
3. Baseline Information
4. Measurement and Verification Approach

We begin with a brief description of the CAMP Program and the *energy efficiency measures and practices* it promotes. This is followed by a description of the *evaluation approach* in terms of the list of questions that were answered through our evaluation, which involved both process and impact components. We will also demonstrate how implementing these two evaluation components met the EM&V objectives of the CPUC listed in the EEPM. We go on to describe the process component, which provided on-going feedback to Program Implementers (PI). We next describe the impact component in which we consider the issues of *baseline information* and the *measurement and verification approach*. We treat both of these issues together since they are integral to the EM&V approach outlined in the IPMVP manual. In the impact section, we also describe the sample design and the method by which adjusted the savings estimated by the PI. Interwoven into the discussion of the impact and process components of our evaluation will be a discussion of the specific evaluation activities that we undertook.

2.1 The CAMP Program and Promoted Measures & Practices

The PY 2002-2003 CAMP provided a free measurement-based performance assessment of compressed air systems[2]. The assessment provided specific recommendations to plant operators and the PI offered technical follow-up support to help motivate adoption of these recommendations. These recommendations showed plant operators how they can achieve and sustain large improvements in the efficiency of their compressed air systems through a combination of capital improvements and better operating and maintenance practices. Below, we present the list of possible efficiency measures. As would be expected, the list of possible measures continues to grow and evolve as the program is implemented.

COMPRESSORS/SUPPLY SYSTEM

Operations & Maintenance

- Reduce system pressure
- Adjust cascading setpoints

[2] Compressed air is commonly used to operate equipment, position pneumatic and hydraulic devices, and pressurize, atomize, and agitate liquids.

- Reduce run time
- Replace inlet / in-line filter elements
- Improve heat rejection performance (clean heat exchangers, provide cooler cooling air/water)
- Perform comprehensive compressor maintenance

Capital Improvements

- Retrofit unloading controls
- Add heat recovery from compressors, aftercoolers, or refrigerated dryers
- Control compressors with an automatic sequencer
- Add primary receiver volume
- Replace filters for end uses with air quality requirements higher than the preponderance of end uses
- Install dedicated dryer and filters to serve end uses with low air quality requirements

DISTRIBUTUION SYSTEM

Operations & Maintenance

- Reduce air leaks
- Replace, repair, or clean inefficient, broken, or clogged condensate drains
- Valve off headers or lines feeding abandoned equipment
- Remove or reduce flow restrictions
- Eliminate inappropriate end uses

Capital Improvements

- Add secondary receiver w/metered inlet flow
- Improve end use efficiency

2.2 Rebates

CAMP offered a two-part financial incentive to participants. The incentive was designed to encourage customers to participate in the program by implementing the recommended efficiency improvements and establishing a three-year maintenance agreement to ensure a continuation of the savings in future years. Terms of the incentive were as follows:

1. **Implementation Incentive**: For recommended improvements (allowing for modifications made by the customer) that are installed by the customer within 120 calendar days of the presentation of the Assessment Report, CAMP will provide a one-time incentive of two cents per annual kWh saved. The total Implementation Incentive will be capped at 60 percent of the implementation costs. Both the annual savings and installed cost will be determined during savings verification.

2. **Maintenance Incentive**: If the customer commits to a three-year maintenance program within 30 calendar days from the date of the savings verification report, they would receive a one-time Maintenance Incentive of two cents per annual kWh saved. The total Maintenance Incentive cannot exceed 100 percent of the cost of the three-

year maintenance program. The annual savings will be determined by the PI during savings verification (Note: this is the same savings estimate used to determine the implementation incentive). This rebate was used to motivate the customer to take steps needed to ensure that savings persist.

2.3 Market Barriers

The CAMP Program is designed to address several market barriers identified by the Compressed Air Challenge and SBW. These are:

- Information/Search Costs
- Performance Uncertainty
- Organizational Practices
- Asymmetric Information

Each is discussed below.

2.3.1 Information/Search Costs & Performance Uncertainty

One major barrier is the cost of identifying energy efficient products. In addition, plant managers are skeptical about unfamiliar energy services and do not readily accept unproven concepts. Further, these market actors are not sure if the innovative concepts will either work or perform as claimed.

> *Plant managers lack reliable data on costs and benefits of possible improvements to the compressed air system.*

It is hypothesized that providing plant managers with savings estimates based on measurements of power and pressure and including AIRMaster$^+$ analysis by qualified engineers will reduce these market barriers.

2.3.2 Organizational Practices

Within organizations, certain kinds of behavior or systems of practices discourage or inhibit cost-effective energy efficiency decisions.

> *Plant managers do not know how much they are spending on compressed air and thus do not see it as a major target of cost control.*

> *Plant managers and their operation staff do not understand how their compressed air systems work.*

> *Plant managers give compressed air a low priority because they think of it as a utility and not as a primary production system.*

> *Plant managers do not have adequate maintenance programs for their compressed air systems.*

It is hypothesized that providing assessments on compressed air systems will significantly reduce this barrier.

2.3.3 Asymmetric Information

When shopping for new equipment, customers find it difficult to evaluate the veracity, reliability, and applicability of claims made by sales personnel. Sellers of energy efficient products typically have more and better information about their offering than do consumers and sellers can have an incentive to provide misleading information.

> *Plant managers do not trust energy efficiency advice provided by compressed air equipment venders because of a perceived conflict of interest.*

It is hypothesized providing objective third-party advice will reduce this barrier.

2.4 CAMP Performance Goals

The goal for CAMP (2002-03) was to meet or exceed the target for verified gross savings shown in the last column of Table 2-1.

Table 2-1
CAMP Performance Targets

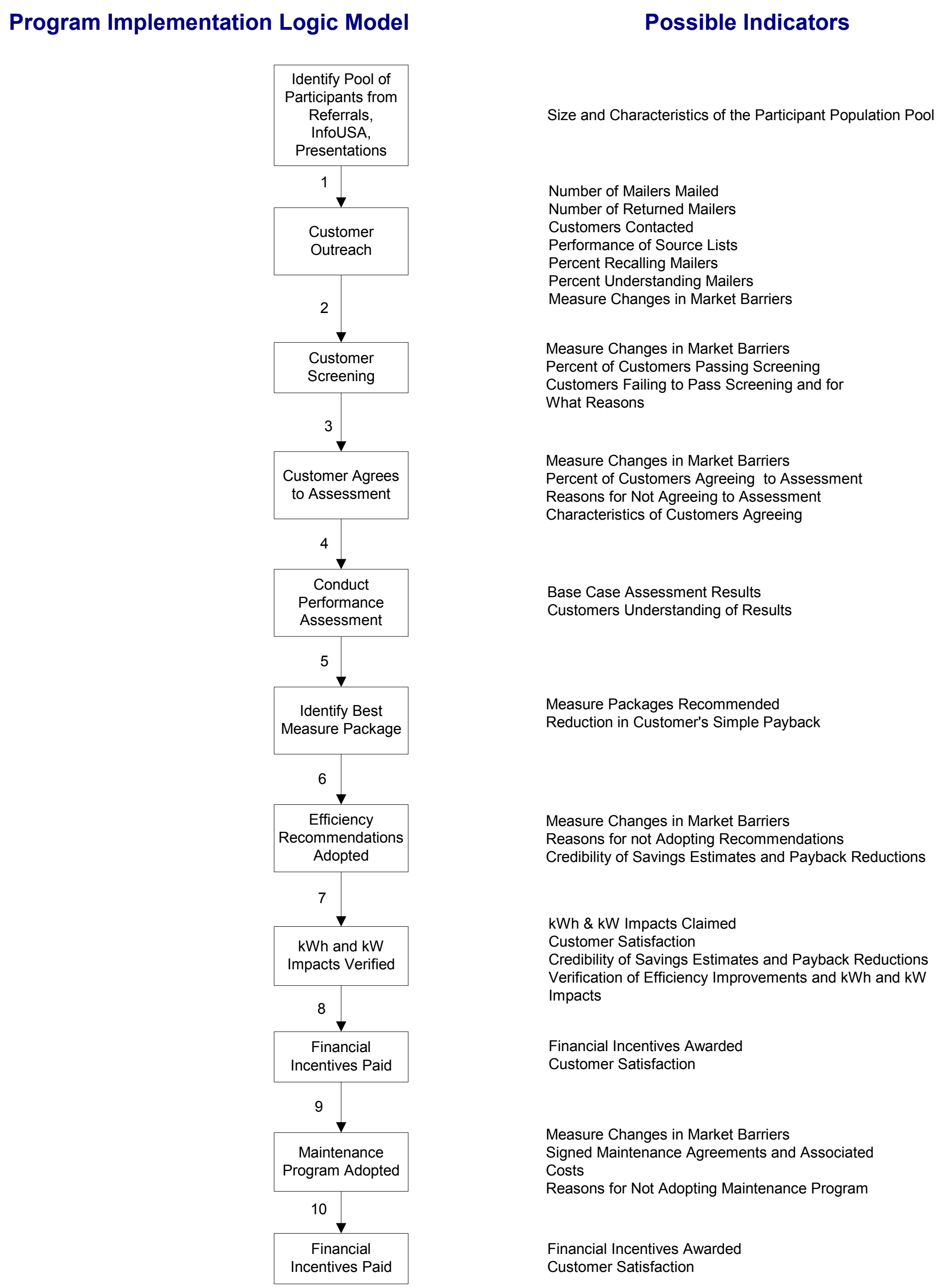
Quarter	Target for Customer Participation Agreements	Target for Completed Performance Assessments	Target for Savings Verification Reports Completed	Target for Verified Gross Savings (kWh)
Q2 2002 (Apr - Jun)				
Q3 2002 (Jul - Sep)	8			
Q4 2002 (Oct - Dec)	12	8		
Q1 2003 (Jan - Mar)	12	11		
Q2 2003 (Apr - Jun)	3	12	5	1,745,493
Q3 2003 (Jul - Sep)		4	10	3,490,986
Q4 2003 (Oct - Dec)			10	3,490,986
Q1 2004 (Jan - Mar)			10	3,490,986
Total	35	35	35	12,218,451

Note that these goals were originally based on an overall target of 35 performance assessments. Through an agreement between SBW and the Energy Division, the goal of 35 performance assessments was reduced to 27, while keeping the original kWh and kW goals. Also note that SBW defined a participant installer as a customer who received a performance assessment and management presentation and who subsequently installed at least some of the recommended measures. A participant non-installer was defined as a customer who received a performance assessment and management presentation but who did not install any of the recommended measures. A nonparticipant was defined as a customer who qualified for participation but who never agreed to have a performance assessment conducted.

2.5 Logic Model

Below in Figure 2-1 we present our understanding of the program implementation logic and possible indicators associated with each stage of implementation. The first task in this evaluation was to finalize this logic model and the associated indicators that our evaluation focused upon.

Figure 2-1
Program Logic Model



2.6 EM&V Objectives

In this section, we list the eight EM&V objectives set forth in the EEPM.

1. Measuring level of energy and peak demand savings achieved (except-information-only)
2. Measuring cost-effectiveness (except information-only)
3. Providing up-front market assessments and baseline analysis, especially for new programs
4. Providing ongoing feedback, and corrective and constructive guidance regarding the implementation of programs
5. Measuring indicators of the effectiveness of specific programs, including testing of the assumptions that underlie the program theory and approach
6. Assessing the overall levels of performance and success of programs
7. Informing decisions regarding compensation and final payments (except information-only)
8. Helping to assess whether there is a continuing need for the program.

In Table 2-2, one can see that all of the eight evaluation objectives are addressed by the process and impact evaluation components. Some of the evaluation objectives (5, 6, & 8) were addressed by both the process and impact evaluations.

Table 2-2
Evaluation Objectives Addressed by Process and Impact Evaluations

	Evaluation Objectives							
Evaluation Component	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Process Evaluation				X	X	X		X
Process & Impact Evaluation	X	X	X				X	
Impact Evaluation					X	X		X

In the following Methods Section, we describe the components of our evaluation and how the process and impact evaluations were designed to achieve these eight EM&V objectives.

3 Methods

In this section, we address each of the components of the EM&V plan that are listed in Table 6.1 of the Energy Efficiency Policy Manual. We first discuss the *process* evaluation followed by a discussion of the *impact* evaluation.

3.1 Process Evaluation

The process evaluation was conducted throughout the program period and consisted of the following elements:

1. An examination of the entire program delivery process to determine whether there were any significant deviations from the original program design. Any such deviations were documented along with their motivations. This effort involved in-depth interviews with three SBW staff.

2. In-depth telephone interviews with a random sample of 10 decision makers who were determined to be qualified for the CAMP, but declined to participate. We attempted to assess the barriers to their participation and whether these barriers are among those targeted by SBW.

3. In-depth interviews with 14 of 16 participant decision makers (representing 17 assessments) to determine why and how they decided to join the program. They were also asked questions regarding program satisfaction, the effect of the program on reducing their perception of market barriers, ideas for improvement in the program's services and procedures, the relative importance of information vs. incentives in getting the customer to participate, and the likely persistence of the maintenance contract. Note that one additional customer was interviewed for whom an Assessment Report was done but who failed to implement any of the recommendations.

As data was collected for the first two points, feedback was provided to SBW in order to provide corrective and constructive guidance regarding the implementation of the program. Responses from the participant survey are included in this report.

3.2 Impact Evaluation

We begin with a description of SBW's impact methods that are used as part of its service delivery, followed by a description of Evaluation Team's impact methods.

3.2.1 The SBW Impact Methods

In this section, we describe the methods used to estimate the initial estimate of savings that are provided to the customer in the Assessment Report. Next, we describe the methods used to verify the achieved savings that are presented to the customer in the Verification Report.

3.2.1.1 Savings Assessment Methods

A summary of the baseline measurement methods, taken from the CAMP *Performance Assessment Best Practice Guide,* is provided below:

> **Establish Measurement Plan**
> Establish a plan for measuring power and pressure at appropriate points in the compressed air system. At a minimum, true power for each of the compressors and system supply pressure downstream of dryers, filters etc., i.e. at the point of delivery to the plant, must be measured. In addition, tone must identify other points in the system where pressure trends or spot pressure measurements will be needed, such as at a point furthest from compressors or in areas of known pressure problems. Determine where the data loggers will be located and assign measurement points to associated data logger channels.
>
> **Set Up Monitoring Equipment and Collect Three-Second Data**
> Set up the monitoring equipment according to the plan. Plant staff must make all connections with the electric panels. Data loggers must be configured to collect data every 3 seconds. Measurements at 3-second intervals can uncover changes in the compressed air system that occurs very quickly. This data will also reveal the relationship between pressure and power, which will be useful when modeling system performance in AIRMaster+.
>
> After the short-term measurement interval has passed, download the data, check it again, and if it appears acceptable, the data loggers can be reconfigured for long-term measurements.
>
> **Spot Pressure Measurements**
> Configure a data logger with one pressure sensor so that it can be used to take spot measurements throughout the plant. These spot measurements are used to identify areas where large pressure drops occur and to determine the pressure requirements at important end uses.
>
> **Long-term, 1-Minute Interval Data Collection**
> Set the data loggers to collect data once each minute over a period long enough to define typical daily and weekly profiles. This period should include times when plant air demand is at its lowest, such as on a weekend, on a third shift, or overnight in one- or two-shift operations. In most cases, 7 to 10 days of data collection will be sufficient. This information is used to determine typical daily power profiles for the compressors, which is subsequently used as input to AIRMaster+ to describe compressor performance.

All data collected were then processed using LogTool. LogTool is a MS Excel 2000 based application that processes data collected by AEC MicroDataLoggers and supports diagnostic and daytype profile analysis of these data. Diagnostic time-series plots with two Y-axes (pressure and power) can be then prepared. Daytype plots are also supported. These are used to group days that have similar profiles of system power consumption (all compressor kW readings for each system are automatically added to create the system total). Once days are assigned, LogTool generates a 24-hour profile table that can be pasted into AIRMaster+ (adjustments in Excel to reflect seasonal changes in operating profiles may be required prior to their use in AIRMaster+). LogTool diagnostic plots were used to understand control sequences and identify possible performance problems.

AIRMaster+ is a public-domain software program that analyzes compressor and compressor system efficiency[3]. It is designed for utility auditors, industrial plant energy coordinators, and consulting engineers. AIRMaster+ is used to identify inefficient or oversized compressors and compute the energy and demand savings associated with selection of a replacement energy-efficient model. AIRMaster+ contains six modules for entering information about the facility and its existing compressed air systems. The main information in each module is as follows:

1. **Company**: Name, address, and contact information for the company.
2. **Utility**: Electric energy and demand rate schedules, by season if appropriate. This section provides the program with information needed to estimate the energy cost of the system and energy cost savings. This information is sufficient for the purpose of screening efficiency measures. However, more accurate calculation of energy cost savings is required for the final recommendations and can be achieved using the Time-of-Use Electricity Cost Calculator described in Appendix L of the AIRMaster$^+$ documentation.
3. **Facility**: Contact information and utility rate schedules for the facility.
4. **System**: Compressed air system capacities, pressures, and daytypes[4].
5. **Compressor**: Ratings, control types, actual performance points, and other details for each unit.
6. **Profile**: Average hourly compressor loads for each daytype.

Once the baseline data from LogTool are entered into AIRMaster+, it was then used to estimate the *baseline* kWh and kW use. A *second* AirMaster+ case was then prepared that incorporated the recommended changes. The difference in kWh and kW represents the estimated gross impacts that are presented to the customer in the Assessment Report. SBW's use of a calibrated the AIRMaster+ model to model baseline energy use for impact for a full year and as a design simulation tool to estimate the post-installation

[3] Copies of the latest AIRMaster+ software can be ordered via e-mail from Clearinghouse@ee.doe.gov or by calling the Clearinghouse at 800-862-2086.

[4] A daytype is a group of days, defined by day of the week, or season during which there is a consistent pattern of compressor operation. For example if a plant operates 2 shifts, five week days per week throughout the year, two daytypes would be defined: one for weekend days and one for weekdays.

energy use assuming all recommended measures were adopted is consistent with IPMVP option D.

3.2.1.2 Savings Verification Methods

In this section, we describe the SBW M&V methods that were used to *verify* annual kWh saved. SBW believes, and Evaluation Team agrees, that SBW's M&V methods are consistent with the requirements of IPMVP. After installation and commissioning, the same data collection procedures used to establish the baseline are used again. When all the energy-related impacts on the system following the Assessment can reasonably be attributed to CAMP (i.e. efficiency-related changes), it was only necessary to determine the hourly kW profiles in LogTool, enter the results into the verification database as the "as-built" condition, and extrapolate these savings to a full year in a way that takes seasonality and various day types into account. *There was no need to perform any further AIRMaster+ modeling because the impacts of the changes will all be reflected in the verification data and the contributions of individual measures cannot be disaggregated.*[5] SBW's isolated end use metering (power and pressure for the affected compressed air system) to establish the baseline and post-installation energy use is consistent with IPMVP option B. In Option B, savings are determined by field measurement of the energy use of the systems to which the energy conservation measure was applied, separate from the energy use of the rest of the facility. Short-term or continuous measurements are taken throughout the pre- and post-retrofit periods. Savings are then calculated using engineering calculations. In some cases, there were significant changes in the post-installation period at the site that affected energy use, e.g., elimination of a compressor or the addition of a new shift. In these cases, the pre-metering data were adjusted on a case-by-case basis to reflect post-installation conditions. Once these adjustments were made, gross savings were estimated as the difference between the pre- and post-period energy use.

3.2.2 The Evaluation Team Impact Methods

Given the available budget for this evaluation, and the fact that there are important process questions as well as impact questions that must be addressed, the Evaluation Team was unable to collect any additional metering and monitoring data beyond what SBW has collected in a manner consistent with the IPMVP. Rather, we conducted on-site inspections of a random sample of sites to verify installations, the adoption of maintenance programs, and pre- and post- installation conditions and to review metering

[5] For one of the earliest sites, SBW used a different approach to verify savings. The baseline was modeled as described in Section 3.2.1.1. However, the post-installation was handled differently. The pre and post measurements of compressed air system power and pressure were combined with the use of the AIRMaster+ model to estimate and then verify savings. Using the post-installation performance data, including 1-minute data logging for seven to ten days, SBW modified the AIRMaster+ model that was used to estimate savings for the recommended package of measures to reflect the as-implemented characteristics of the measures. The modified model was calibrated when it contains realistic data on the implemented measures and closely predicts the measured consumption of the system. The modified model was then used to estimate actual savings from the improvements. Because this approach was far more complex and labor intensive that originally envisioned, it was replaced by more straightforward calculations using the LogTool data within an Excel spreadsheet.

and monitoring data collected as well as the completed AIRMaster+ mdb files submitted by SBW for each site. Using this information, we adjusted, either up or down, the savings reported by SBW.

We describe below in greater detail Evaluation Team's on-site inspection and engineering review procedures.

3.2.2.1 On-site Inspections

Once installations were completed, we conducted an inspection of 11 sites and their compressed air systems accompanied by appropriate plant staff, so that we could verify that the measure package was adopted. During the on-site inspections, we:

1. Reviewed program documentation and interviewed appropriate plant staff so that we could verify baseline and post-installation plant conditions
2. Used block diagrams supplied by SBW to verify the placement of all monitoring equipment installed by SBW.
3. Identified any issues that may relate to air quality, compressor reliability, or energy concerns that may affect SBW-estimated savings
4. Noted feasibility of locations picked by SBW for logging and sample rates used.

More specifically, the on-site inspections involved an investigation of the following:

1) By reviewing program documentation and interviewing appropriate plant staff, verified baseline and post-installation plant conditions.
   a) Used in conjunction with SBW supplied Block Diagram of the facility
      i) Arranged for the appropriate plant personnel to provide a guided tour of the facility.
      ii) Developed a general understanding of the compressed air system and how it fits into overall plant operations – how the compressed air is used to support production.
      iii) Observed:
         (1) Inappropriate air use
         (2) Point of use connections
         (3) High volume intermittent demands
   b) Visited sites when post installation/commissioning metering and monitoring equipment were in place so that placement of the equipment can be identified and reviewed.

2) Using block diagrams supplied by SBW verified the placement of all monitoring equipment installed by SBW.
   a) Identified that true power is measured on all the compressors in the system.
   b) Identified where pressure measurements are being taken in the supply side.

c) Identified other areas in the system where a pressure measurement might be taken.

3) Identified any issues that may relate to air quality, compressor reliability, or energy concerns that may affect SBW-estimated savings.
   a) Observed items such as:
      i) Human error
      ii) Connection to the system
      iii) Ambient conditions
      iv) Maintenance issues

4) Noted feasibility of locations picked by SBW for logging and sample rates used.
   a) Measurements at 3-second intervals can uncover changes in the compressed air system that occurs very quickly.
      i) Observed if any spot pressure measurements were sampled incorrectly.
      ii) This was based on Nyquist Theorem of at least 3 data points for the shortest event being measured.

On-site data collection instruments, prepared in order to standardize data collection, were be used in conjunction with SBW-supplied block diagrams during on-site inspections.

We attempted to visit sites when post installation/commissioning metering and monitoring equipment were in place so that placement of the equipment could be identified and reviewed. However, only two trips to the PG&E service territory were planned for conducting on-sites. For each visit, 5 to 6 on-sites were conducted. Because SBW maintains only a limited amount of metering and monitoring equipment, and the different sites may be in different stages of participation, we were not be able to inspect the metering and monitoring equipment in more than one or two sites per trip. We attempted to coordinate closely with SBW to make sure that the scheduling of these trips was efficient and productive.

Data collection instruments for recording all on-site observations are in Appendix C.

3.2.2.2 Engineering Review

For each of the sites visited, we reviewed the completed AIRMaster$^+$ mdb files submitted by SBW. For each of the six AIRMaster$^+$ modules we reviewed the information entered by SBW. For each site, we:

1. Verified that all information has been correctly input into AIRMaster+ files
2. Examined the installed EEM's (energy efficiency measures), which were analyzed using AIRMaster+, and verified their feasibility
3. Compared Evaluation Team AIRMaster+ results to SBW's AIRMaster+ findings

Specifically, the engineering review involved an investigation of the following:

1) For each of the sites visited, we reviewed the completed AIRMaster+ mdb files submitted by SBW.
   a) For each of the six AIRMaster+ modules we reviewed the information entered by SBW.
      i) Verified that all information had been correctly input into AIRMaster+ files
         (1) <u>Company</u>
            (a) Verified company information.
         (2) <u>Utility</u>
            (a) Verified utility company data or rate schedules
         (3) <u>Facility</u>
            (a) Reviewed facility data, facility utility rate assignment, and a summary of the air compressors on site for the selected company.
         (4) <u>System</u>
            (a) Verified system-level information, including design and performance parameters, automatic sequencer control pressure set points, daytypes, and end uses.
         (5) <u>Compressor</u>
            (a) Verified air compressor information, including detailed specifications.
         (6) <u>Profile</u>
            (a) Reviewed hourly average airflow or power information and operating schedules.
            (b) Verified system baseline airflow requirements and associated energy and demand costs for the selected system and daytype.

2) Examined the possible EEM's (energy efficiency measures), which were analyzed using AIRMaster+, and verified their feasibility.
   a) Evaluated air system energy savings potential from the selected Energy Efficiency Measures, considering interactive effects of EEMs:
         (1) Reduce Air Leaks
         (2) Improve End Use Efficiency
         (3) Reduce System Air Pressure
         (4) Use Unloading Controls
         (5) Adjust Cascading Set Points
         (6) Use Automatic Sequencer
         (7) Reduce Run Time
         (8) Add Primary Receiver Volume

For each site, we provided a mini-case study describing each site, the results of the on-site visits and the engineering reviews, and recommended kWh and kW impacts. Data collection instruments for recording all observations regarding SBW's documentation and use of AIRMaster+ are in Appendix D.

3.2.2.3 Review of LogTool Data

The Evaluation Team reviewed the LogTool files for each of the 11 sites in our sample. The objectives of this review were to verify that the calculations of savings for each site were correct and the savings estimates were correctly entered into the Verification Reports. Recall that SBW estimated the savings by taking the differences between the baseline and as-built profiles on an hour-by-hour basis. The hourly demand reductions were summed for each daytype and extrapolated to a full year according to the number of occurrences of each daytype in a year.

For our analysis of each site, SBW supplied the hourly kW demand for each day type and the number of hours per year for each day type. Using these data we estimated the energy savings and compared these savings to those published in the Verification Reports.

3.2.2.4 Adjustments

Based on these engineering reviews and site visits, any necessary adjustments were made to SBW's estimates of kWh and kW impacts. The method used to adjust SBW's estimates involved the ratio approach (Cochran, 1977). The equation below illustrates how the ratio approach was used to adjust the savings for the population of projects based on the on-site inspections and engineering reviews of randomly sampled projects.

$$\hat{Y}_R = \frac{\bar{y}}{\bar{x}} X \qquad (1)$$

where

$\hat{Y}_R$ = Ratio estimate of total kWh and kW in the population of sites

X = Total kWh and kW impacts for population of projects estimated by SBW

$\bar{x}$ = Sample mean kWh and kW impacts estimated by SBW

$\bar{y}$ = Sample mean kWh and kW impacts estimated by R&A

From Equation 1, we can see that the total adjusted kWh and kW impacts for the population of CAMP projects, *X*, is adjusted using the ratio of the mean kWh and kW impacts for the sampled sites estimated by R&A to the mean kWh and kW impacts estimated by SBW.

An estimated ratio of 1.0 indicates that the Evaluation Team's estimate of savings is identical to SBW's estimate of savings. Our null hypothesis is that the difference between the R&A-estimated realization rate and 1.0 is not statistically significant at the 90 percent confidence level. If it is not, then no adjustment will be made to the SBW savings claim. If it is, then the SBW savings will be adjusted using the estimated realization rate.

The plan was to test this hypothesis using the following equation:

$$t = \frac{\hat{R} - 1.0}{\sqrt{c_{\overline{yy}} + c_{\overline{xx}} + -zc_{\overline{yx}}}} \qquad (2)$$

where

$$c_{\overline{yy}} = \frac{N-n}{Nn}\frac{s_y^2}{\overline{y}^2} \qquad (3)$$

is the square of the estimated coefficient of variation of $\overline{y}$ with analogous definitions of $c_{\overline{xx}}$ and $c_{\overline{yx}}$ and z is the normal deviate corresponding to the 90 percent level of confidence (1.645)

A value of *t (two-tailed test)* that is 1.81 (degrees of freedom=10) or greater indicates that the difference is statistically significant at the 90 percent level of confidence. Final adjustments were made based on an agree-upon net-to-gross ratio of 0.80.

3.2.3 Sample Design

The sample sizes for on-sites, participant interviews, and non-participant interviews are discussed in this section.

3.2.3.1 On-Sites

The sample size for on-site and engineering review was driven both by the size of the evaluation budget and the need for reasonable statistical confidence and precision. The initial sample size of 13 was determined, using the equation below, was to meet these two criteria.

$$n = \frac{z^2 \times N \times (V_x^2 + V_y^2 - 2\rho_{xy} \times V_x V_y)}{z^2 \times (V_x^2 \times V_y^2 - 2\rho_{xy} \times V_x V_y) + (N-1)\varepsilon^2} \qquad (4)$$

where

z= the standard normal deviate for the given confidence level, specified as 1.645 for the 90 percent confidence

N= the population of projects

V_x^2= the square of the coefficient of variation for x defined as $\frac{[(N-1)/N]s_x^2}{\hat{\bar{x}}^2}$ where s_x^2 is the variance of x and $\hat{\bar{x}}^2$ is the square of the estimated mean of x

V_y^2= the square of the coefficient of variation for y defined as

$\frac{[(N-1)/N]s_y^2}{\hat{\bar{y}}^2}$ where s_y^2 is the variance of y and $\hat{\bar{y}}^2$ is the square of the estimated mean of y

ρ_{xy} = assumed simple correlation between x and y (assumed to be 0.80)

ε^2 = the square of allowable relative error in the estimate of the ratio (0.15)

Note that, because a specific compressed air evaluation study in which realization rates were calculated could not be identified, we assumed a coefficient of variation of 0.70.

The original sample size of 13 was driven at least in part by the expectation that there would be 35 participating sites. Because the number of participant installer sites was 16, a sample of 11 sites was sufficient to meet the targeted confidence level of 90 percent with an allowable relative error of 15 percent (Levy and Lemeshow, 1999). Also, because the participation of the sites took place over time and the on-site visits conducted by the Evaluation Team had to be conducted soon after the installation/commissioning phase, we could not wait until the full list of participating sites was available. Thus, we were forced to use the first 11 sites available. It is assumed that there are no systematic differences between the first eleven sites and the remaining 5 sites. As a result, we were able to apply the realization rate based on the first 11 sites to the remaining 5 sites. All 11 sites contacted agreed to an onsite inspection.

3.2.3.2 Participant Installer Survey

In-depth interviews were attempted with all 16 participant installers who installed at least some of the recommended equipment. E-mails were sent to each of the contacts for whom we had email addresses alerting that we would be calling to conduct a telephone interview. We were able to complete interviews with 14 of the 16 participant installers. Two participants were called three times, at different days and times of the day, with messages left. However, we received no response. The final disposition of the sample is presented in Table 3-1.

Table 3-1
Participant Survey Disposition

Disposition	N	%
Completed	14	88%
Unable to reach	2	13%
Total	16	

The two participants we were unable to reach had large ex post impacts, but were not the largest of all the participants. These two sites covered 15% of the ex post impact. Tables of all participant survey responses are presented in Appendix B.

3.2.3.3 Nonparticipant Survey

For nonparticipants who were deemed qualified but who chose not to participate, we conducted in-depth interviews with 10. Over three days in June, 2003, the Evaluation Team conducted telephone interviews that focused on reasons for not participating as well as firmographics and basic information about existing compressed air plant equipment. This sample size provided estimates at the 80 percent level of confidence with an error of plus or minus 20 percent. Tables of all nonparticipant survey responses are presented in Appendix A.

Next, we discuss the disposition of the sample. There were 95 unique DUNS numbers (called a site within this document) with "not interested" as their final disposition in the database provided by SBW. We looked through the comment field on each site and removed 12 based on the comments. Seventy-three sites were in the population slated for calls. All sites were called at least once and a maximum of three calls per site was. The final disposition is shown below in Table 3-2.

As seen in the Table 3-2, there were another 14 sites that were deemed to be ineligible and dropped prior to any calls. These were considered ineligible for various reasons, among them that it was indicated that the site had had work performed already.

Table 3-2
Final Disposition of Non-Participant Telephone Survey

Disposition	N
COMPLETE	10
Schedule Call Back	0
Refuses to do Survey	2
Not in Service	0
Eligible Respondent Not Available	8
Call Back Later	1
Answering Machine	26
Fax Machine	0
No Answer	3
Busy	2
Ineligible	14
Other	7
Total	73

3.3 Benefit/Cost Calculations

Two benefit/cost ratios were calculated, the Total Resource Cost (TRC) Test and the Participant Cost (PC) Test. The calculations were done using the SBW fourth quarter reporting spreadsheet, *SBWConsultingInc_9702_Q4_2004.xls*. SBW input information regarding administration cost, participant costs, the default net-to-gross ratio of 0.80, and the number of units (i.e., performance assessments). SBW then passed the spreadsheet to the Evaluation Team who incorporated its final estimates of gross and net kWh and kW impacts, allowing the calculation of the final TRC test and PC test results. This spreadsheet was then returned to SBW and included as part of its final report to the CPUC.

The TRC measures the net costs of a demand-side management program as a resource option based on the total costs of the program, including both the participants' and the utility's costs. The benefits calculated in the TRC are the avoided supply costs, the reduction in transmission, distribution, generation, and capacity costs valued at marginal cost for the periods when there is a load reduction. The avoided supply costs is calculated using net program savings, savings net of changes in energy use that would have happened in the absence of the program.

The costs in this test are the program costs paid by both the administrator and the participants. Thus, all equipment costs, installation, operation and maintenance, cost of removal (less salvage value), and administration costs, no matter who pays for them, are included in this test.

Equations 5 and 6 were used to calculate the CAMP benefits and costs, respectively.

$$BTRC = \sum_{t=1}^{N} \frac{UAC_t}{(1+d)^{t-1}} \qquad (5)$$

$$CTRC = \sum_{t=1}^{N} \frac{PRC_t + PCN_t}{(1+d)^{t-1}} \qquad (6)$$

where
CTRC = Costs of the program
PRCt = Program Administrator program costs in year t
PCN = Net Participant Costs
BTRC = Benefits of the program
UACt = Utility avoided supply costs in year t
d = discount rate

In the PC, the benefits of participation in a demand-side program include the reduction in the customer's utility bill(s), any incentive paid by the utility or other third parties, and any federal, state, or local tax credit received. The reductions to the utility bill(s) are calculated using the actual retail rates that would have been charged for the energy service provided (electric demand or energy or gas). Savings estimates are based on *gross* savings, as opposed to net energy savings[6].

The costs to a customer of program participation are all out-of-pocket expenses incurred as a result of participating in a program, plus any increases in the customer's utility bill(s). The out-of-pocket expenses include the cost of any equipment or materials purchased, including sales tax and installation; any ongoing operation and maintenance costs; any removal costs (less salvage value); and the value of the customer's time in arranging for the installation of the measure, if significant. Equations 7 and 8 were used to calculate the CAMP benefits and costs, respectively.

$$B_p = \sum_{t=1}^{N} \frac{BR_t + INC_t}{(1+d)^{t-1}} \qquad (7)$$

$$C_p = \sum_{t=1}^{N} \frac{PC_t}{(1+d)^{t-1}} \qquad (8)$$

where

B_p = Benefit to participants
BR_t = Bill reductions for participant in year t
INC_t = Incentives paid to participant in year t
C_p = Costs to participants
PC_t = Participant costs in year t
d = discount rate

Once the kWh and kW impacts were estimated by the Evaluation Team for the entire CAMP Program, we recalculated the TRC and the PC. A net-to-gross ratio of 0.8 has been used, consistent with the value given by the policy manual for all other non-residential programs. An Effective Useful Life (EUL) of 5 years has been used.

This task met evaluation objective #2.

[6] Gross energy savings are considered to be the savings in energy and demand seen by the participant at the meter. These are the appropriate program impacts to calculate bill reductions for the Participant Test. Net savings are assumed to be the savings that are attributable to the program. That is, net savings are gross savings minus those changes in energy use and demand that would have happened even in the absence of the program.

4 Results

4.1 Process Evaluation

The process evaluation addressed a number of important issues including:

- marketing outreach and customer recruitment,
- deviations from original program design,
- interviews with nonparticipants whom SBW deemed as qualified for the CAMP, but who did not participate, and
- interviews with participants.

4.1.1 Marketing Outreach and Customer Recruitment

Marketing outreach and customer recruitment included a variety of methods to reach and attempt to recruit customers:

- CAMP brochures distributed to trade allies
- direct mailers
- direct telephone marketing
- as part of the direct telephone marketing campaign, e-mailed and faxed SBW statement of qualifications to customers
- distributed SBW statement of qualifications to trade allies

Table 4-1 presents a summary of the SBW marketing outreach effort.

Table 4-1
Summary of Marketing Outreach Effort

Outreach Effort	Total Counts
Brochures Produced	1,535
CAMP brochures distributed to trade allies	800
Direct Telephone Marketing Calls	1,685
SBW Qualifications Produced	585
E-mailed and faxed SBW statement of qualifications	440
Distributed via trade allies	122
Sites Visited for Recruitment	50

This marketing outreach effort was both thoughtful and considerable and represents a good faith effort to reach customers and inform them about the benefits of addressing compressed air issues.

4.1.2 Deviations from Original Program Design

Perhaps the most important deviation from the original plan was the fact the effort to recruit participants was far greater than anticipated. The original assumption was that it would require approximately $1,500 to recruit each participant. However, the actual costs were approximately $10,000, nearly 7 times the original amount. That SBW was a new player in a tough market where significant market barriers exists explains much of this increased cost.

Another important deviation from the original program design was a significant modification of the original maintenance agreement. Originally SBW required that customers enter into a three-year maintenance program for the compressed air system that had energy efficiency measures installed. The maintenance program had to include at a minimum, the maintenance recommendations made by SBW in the Assessment Report. SBW furnished the participant with a list of qualified service providers. To be eligible to receive the maintenance incentive, a qualified service provider must supervise the maintenance program. Proof of the participant's commitment to the three-year maintenance program had to be provided to SBW within 30 calendar days of the date of the Assessment Report.

To make sure that there were a sufficient number of qualified service providers, SBW conducted two classes both in Stockton California. The first class, with six trainees, was Compressed Air Challenge (CAC) Level 2, which is a prerequisite for the CAC AIRMaster Specialist class. It was held October 16-17, 2002. The second class, with 13 trainees was the CAC AIRMaster Specialist class, held October 29-31. Materials used in these classes were provided by CAC. Each student received from CAC a class workbook containing all the required instructional materials. To become a CAC certified AIRMaster Specialist, a student was required to pass a rigorous written and practical exam given as part of the AIRMaster Specialist class. These tests were graded by CAC.

By early spring of 2004, it became clear that this requirement was a significant hurdle to participation. In response, SBW simplified the maintenance agreement. They issued a letter to participants, which stated:

> The maintenance incentive is still based entirely on the verified annual energy savings that your company achieved by implementing the recent CAMP recommendations. However, it is <u>no longer required that the compressed air system maintenance activities be performed under the guidance of a Qualified Service Provider</u>.
>
> Instead, SBW requires only that a responsible representative of your company affirm your ongoing commitment to conduct a high standard of maintenance on the affected compressed air system by signing the attached Letter of Agreement. The Letter of Agreement provides assurance to SBW that, to the best of your abilities:

1. Your company intends to apply the incentive funds to maintenance on the affected system,
2. The maintenance activities will continue for a period of at least three years, and
3. The maintenance activities will conform to the recommendations in the CAMP Maintenance Recommendations Report.

SBW continues to rely on your good faith efforts to comply with the program standards. There are no follow-up inspections, nor will there be any penalties associated with your participation in the Maintenance Program.

If, after reading the Letter of Agreement you would like to receive your maintenance incentive, sign and return the attached Letter of Agreement so it is received by SBW no later than October 20, 2004. The incentive amount to which your company is entitled is identified in the attached Letter of Agreement. Please contact the SBW engineer for your project if you have any questions about the amount of your maintenance incentive.

The customer was then asked to sign a letter a agreement that formally recognized the modification of the CAMP Participation Agreement by eliminating the requirements to provide "proof of commitment to a 3-year maintenance program", and that the compressed air system maintenance "will be supervised by a CAMP-qualified maintenance provider", in order to qualify for the maintenance incentive. The letter also notified the customer of the dollar amount of the CAMP maintenance incentive. To receive the CAMP Maintenance Incentive, the participant had to agree to the following:

- to make a good faith effort to apply any CAMP maintenance incentive monies received toward the care and maintenance of the compressed air system improved upon by the implemented measures in the CAMP Verification of Savings Report.

- to make a good faith effort to maintain the compressed air system enhanced by the measures in the CAMP Verification of Savings Report in the present, improved condition for a period of at least three years.

- to make a good faith effort to comply with the maintenance recommendations and service frequencies provided in the Maintenance Practices Schedule, taken from the CAMP Maintenance Recommendations Report (MRR) developed specifically for the Participant's site.

- if compressed air system maintenance services are provided by outside contractors, to make a good faith effort to have services provided by said contractors comply with the CAMP MRR developed specifically for the Participant's site. (As an affirmation of this compliance, the Participant was requested to have the contractor provide documentation to SBW indicating they are cognizant of the requirements of the CAMP MRR and intend to make a good faith effort to abide by the recommendations. This documentation was not a requirement for receiving the CAMP maintenance incentive, but was strongly recommended.)

The effect of this change was a dramatic increase in the number of participants signing the maintenance agreement.

4.1.3 Nonparticipant Results

The results of the survey with the ten nonparticipants are grouped by area.

Avenue of CAMP Introduction & Understanding of the Program: Most of the nonparticipants surveyed (60 percent) did not recall being contacted about a program for their compressed air program. Of those who remembered being contacted, three of them (75 percent) knew that it was a program sponsored by the California Public Utilities Commission (CPUC). Of those three, all knew that they could have received a free energy assessment, and two (66 percent) knew that the program offered incentives to make improvements to their compressed air systems. All three felt that they had a good understanding of the program. However, any insights regarding the effect of the participation agreement on their decision not to participate were unavailable since they decided not to participate before they had ever seen the participation agreement.

Asymmetric Information: Based on the logic of the skip patterns in the questionnaire, three of the ten completed survey sites were asked questions regarding asymmetric information. All of the three stated that they trusted the information provided by the Program. However, one person thought that SBW was trying to sell them something, one person was not sure, and the third person did not think that SBW was selling them anything.

Customers preferred to obtain information about energy efficiency from e-mail, regular mail or in-person (although one person stated that they only want in-person contact *after* they actually call the person.). Obtaining information via fax, trade shows, or workshops were not desired by any of the surveyed people and only one stated that information by telephone was wanted. One person wanted to "go and get it" when they desired information.

Information/Search Costs: Most of the respondents consider themselves somewhat aware (30 percent) or very aware (60 percent) of ways to reduce energy consumption in their compressed air systems. The same 90 percent are somewhat or very satisfied with the information they have on this issue. The one survey participant, who indicated that he was not at all aware, stated that he was not satisfied with their information provided by in house staff. Their site used compressed air 24/7 and they were unaware of any type of efficiency measures for this type of set-up where the air is required at a steady rate all the time. Most of those surveyed stated that they trust their compressed air vendor or local utility to provide them with unbiased information on compressed air information. One person was unsure of whom to trust.

Organizational Practices: All of the respondents indicated that their companies had invested in energy efficiency in recent years with *half* of them investing in their compressed air systems. The sites either viewed the investment as successful (60 percent) or the efficiency measure was so new that they did not know whether it could be considered successful (40 percent). Interestingly, the same 50% percent who invested in their compressed air systems previously felt that there could be significant remaining energy savings as a result of making changes to their compressed air system. There was one more site that felt they could save energy, but would not consider making upgrades due to cost (the site is over 2 acres in size) and a poor economy. Eighty percent of the sites felt that firms that offer energy efficiency services are tied to companies that try to sell them equipment.

Other: Survey participants were asked at the end of the survey if there was anything else about which they wanted us to be aware. Half of them responded to this question. Two of the respondents stated that they had recently worked with their local electric utility and upgraded their compressed air system One person seemed to worry about the call from SBW because they were only focusing on compressed air and not other energy end uses. That person felt that they may get a sales pitch.

The final disposition provides some insight into the difficulty in reaching this group of customers. If the ineligible customers are removed from the total, answering machines are 44 percent of the total calls. Many messages were left, but only one person called back. Even the customers who completed the survey were somewhat reluctant to do so until they realized that it would take literally only a few minutes (the average survey length was 4 minutes). This image of very busy people was further supported by comments of a few indicating that they want to initiate contact for information and implied that they did not like to be approached for a potential sales call. Given that the majority felt that firms that offer energy efficiency services are tied to companies selling equipment, it is expected that CAMP may have difficulty making initial contact with compressed air customers.

All the companies appear to understand that energy efficiency is a positive investment as all have recently done some type of efficiency retrofit. They believe that they are aware of how to create efficiency in their compressed air systems and know where to get information on the issue if needed. However, there was little apparent willingness to put forth more effort than they already do in improving the efficiency of their compressed air systems.

These two issues make it doubly difficult for CAMP to successfully sell their program to prospective customers. The customers state that they trust information from their compressed air vendors. Part of this response may be due to long-standing relationships between the customer and their vendor. Additionally, part of this trust may be because the customer calls the vendor when they have a problem. It is suggested that SBW explore further a partnering with vendors as an avenue to make initial contact with customers. (It is known that SBW has used this approach to a certain extent.) It is also recommended that SBW make it explicitly clear that they do not sell equipment, but only provide information services. This should be apparent and stressed very early on in any contact with the customer. The program should make it understood that the services provided are paid by funds already paid by the company to their IOU. Since customers state that email and regular mail are preferred avenues for contact, perhaps SBW could enlist vendors to leave with each customer a one page flyer or tri-fold brochure that provides information on the Program. The e-mail option might not be practical since obtaining the email of the appropriate person might be difficult if not impossible.

4.1.4 Participant Installer Results

In this section, we present the results of the interviews with participant installers. These interviews averaged 16.7 minutes in length with a standard deviation of 5.6 minutes.

4.1.4.1 Satisfaction

There was a high level of satisfaction among the participants with CAMP as shown in Table 4-2.

Table 4-2
Satisfaction with Program

Question	N	1=Disagree Strongly	2=Disagree Somewhat	3=Agree Somewhat	4=Agree Strongly	Mean	Std. Dev.
I was very satisfied with the application procedures of the CAMP Program	14	1	0	6	7	3.36	0.842
Overall, I was very satisfied with the CAMP Program.	14	0	1	4	9	3.57	0.646

These findings are backed up by the less structured question where the respondents were asked about what they considered the most positive parts of the program. The majority of participants indicated that obtaining the data from CAMP was positive. Quotes such as "*Made them look at a system that they had ignored for a while*." and "*The measuring of the equipment...gave him a starting point to work from.*" showed that the metered information was desired and appreciated. A couple of companies indicated that they liked the approach taken by CAMP and found SBW both professional and knowledgeable: "*Working with a technically qualified individual from SBW and an organization who approaches it without product bias, but looking for the best system solution*." and "*Working with SBW. He [the SBW representative] was very knowledgeable and helpful.*"

Eight of the respondents could not think of anything when asked about what parts of the program they were most unhappy with and why. This seems to validate the high level of satisfaction. For those who provided us with a specific part of the program they had difficulties with, four of them were what we consider "process" issues such as paperwork

("*The paperwork part of it"*) or incentives ("*Always unsure until the last moment that would be getting an incentive check. Had a good letter of intent at the beginning and relied on this that the state would not change things.*"). The last two were around information type of issues where SBW did not communicate to the manager about difficulties with the project until it was too late or SBW recommended a smaller compressor than the manager felt was needed for their plant.

There were few recommendations from the participants on how to change the program, which is another sign of high satisfaction. One participant recommended that CAMP "*spell out ahead of time that they cannot cancel it and go to another program.*" In this case, the customer had been told by their compressed air vendor that PG&E had a program where they could obtain a higher incentive and the participant was considering this program instead of CAMP.

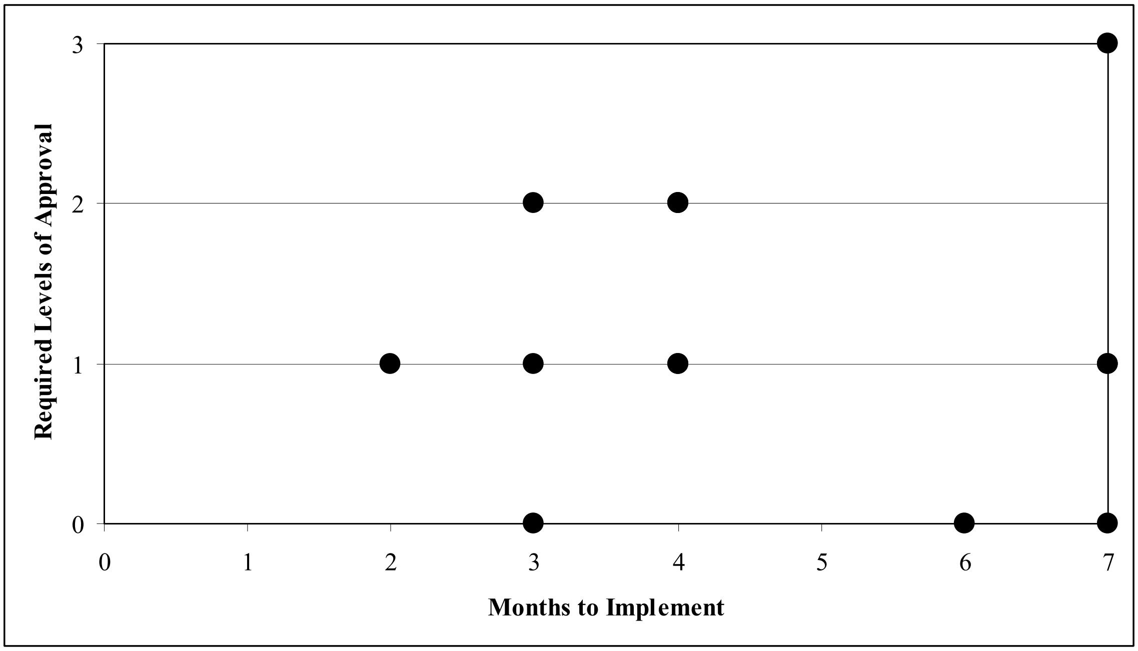
With respect to why they chose to participate, two of the survey respondents indicated that they were told to do so as part of their job by their manager. Of interest is that the two participants who were least satisfied (i.e., responding with a 1 or 2 in Table 4-2) were these two respondents. This suggests that it is important not only to obtain the buy-in up front from management, but also from the person responsible for the work.

Other reasons for participating included timely marketing (i.e., the program came along just as the company was looking for help in this area), word-of-mouth (i.e., a parent or sister company was already in the program), free information, and marketing in general (i.e., they joined because they were approached by CAMP). While how they learned about the program varied, about half indicated that they preferred to obtain information via email. The contact preferences of the other half varied among in-person contact, books, and PG&E.

Once the decision to participate was made, the process for the companies to allocate budget to the retrofits ran the gamut of easy to time consuming. A few companies required only the decision of the surveyed respondent to proceed although typically there were one or two levels of approval required. One company had to define the project and perform their own cash flow and analysis to obtain the funds while another had to go through the plant controller, plant manager, and his boss.

Next, we explored the relationship between the number of organizational layers involved in the decision to participate and the length of time required to install the measures. However, from Figure 4-1, one can see that these two variables are not correlated. When asked what CAMP could have done to help shorten the time before implementation, there was little that the respondents felt could be done.

Figure 4-1
Months before Implementation, by Levels of Approval



4.1.4.2 Market Barriers

The survey collected information on four potential market barriers.

Information and Search Costs: The cost of identifying energy efficient products could be a barrier to implementing energy efficiency measures. Respondents were asked how aware they are currently of ways to reduce the energy consumption of their compressed air systems. On average, they are very aware. On a scale of 1 to 4, with a "1" meaning "Not At All Aware" and a "4" meaning "Very Aware", the average for all 14 respondents was 3.6 with a standard deviation of 0.51.

However, while they report that they are *currently* aware, answers to subsequent questions suggest that prior to participating in CAMP they were less aware. For example, many of the participants (64.3%) were surprised at the cost of operating their compressed air systems. This seems to indicate that there was an information/search barrier that was addressed by providing metered data about the kW and kWh used by the compressed air system. Nearly 79 percent indicated that this information helped their company to decide to participate in CAMP and motivated their company to implement the recommended changes as soon as possible. Finally, nearly 86 percent either agreed somewhat or agreed strongly that, since participating in CAMP, they have a much better idea about the costs of operating their compressed air systems. CAMP appears to have a strong impact on reducing the information/search cost barrier.

Performance Uncertainty: Along with information costs as a barrier is skepticism that an energy efficiency measure will either work or perform as claimed. The participants were provided two reports with savings estimates and payback information. They were asked to the extent to which they found each of these report believable (1=Not At All Believable and 4=Very Believable). From Table 4-3, one can see that while participants found the objective data presented in the Assessment Report to be believable, they found the objective data presented in the Verification Report to be somewhat more believable. The provision of objective data over time appears to result in further reduction in performance uncertainty. However, the sample sizes of 14 are too small to reliably estimate whether these observed differences are statistically significant.

Table 4-3
Difference between Assessment and Verification Report

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Q6B	3.21	14	.579	.155
	Q6C	3.57	14	.646	.173

Q6B = Believability of Assessment Report (4=very believable)
Q6C = Believability of Verification Report (4=very believable)

In addition, 64 percent of the participants stated that they felt that the repair and upgrade of their systems was cost effective. Thus, the performance uncertainty barrier appears to have been addressed through the Assessment and Verification Reports.

Organizational Practices: Within organizations, certain kinds of behavior or systems of practices discourage or inhibit cost-effective energy efficiency decisions. While most of the companies (93 percent) had successfully invested in energy efficiency in recent years, slightly more than 39 percent of the respondents indicated that since participating in CAMP energy efficiency had become a greater priority for their company. CAMP appears to have had a moderate impact on organizational practices.

Of interest is that only 4 (29%) of the companies indicated that the incentive played a large part in making the recommended changes (Table 4-4), but this may be misleading.

Table 4-4
Influence of Incentives on Participation

If there were no incentives and you only had the information contained in the initial Assessment Report, how likely do you think it would have been that your company made the recommended changes in your compressed air system?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1=Very Unlikely	1	7.1	7.1	7.1
	2-Somewhat Unlikely	3	21.4	21.4	28.6
	3=Somewhat Likely	6	42.9	42.9	71.4
	4=Very Likely	4	28.6	28.6	100.0
	Total	14	100.0	100.0	

Many of the respondents chose to clarify their response to this question with follow-ups such as:

- "*But not to the extent that they did."* (somewhat likely response)
- "*...If their costs to implement had been substantial, the incentive would probably have played a bigger part.*" (very likely response)
- *"The company was on a capital freeze, but they got this through based on the payback in the SBW reports."* (somewhat likely response)
- *"Definitely people behind it, but the incentives made it easier to do the request for capital and the ROI became more attractive with the incentives."* (somewhat likely response)

Such clarifications demonstrate that many of the organizations took the incentives into account when deciding to participate.

Asymmetric Information: Sellers of energy efficient products typically have more and better information about their offering than do consumers. Sellers can also have an incentive to provide misleading information. This can cause a lack of trust and decrease the energy efficient changes to a system. It was hypothesized that objective third-party advice would reduce this barrier. However, as a third-party, CAMP had no history with these companies to build a reputation of knowledge that some compressed air vendors may have had. Regardless, the majority of participants (93%) trusted the information provided to them about the CAMP program, although some (36%) did feel that CAMP was just trying to sell them something. When asked who they trusted to provide them with unbiased information on reducing the energy use of their compressed air systems, many indicated PG&E (five participants) or a third party such as CAMP (six participants). Only two indicated that they trusted their compressed air vendors to provide them with unbiased advice. Thus, there is some evidence that objective third-party advice has reduced this barrier.

4.1.4.3 Diffusion of Information

Most of the participants (64%) have not shared the benefits of making improvements to their compressed air systems with other colleagues in other businesses. One company indicated that they would not share with competitors that they were successfully reducing their bottom line as it gave them an edge. Two participants have shared information with fellow employees within their own company or with other divisions within the same company. One discussed their compressed air energy reduction with a near by company while another talked with 3 or 4 others in the business. For this company, they called another participant prior to deciding to participate and, after participating, were contacted themselves by a compressor manufacturer and another business who were calling to see how the measure they had installed was working and whether it was saving them energy. Based on this data, diffusion of information may be slow within this sector.

4.1.4.4 Spillover

Several questions were asked to determine whether there was any participant spillover. Such spillover is defined as additional energy efficient measures that were installed without a rebate from CAMP but influenced by their positive experience with CAMP. Of the 14 respondents, 3 (21.4 percent) indicated that they had recently invested in energy efficiency after participating in CAMP. Of these three, two indicated that the CAMP was either "Somewhat" or "Very" influential in their decision to install these additional measures.

4.1.4.5 Reasons for Non-Adoption

Some customers chose not to adopt certain measures recommended by SBW and/or chose not to participate in the maintenance agreement. We first discuss the non-adoption of recommended measures and then address the failure to participate in the maintenance agreement.

Recommended Hardware: There were eight participants who chose not to adopt one or more recommended hardware changes. There was no central theme as to why the participants chose not to adopt – the reasons ran from safety issues (i.e., could not shut down the compressed air system within their 24/7 operation to do the work) to regulatory hassle if they implemented the change, to a lack of technology needed for the upgrade. There were two sites that chose not to implement any of the recommendations because of cost issues. Of these eight who did not adopt all the recommendations, six indicated that there were plans to possibly implement the measures within the next 3 years, although there were qualifications. One company is waiting for the technology to advance to cost effectively make the upgrade while another plans to adopt the recommendations if they do any other upgrades to the system.

Recommended Maintenance Practices: CAMP attempted to improve maintenance practices through two avenues. They provided incentives if a company committed to three years of specified "good faith" maintenance practices and also provided two or three pages of recommended maintenance practices within the assessment report. There were six companies who chose not to obtain the maintenance incentive. Two felt that their own O&M (operations and maintenance) were sufficient while one did not want to deal with the paperwork. One company appeared to not fully understand the latest maintenance agreement. The respondents indicated that there was nothing that CAMP could have done to influence this decision.

There were eight companies who participated in the simplified maintenance agreement. They were queried about why they chose not to adopt the original agreement. One indicated that the requirement of a third-party to oversee their maintenance was too onerous while another did not have the needed service provider in their remote area. One company has a policy to sign for services that are only under a year in length. Of interest is that two companies indicated they probably would have signed the original agreement, but the change in the original O&M agreement occurred while they were making decisions about the hardware. They liked the new O&M agreement and choose to sign it. These companies have modified their existing preventive maintenance (PM) to implement some of the maintenance recommendations. We did not cover each of the O&M recommendations with the respondents to find out if each was being implemented as described in the Assessment Report, although one respondent did indicate that they felt that some of the recommendations were "overkill".

Regardless of whether the company signed the O&M agreement, we asked whether the maintenance practices recommended in the assessment report were being used. The majority (86%) indicated that they were implementing the changes, at least to some degree. The two who indicated they were not stated it was because they already employed rigorous O&M procedures at their company.

4.1.4.6 Comparing Nonparticipant and Participant Results

There were nine identical questions between the nonparticipant and participant surveys. We compared the responses to try to see if there were differences between the two groups. One has to remember, however, that due to small sample sizes, statistically significant differences are not expected.

There were very few differences noted between the two groups when comparing their answers to these common questions.

- Both groups claim to trust the information provided to them about CAMP.
- There was also a moderate feeling in both groups that CAMP was just trying to sell them something.
- Both groups claimed that they were aware of ways to reduce the energy consumption of their compressed are systems. This is somewhat surprising since nonparticipants would be expected to be less aware that participants. However, as we noted earlier, nonparticipants might be overestimating their level of awareness.
- There was a tendency in both groups to believe that firms offering energy efficiency services are usually tied to companies trying to sell you equipment.
- Both groups had invested in energy efficiency in recent years and both groups considered these investments to have been successful.
- When asked about who they trusted for unbiased information on ways to reduce energy use, only one nonparticipant indicated an energy efficiency service company and none indicated a third party such as CAMP. The participants, after working with CAMP, had a large percentage who stated that they trusted a third party such as SBW to provide this information.
- Nonparticipants were pretty evenly spread in how they wanted to be contacted, while participants most often chose email.

In the end, these comparisons provide little insight into how SBW can improve the targeting of market and outreach efforts.

4.2 Impact Evaluation

In this section, we present the results of SBW's Assessment and Verification Reports, discuss the estimation of the realization rates based on the on-site inspections and the engineering reviews for 11 sites. These realization rates and the default net-to-gross ratio are then applied to the ex ante gross energy and demand impacts for all 16 sites to yield the net energy and demand impacts for the Program. . In addition, we discuss the impact of maintenance agreements on the persistence of savings. Finally, we present the results of the TRC (total resource cost test).

4.2.1 Results from Assessment and Verification Reports

SBW met its revised goal of 27 assessments, which involved 26 sites (one site had two assessments). Table 4-5 presents the estimated gross savings contained in these 27 assessment reports.

Table 4-5
Gross kWh Savings in Assessment Reports

Site	kWh
CAMP_01	248,735
CAMP_02	282,347
CAMP_03	83,642
CAMP_04	226,056
CAMP_05	408,538
CAMP_06	535,594
CAMP_07	417,789
CAMP_08	827,820
CAMP_09	310,492
CAMP_10	352,308
CAMP_11	1,147,381
CAMP_12	124,596
CAMP_13	420,165
CAMP_14	3,101,626
CAMP_15	664,435
CAMP_16	259,366
CAMP_17	161,392
CAMP_18	1,627,917
CAMP_19	199,394
CAMP_20	979,472
CAMP_21	162,136
CAMP_22	465,416
CAMP_23	410,698
CAMP_24	414,960
CAMP_25	1,353,009
CAMP_26	360,335
Total	15,545,619

We also note that, while SBW did not have hard-to-reach targets, 18 of the 26 recruited sites (62 percent) were in hard-to-reach areas (as defined by the CPUC, hard-to-reach areas are those located outside of San Francisco, San Mateo, Santa Clara, Contra Costa, Alameda, Marin, Solano, Napa and Sonoma counties).

The 15,545,619 kWh represents 127 percent of the goal of 12,218,451 kWh. However, the SBW Program Implementation Plan (PIP) assumed that each customer receiving an Assessment Report would on average implement 60 percent of the recommended measures. Given this, one might argue that SBW should have recruited enough customers to yield 20,364,085 (12,218,451/0.60) in order to achieve their goal of 12,218,451. However, if the implementation rate exceeded 60 percent there was the chance they could not have paid all participants the agreed-upon incentive. Thus, SBW decided to halt recruitment at the 15,545,619 kWh as a way of minimizing the risk to their budget.

However, for only 17 (63 percent) of the 27 assessments were at least some of the recommended measures adopted thus requiring a Verification Report. The Evaluation Team selected 11 sites from the 16 sites that represented these 17 assessments. These 11 sites were the focus of our on-site and engineering reviews. These 16 Verification Reports[7] claim gross impacts of 5,280,000 kWh and 625.9 kW. Thus, the actual implementation rate was 34 percent (5,280,000 kWh/15,545,619 kWh), far less than the original 60 percent. The percent of the gross impacts contained in the Verification Reports that were verified by the Evaluation Team is discussed in the next section of this report.

4.2.2 Results of On-Sites and Engineering Reviews

The details of the results of the on-sites and engineering reviews for each of the 11 sites sampled are presented in Appendix E. The onsites verified the following:

- Baseline and post-installation plant conditions accurately described
- Using block diagrams supplied by SBW, verified all installations
- Issues identified that may relate to air quality, compressor reliability, or energy concerns that might affect SBW-estimated savings.
- The placement of all monitoring equipment installed by SBW were correct
- Locations picked by SBW for logging and sample rates used were feasible

That is, the on-sites found no discrepancies between SBW's characterization of the site and that of the Evaluation Team.

The engineering review verified the following:

- All information correctly entered input into AIRMaster+ files
- EEMs were feasible.
- AIRMaster+ results match SBW's AIRMaster+ findings.

The engineering reviews found no discrepancies between SBW's analysis of site-specific data in AIRMaster+ and those of the Evaluation Team.

[7] Only one Verification Report was prepared for the one site which had two performance assessments.

4.2.3 Results of LogTool Reviews

The Evaluation Team reviewed each of the LogTool files for 10 of the 11 sites in our sample. The Evaluation Team confirmed that the calculations of the savings, using the log data for each site, were correct and that the savings estimates were correctly entered into the Verification Reports. For each of the 10 sites, we present, in Appendix F, the hourly kW demand for each day type for both the baseline and as built cases. We also show the number of hours per year for each day type and the resulting kWh for each hour for each day type. Finally, we show the kWh savings calculated by the Evaluation Team and compare them to those kWh savings presented in the SBW Verification Reports. As one can see, in each case, we were able to replicate the savings presented in the Verification Reports. For the one remaining site in our sample, AirMaster+ was used to verify the savings. For this one case, we reviewed the AirMaster+ tables representing the baseline energy use and the as-built energy use and were also able to replicate within 0.2 percent the savings presented in the Verification Reports. These tables are also contained in Appendix F.[8]

4.2.4 Gross and Net Energy and Demand Impacts

Thus, based on the onsites, engineering review of AIRMaster+ files, and reviews of LogTool files, the Evaluation Team was able to verify the energy savings of 4,337,848 kWh and the demand reductions of 501.2 kW that were contained in the SBW Verification Reports for the 11 sites in the sample. The resulting realization rates are all 1.0. Therefore, no adjustments to the gross savings of 5,280,000 kWh and 625.9 kW for all 16 participant installer sites were required.

While the kWh associated with the recommended measures in the 27 SBW Assessment Reports was, as we noted earlier, 127 percent of the original goal of 12,218,451 kWh, the 5,280,000 kWh is only 43 percent of this original goal and only 34 percent of the 15,545,619 kWh contained in the Assessment Reports for the 26 participant installer sites. The overall implementation rate of 34 percent is far short of the implementation rate of 60 percent used by SBW for program planning. It is surprising that there were 10 participant non-installers, who received significant SBW services in the form of site visits, metering, AIRMaster modeling, savings estimates, and presentations to management who were, by SBW accounts, enthusiastic, but who ultimately chose not to implement any of the recommended measures. While telephone interviews were conducted with the 10 nonparticipants and 14 of the 16 participant installers, we did not interview these 10 participant non-installers. These 10 customers will be interviewed as part of the evaluation of the PY 2004-05 CAMP in an attempt to identify which customer characteristics predict implementation. Such information could be used to improve recruitment for the PY 2004-05 CAMP.

The gross kWh and kW impacts were adjusted by the default NTGR of 0.80 to yield program-level net impacts of 4,224,000 kWh and 500.7 kW. Table 4-6 presents these

[8] Note that there are no tables for CAMP_16. A full verification was never done by SBW since the efficiency measures taken were considered to have only a trivial impact on kWh and kW. Instead, SBW assumed that the savings were zero.

results. Those sites that are shaded were not part of evaluation sample[9]. The realization rate of 1.0 based on the 11 sampled sites was applied to these four sites.

[9] Rows that are shaded identify those sites that were not in the EM&V sample.

Table 4-6
SBW Reported and Evaluation Team Verified Gross and Net kWh and kW Impacts

	SBW Implemention Reports		SBW Proposed & Verified Gross Impacts				Evaluation Team	Evaluation Team Ex Post Gross Impacts		Evaluation Team Ex Post Realization Rates		Evaluation Team Ex Post Net Impacts	
Site	**Performance Assessment Report Date**	**Verification Report Date**	**Proposed In Assessment Report kW**	**Proposed in Assessment Report kWh**	**Verified in Verification Report kW**	**Verified in Verification Report kWh**	**Onsite Audit Date**	**kW**	**kWh**	**kW**	**kWh**	**kW**	**kWh**
CAMP_01	Mar-03	Jan-04	45.2	248,735	57.8	301,211	Oct-04	57.8	301,211	100.0%	100.0%	46.2	240,968.8
CAMP_02	Dec-03	May-04	33.6	282,347	2.0	58,666	Oct-04	2.0	58,666	100.0%	100.0%	1.6	46,932.8
CAMP_03	May-03	Jan-04	41.8	83,642	32.9	103,573	May-04	32.9	103,573	100.0%	100.0%	26.3	82,858.4
CAMP_04	Mar-03	Jan-04	14.4	226,056	9	36,472	Oct-04	9.00	36,472	100.0%	100.0%	7.2	29,177.6
CAMP_05	Aug-03	Mar-04	45.5	408,537	3.1	301,092	Oct-04	3.1	301,092	100.0%	100.0%	2.5	240,873.6
CAMP_06	Sep-03	Apr-04	12.7	535,595	4.6	23,733	Oct-04	4.6	23,733	100.0%	100.0%	3.7	18,986.4
CAMP_07	May-02	Feb-04	86.4	417,778	52.7	327,228	May-04	52.7	327,228	100.0%	100.0%	42.2	261,782.4
CAMP_08	May-02	Sep-03	94.5	827,820	83.7	722,262	Apr-04	83.7	722,262	100.0%	100.0%	67.0	577,809.6
CAMP_09	Aug-03	Sep-04	34.4	310,492	25.7	225,982	N/A	25.7	225,982.0	100.0%	100.0%	20.6	180,785.6
CAMP_10	May-03	Jul-04	3.8	325,308	36.4	655,314	Oct-04	36.4	655,314.0	100.0%	100.0%	29.1	524,251.2
CAMP_11	Aug-02	Apr-04	129.0	1,147,381	79.3	396,396	Oct-04	79.3	396,396.0	100.0%	100.0%	63.4	317,116.8
CAMP_12	Nov-03	Jun-04	5.0	124,597	10.9	16,127	N/A	10.9	16,127.0	100.0%	100.0%	8.7	12,901.6
CAMP_13	Nov-03	Oct-04	47.8	420,165	51.1	501,537	N/A	51.1	501,537.0	100.0%	100.0%	40.9	401,229.6
CAMP_14	Nov-03	Jun-04	307.0	3,101,626	140.2	1,411,901	Oct-04	140.2	1,411,901.0	100.0%	100.0%	112.2	1,129,520.8
CAMP_15	Nov-03	Sep-04	85.1	664,435	36.5	198,506	N/A	36.5	198,506.0	100.0%	100.0%	29.2	158,804.8
CAMP_16	Dec-04		49.3	259,366	0.0	0	N/A	0.0	0.0	100.0%	100.0%	0	0
TOTAL			1,035.5	9,383,880	625.9	5,280,000		625.9	5,280,000	100.0%	100.0%	500.7	4,224,000.0

5 Continuing Need for CAMP

The Energy Efficiency Policy Manual requires that each evaluation address the continuing need for the program that is being evaluated. Two key factors must be taken into account when assessing the continuing need for a program: 1) remaining market potential and 2) remaining market barriers. If the remaining market potential is high and the market barriers haven not been significantly reduced, then there is a continuing need for intervention in the market.

5.1 Economic Potential

Our assessment of market potential relies on:

- Work papers associated with the "California's Secret Energy Surplus: The Potential for Energy Efficiency" (Rufo and Coito, 2002)
- "Potential Energy Savings in the California Compressed Air Market" (SBW Consulting, 1999).

We begin by noting that the industrial sector consumes 83,000 GWh annually and has a peak demand of 13,000 MW. Rufo and Coito (2002) estimated that compressed air consumes about 14 percent of this energy. A somewhat lower number was estimated by SBW (1999) of 9.2 percent. Coito and Rufo also reported that the three investor-owned utilities (IOUs) account for about 84 percent of the industrial energy consumption and 89 percent of the peak demand. Figure 5-1 and Figure 5-2 show their breakdown of industrial energy consumption, by utility. PG&E accounts for 40 percent of the energy and 44 percent of the demand.

Figure 5-1
Breakdown of Industrial Energy Consumption by Utility

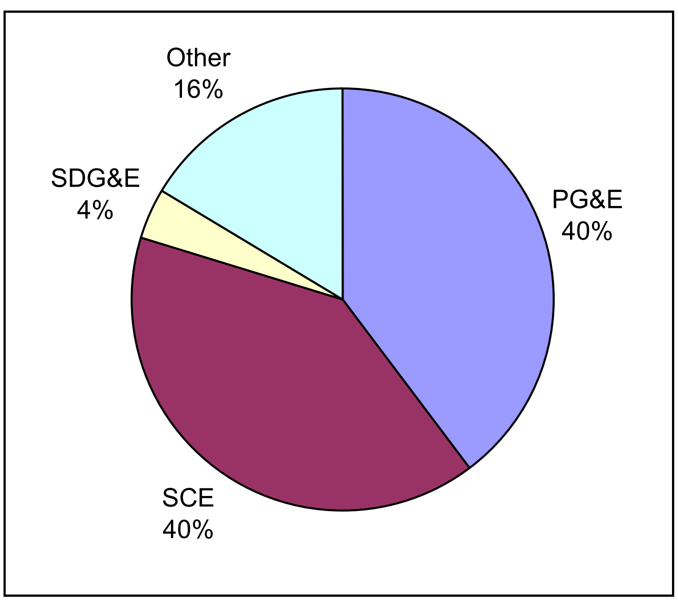
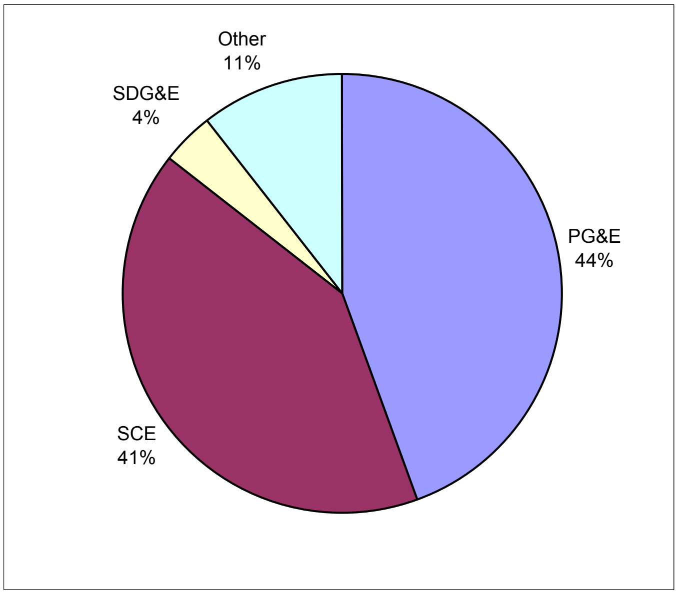


Figure 5-2
Breakdown of Industrial Peak Demand by Utility



Multiplying the 83,000 GWh by compressed air's 14 percent by the utility share of 84 percent and finally by PG&E's 40 percent share yields 3,904 GWh that are being consumed by compressed air in PG&E's service territory. Assuming 9.2 percent compressed air share of energy use yields 2,566 GWh that are being consumed by compressed air in PG&E's service territory.

Multiplying the 13,000 MW by compressed air's 14 percent by the utility share of 84 percent and finally by PG&E's 44 percent share yields 673 MW that are being demanded by compressed air in PG&E's service territory. Assuming 9.2 percent compressed air share of energy use yields 442 MW that are being demanded by compressed air in PG&E's service territory.

The economic potential for compressed air in California was estimated by Rufo and Coito (2002) to be 888 GWh and 122 MW. These estimates represent only 1.1 percent of the California industrial energy use and 0.9 percent of the demand. Assuming that PG&E has 40 percent of the economic potential, the energy savings from compressed air as a percent of compressed air energy use range from 9.1 percent to 13.8 percent. Again, assuming that PG&E has 44 percent of the economic potential, the demand reductions from compressed air as a percent of compressed air demand range from 7.2 percent to 11 percent.

The estimated gross impacts for the PY 2002-03 CAMP are 5,200,000 kWh and 4.2 MW. This represents only 1.5 percent of the PG&E economic potential and only 7.8 percent of the PG&E demand reduction potential. Clearly, there remains room for additional energy savings for this end use in this sector.

5.2 Market Barriers

We reported earlier that participation is less that originally planned suggesting that significant barriers remain. The results of our investigation into market barriers facing both nonparticipants and participants presented earlier are summarized in this section. Note that while the nonparticipant sample was very small (n=10), the interviews with those who qualified for CAMP but who later chose not to participate can provide some insights into market barriers.

For nonparticipants, the major findings are:

- Most consider themselves somewhat aware (30 percent) or very aware (60 percent) of ways to reduce energy consumption in their compressed air systems.

- Both participants and nonparticipants indicated that their companies had invested in energy efficiency in recent years. Half of the nonparticipants had invested in their compressed air systems.

- Eighty percent of the sites felt that firms that offer energy efficiency services are tied to companies that try to sell them equipment.

- Those who work in the targeted market appear to be very busy and have little time for they believe in many cases to be sales calls. A few indicated that they want to initiate contact for information and implied that they did not like to be approached for a potential sales call.

- There was little apparent willingness to put forth more effort than they already do in improving the efficiency of their compressed air systems.

Other insights are based on anecdotal evidence gleaned through the participant interviews and EM&V participant onsites.

- While over half of the participants stated they are currently aware of ways to reduce energy consumption, many of them (64.3%) were surprised at the cost of operating their compressed air systems. This seems to indicate that there was a greater information barrier than that suggested by the nonparticipant interviews. It appears that metered data provided by CAMP about the kW and kWh used by the compressed air systems were both new and useful.

- In addition, the cumulative effect of the Assessment Report and the Verification Report appears to have reduced somewhat any performance uncertainty participants might have had about savings.

- CAMP appears to have had some impact on organizational practices suggesting that this may be a barrier for nonparticipants.

- Several participants indicated that they did not do more energy efficiency since they were experiencing serious cash-flow problems, which is not surprising given the current sate of the California economy. This would explain why only 42 percent of the measures that were recommended by SBW to the participants were never implemented.

- Finally, the energy and demand reduction potential for compressed air is a very small portion of the total energy use. Improvements to compressed air systems are very likely competing with other capital investments that might have greater savings potential.

Clearly, some important barriers remain:

- Asymmetric information remains a barrier with 80 percent of the nonparticipants stating that firms that offer energy efficiency services are tied to companies that are trying to sell them equipment.

- Those who work in the targeted market appear to be very busy and have little time for what they believe in many cases are sales calls.

- The information/search cost barrier, while appearing to be low among nonparticipants, may be understated. While over half of the participants stated they were aware of ways to reduce energy consumption, many were surprised at the money being spent on their systems. It appears that metered data provided by CAMP about the kW and kWh used by their compressed air system were both new and useful.

- In addition, the cumulative effect of the Assessment Report and the Verification Report appears to have reduced somewhat the performance uncertainty participants might have had about improvements to their compressed air systems. This suggests that performance uncertainty may be a barrier for nonparticipants.

- Other barriers remain such as uncertainty concerning the California economy, cash flow problems, and other competing capital investments, but are beyond SBW's power to affect.

5.3 Conclusions

Clearly, much potential remains and there are some remaining barriers among the general industrial population. In addition, general uncertainty in the economy might have made both participants and nonparticipants reluctant to make any investments, even for those with relatively short paybacks. Such market imperfections require a continued effort to intervene in the marketplace to lower barriers and reduce first costs.

6 Benefit-Cost Test Results

The results of the total resource cost (TRC) benefit-cost test and the participant cost (PC) benefit-cost test are presented in this section. As mentioned earlier, the calculations were done using the SBW fourth quarter reporting spreadsheet, *SBWConsultingInc_9702_Q4_2004.xls*. SBW input information regarding administration cost, participant costs, the default net-to-gross ratio of 0.80, and the number of units (i.e., performance assessments). SBW then passed the spreadsheet to the Evaluation Team who incorporated its final estimates of gross and net kWh and kW impacts, allowing the calculation of the final TRC test and PC test results.

Several problems with the spreadsheet required the Evaluation Team to calculate the B/C ratios in a manner somewhat different that originally intended. First, when going to the tab, *T10-Annual Report Summary*, where the final benefits/cost ratios are calculated, the costs appear to be correctly calculated but the benefits appear to be overestimated because they are linked to the kWh and kW that appeared in SBW's Program Implementation Plan rather than the ex post kWh and kW estimated by the Evaluation Team. This incorrect linkage could not be modified by the user. However, the benefits could be correctly calculated in the *TPIP3-Cost Effectiveness Test* tab. As a result, the Evaluation Team used the correctly calculated costs from *T10-Annual Report Summary* tab and the correctly calculated benefits from the *TPIP3-Cost Effectiveness Test* tab as the basic inputs to the TRC and PC B/C ratios.

Also note that for the CAMP there was estimated to be approximately $2,151 of operation and maintenance (O&M) costs for each site for each of three years for those customers who adopted the CAMP O&M recommendations. Because the spreadsheet appeared to have no ability to incorporate these costs, the Evaluation Team excluded them. If these O&M costs were somehow supposed to be included, then the estimated B/C ratios are somewhat overestimated. If the CPUC never intended to consider these costs, then the B/C ratios are accurate.

Table 6-1 presents the final TRC and PC benefit/cost ratios.

Table 6-1
Inputs to CAMP TRC and PC Benefit/Cost Ratios

Inputs	TRC	PC
Benefits from TPIP3 - Cost Effectiveness Tests	$1,398,065	$2,124,609
Costs from T10 - Annual Report Summary	$1,102,266	$241,056
Ratio	1.27	8.81

This spreadsheet, relabeled as SBWConsultingInc_9702_Q4_2004 Evaluation Team.xls, was then returned to SBW and included as part of its final report to the CPUC.

Appendix A
In-Depth Non-Participant Interview Guide and Frequencies

In-Depth Interview Guide for CAMP:

Nonparticipants

May I please speak with (INSERT CONTACT NAME)?

My name is Mary of Ridge & Associates. The State of California requires an evaluation of energy efficiency programs and I was hoping to get a few minutes of your time for our evaluation of compressed air programs..

The goal of this interview is to talk with you about how to better provide energy efficiency information to companies like yours. This interview will take about five minutes to complete. I want to assure that your responses will be kept strictly confidential.

Date: ___________ Start Time: _______________

1. Do you recall being contacted by phone or fax recently about an energy efficiency incentive program for your compressed air systems?

   ___ Yes [CONTINUE]
   ___ No [SKIP TO 11]
   ___ Don't Know [SKIP TO 11]
   ___ Refused [SKIP TO 11]

2. Do you remember if this was a program sponsored by the California Public Utilities Commission?
   ___ Yes [CONTINUE]
   ___ No [SKIP TO 11]
   ___ Don't Know [SKIP TO 11]
   ___ Refused [SKIP TO 11]

3. Was it explained to you that the program provided a free energy assessment of your compressed air system?
   ___ Yes
   ___ No
   ___ Don't Know
   ___ Refused

4. Was it explained to you that the program offered incentives for making improvements to your compressed air system?
   ___ Yes
   ___ No
   ___ Don't Know
   ___ Refused

5. Did you trust the information provided to you about the program?
    ___ Yes
    ___ No
    ___ Don't Know
    ___ Refused

6. Did you think that they were just trying to sell you something?
    ___ Yes
    ___ No
    ___ Don't Know
    ___ Refused

7. Based on the information provided by the contact, did you feel that you had a good understanding of the Program?
    ___ Yes
    ___ No
    ___ Don't Know
    ___ Refused
    IF NO, ASK: What about the program didn't you understand?

8. Did you have a chance to review a Participation Agreement provided you by the program?
    ___ Yes
    ___ No [GO TO Q11]
    ___ Don't Know [GO TO Q11]
    ___ Refused [GO TO Q11]

9. Did you understand the terms contained in the language in the Participation Agreement?
    ___ Yes
    ___ No
    ___ Don't Know
    ___ Refused

10. Did you object to any of the terms contained in the language in the Participation Agreement?
    ___ Yes
    ___ No
    ___ Don't Know
    ___ Refused

IF YES: What did you find objectionable?

11. How aware are you of ways to reduce the energy consumption of your compressed air system? Would you say you are very, somewhat, not too, or not at all aware?

__ very aware
__ somewhat aware
__ not too aware
__ not at all aware
__ Don't Know
__ Refused

12. How satisfied are you with the information you have on ways to reduce the energy consumption of your compressed air system? Would you say you are very, somewhat, not too, or not at all satisfied?

__ very satisfied
__ somewhat satisfied
__ not too satisfied
__ not at all satisfied
__ Don't Know
__ Refused

13. Who do you trust to provide you with unbiased information about reducing the energy use of your compressed air system? (CHECK ALL THAT APPLY)
__ a business colleague or professional peer
__ publication from a trade association
__ California Public Utilities Commission
__ PG&E
__ a compressed air vendor
__ an energy efficiency service company
__ Other (Please Specify:____
__ Don't Know
__ Refused

14. How do you prefer to obtain that information? (CHECK ALL THAT APPLY)

__ by telephone
__ by E-mail
__ by regular mail
__ by in-person contact
__ by fax
__ by attending a trade show
__ by attending a seminar/workshop
__ Other (Please Specify:____
__ Don't Know
__ Refused

15. Has your company invested in energy efficiency in recent years?

___ Yes [CONTINUE]
___ No [SKIP TO Q18]
___ Don't Know [SKIP TO Q18]
___ Refused [SKIP TO Q18]

16. Was this investment viewed as successful?

___ Yes
___ No
___ Don't Know
___ Refused

17. Was this investment in your compressed air system?

___ Yes
___ No
___ Don't Know
___ Refused

18. Do you believe that there could be significant energy savings as a result of making changes to you compressed air system?

___ Yes
___ No
___ Don't Know
___ Refused

19. Do you feel that firms offering energy efficiency services are usually tied to companies trying to sell you equipment?

___ Yes
___ No
___ Don't Know
___ Refused

IF NO ON Q1, END; ELSE CONTINUE

20. Other than what we have already discussed, is there anything else you want to tell me about your reasons for deciding not to participate in this Program?

SAY: THANK YOU FOR TAKING TIME FOR THIS INTERVIEW

End Time: ________________

Frequencies

Nonparticipants

May I please speak with (INSERT CONTACT NAME)?

My name is Mary of Ridge & Associates. The State of California requires an evaluation of energy efficiency programs and I was hoping to get a few minutes of your time for our evaluation of compressed air programs..

The goal of this interview is to talk with you about how to better provide energy efficiency information to companies like yours. This interview will take about five minutes to complete. I want to assure that your responses will be kept strictly confidential.

Date: ___________ Start Time: _______________

1. Do you recall being contacted by phone or fax recently about an energy efficiency incentive program for your compressed air systems?

Response	Skip Pattern	Frequency
____ Yes	[CONTINUE]	4
____ No	[SKIP TO 11]	6
____ Don't Know	[SKIP TO 11]	0
____ Refused	[SKIP TO 11]	0

2. Do you remember if this was a program sponsored by the California Public Utilities Commission?

Response	Skip Pattern	Frequency
____ Yes	[CONTINUE]	3
____ No	[SKIP TO 11]	1
____ Don't Know	[SKIP TO 11]	0
____ Refused	[SKIP TO 11]	0

3. Was it explained to you that the program provided a free energy assessment of your compressed air system?

Response	Frequency
____ Yes	3
____ No	0
____ Don't Know	0
____ Refused	0

4. Was it explained to you that the program offered incentives for making improvements to your compressed air system?

Response	Frequency
___ Yes	2
___ No	1
___ Don't Know	0
___ Refused	0

5. Did you trust the information provided to you about the program?

Response	Frequency
___ Yes	3
___ No	0
___ Don't Know	0
___ Refused	0

6. Did you think that they were just trying to sell you something?

Response	Frequency
___ Yes	1
___ No	1
___ Don't Know	1
___ Refused	0

7. Based on the information provided by the contact, did you feel that you had a good understanding of the Program?

Response	Frequency
___ Yes	3
___ No	0
___ Don't Know	0
___ Refused	0

IF NO, ASK: What about the program didn't you understand? NA

8. Did you have a chance to review a Participation Agreement provided you by the program?

Response	Skip Pattern	Frequency
___ Yes	CONTINUE	0
___ No	[GO TO Q11]	3
___ Don't Know	[GO TO Q11]	0
___ Refused	[GO TO Q11]	0

9. Did you understand the terms contained in the language in the Participation Agreement?

Response	Frequency
___ Yes	0
___ No	0
___ Don't Know	0
___ Refused	0

10. Did you object to any of the terms contained in the language in the Participation Agreement?

Response	Frequency
___ Yes	0
___ No	0
___ Don't Know	0
___ Refused	0

IF YES: What did you find objectionable? NA

11. How aware are you of ways to reduce the energy consumption of your compressed air system? Would you say you are very, somewhat, not too, or not at all aware?

Response	Frequency
__ very aware	6
__ somewhat aware	3
__ not too aware	0
__ not at all aware	1
__ Don't Know	0
__ Refused	0

12. How satisfied are you with the information you have on ways to reduce the energy consumption of your compressed air system? Would you say you are very, somewhat, not too, or not at all satisfied?

Response	Frequency
__ very satisfied	4
__ somewhat satisfied	5
__ not too satisfied	0
__ not at all satisfied	1
__ Don't Know	0
__ Refused	0

13. Who do you trust to provide you with unbiased information about reducing the energy use of your compressed air system? (CHECK ALL THAT APPLY)

Response	Frequency	Other Response
__ a business colleague or professional peer	0	
__ publication from a trade association	0	
__ California Public Utilities Commission	0	
__ PG&E	3	
__ a compressed air vendor	5	
__ an energy efficiency service company	1	
__ Other (Please Specify:____________	4	Manufacturer (2) Local Utility (2)
__ Don't Know	0	
__ Refused	0	

14. How do you prefer to obtain that information? (CHECK ALL THAT APPLY)

Response	Frequency	Other Response
__ by telephone	1	
__ by E-mail	3	
__ by regular mail	3	
__ by in-person contact	4	(1 response - but only after they call the person)
__ by fax	0	
__ by attending a trade show	0	
__ by attending a seminar/workshop	0	
__ Other (Please Specify:_______	2	1) He goes and gets it 2) Publications (such as ASHRAE or Plant Engineering)
__ Don't Know	0	
__ Refused	0	

15. Has your company invested in energy efficiency in recent years?

Response	Skip Pattern	Frequency
___ Yes	[CONTINUE]	10
___ No	[SKIP TO Q18]	0
___ Don't Know	[SKIP TO Q18]	0
___ Refused	[SKIP TO Q18]	0

16. Was this investment viewed as successful?

Response	Frequency
___ Yes	6
___ No	0
___ Don't Know	4
___ Refused	0

17. Was this investment in your compressed air system?

Response	Frequency
___ Yes	5
___ No	5
___ Don't Know	0
___ Refused	0

18. Do you believe that there could be significant energy savings as a result of making changes to you compressed air system?

Response	Frequency
___ Yes	6
___ No	2
___ Don't Know	1
___ Refused	1

19. Do you feel that firms offering energy efficiency services are usually tied to companies trying to sell you equipment?

Response	Frequency
___ Yes	8
___ No	2
___ Don't Know	0
___ Refused	0

IF NO ON Q1, END; ELSE CONTINUE

20. Other than what we have already discussed, is there anything else you want to tell me about your reasons for deciding not to participate in this Program?

- They wouldn't do something like this because they have 2.5 acres and it is too costly to upgrade (economy is bad). Wouldn't even consider upgrading.
- It would have been a waste of everyone's time. They had survey 8 years ago and know where to look; they just need to stay up on things.

- Had an intensive compressed air look by SMUD. They did changes and monitored it.
- Didn't have time and the call was keying in on compressed air only & not all the other things that use energy. Was a little leery that they were going to try to sell them something.
- Recently upgraded their compressed air system by working with the Modesto Irrigation District

SAY: THANK YOU FOR TAKING TIME FOR THIS INTERVIEW

End Time: ________________

Appendix B
Participant Survey and Frequencies

In-Depth Interview Guide for CAMP Participants

May I please speak with (INSERT CONTACT NAME)?

My name is Mary of Ridge & Associates. The State of California requires an evaluation of energy efficiency programs and I was hoping to get a few minutes of your time for our evaluation of the Compressed Air Management Program offered by SBW Consulting.

Screener questions:

S1: Your company recently participated in this compressed air audit program in which you implemented one or more of the recommendations. Are you the person who was most involved with the audit and implementation?

[1] Yes	[GO TO Q1]
[2] No	[CONTINUE]
[-8] Don't Know	[CONTINUE]

S2: Can you tell me the name and contact information of the correct person to talk to?

[1] Yes	[Obtain information and call that person]
[2] No	[T&T]
[-8] Don't Know	[T&T]

ALL MISSING/OTHER CODED AS [-7], OTHERWISE CODE IN EXCEL SHEET MAPS TO BRACKETED NUMBER BY QUESTION.

Date: ___________ Start Time: _______________

Background Information

1. I would imagine that you are approached by several entities each year that attempt to provide you with services. Why did you choose to participate in this program? [Probe for specifics about the program that caused them to feel it was a worthwhile program.] {Why/How Join}
   {Open ended response}
   [-8] Don't Know
   [-9] Refused

2. Did you trust the information provided to you about the CAMP Program? {Asymmetric Information}

___ Yes	[SKIP TO Q. 4]
___ No	[CONTINUE]
___ Don't Know	[SKIP TO Q. 4]
___ Refused	[SKIP TO Q. 4]

3. What could the CAMP Program have done that would have given you greater confidence in the information provided? {Asymmetric Information}

4. Did you think that the CAMP Program was just trying to sell you something? {Asymmetric Information}
   ___ Yes
   ___ No
   ___ Don’t Know
   ___ Refused

5. What procedures **within your company** were required to obtain permission to participate in the CAMP Program? {Why/How Join}
   {Open ended response}
   [-8] Don’t Know
   [-9] Refused

Barriers/Satisfaction

6. Now, I'm going to read you a series of questions. For each statement, I want you to tell me whether you "Agree Strongly" , Agree Somewhat", "Disagree Somewhat" or "Disagree Strongly."

Question	Disagree Strongly	Disagree Somewhat	Agree Somewhat	Agree Strongly	Don't Know	Refused
A. I was very satisfied with the application procedures of the CAMP program.{Satisfaction}						
B. I found the savings estimates and payback information provided in the **assessment** report very believable. {Performance Uncertainty}						
C. I found the savings estimates and payback information provided in the **verification** report very believable.{Performance Uncertainty}						
D. Overall, I was very satisfied with the CAMP Program. {Satisfaction}						
E. Repairing and upgrading my compressed air system was cost effective. {Performance Uncertainty}						
F. Since participating in the CAMP Program, I have a much better idea about the costs of operating my compressed air system.{Information/Search Costs}						
G. Since participating in the CAMP Program, energy efficiency has become a greater priority for my company.. {Organizational Practices}						

7. How aware are you of ways to reduce the energy consumption of your compressed air system? Would you say you are very, somewhat, not too, or not at all aware? {Information/Search Costs}

   __ Very Aware
   __ Somewhat Aware
   __ Somewhat Unaware
   __ Very Unaware
   __ Don't Know
   __ Refused

8. As a part of the CAMP Program, the power consumption of your compressed air system was directly measured. Were you surprised by how much your company was spending on energy to drive your compressed air system? {Information / Search Costs}
   [1]___ Yes
   [2]___ No
   [-8]___ Don't Know
   [-9]___ Refused

9. Did this information help you decide to participate in the CAMP Program? {Information / Search Costs}

   [1]___ Yes
   [2]___ No
   [-8]___ Don't Know
   [-9]___ Refused

10. Did this information motivate your company to implement the recommended changes as soon as possible? {Organizational Practices}
   [1]___ Yes [SKIP TO Q12]
   [2]___ No
   [-8]___ Don't Know [SKIP TO Q12]
   [-9]___ Refused [SKIP TO Q12]

11. Why not? {Organizational Practices}

12. How satisfied are you with the information you have on ways to reduce the energy consumption of your compressed air system? Would you say you are very, somewhat, not too, or not at all satisfied? {Information/Search Costs}

__ Very Satisfied
__ Somewhat Satisfied
__ Somewhat Dissatisfied
__ Very Dissatisfied
__ Don't Know
__ Refused

13. According to my records, your company took _____ months to implement the recommended changes. What could the CAMP Program have done to shorten this time period? [Ask only if it took >4 months to implement] {Organizational Practices}

14. Since participating in the CAMP Program, has your company made the recommended improvements to the operation and maintenance procedures for your compressed air system? {Reasons for non-adoption of O&M practices}

[1]___ Yes	[SKIP TO Q. 18]
[2]___ No	[CONTINUE]
[-8]___ Don't Know	[SKIP TO Q. 18]
[-9]___ Refused	[SKIP TO Q. 18]

16. Does your company plan to make the recommended improvements with the next 12 months? {Reasons for non-adoption of O&M practices}

[1]___ Yes	[SKIP TO Q. 18]
[2]___ No	[CONTINUE]
[-8]___ Don't Know	[SKIP TO Q. 18]
[-9]___ Refused	[SKIP TO Q. 18]

17. Why not? {Reasons for non-adoption of O&M practices}

18. Since participating in the CAMP Program, have you shared the benefits of making improvements to compressed air systems with colleagues in other businesses.{Diffusion}

[1]___ Yes	[CONTINUE]
[2]___ No	[SKIP TO Q. 20]
[-8]___ Don't Know	[SKIP TO Q. 20]
[-9]___ Refused	[SKIP TO Q. 20]

19. Approximately, with how many of your colleagues in other business have you shared this information? .{Diffusion}

    ____ Number of Colleagues
    [-8]___ Don't Know
    [-9]___ Refused

Marketing

20. Who do you trust to provide you with unbiased information about reducing the energy use of your compressed air system? (CHECK ALL THAT APPLY) {Marketing}

    [1]__ a business colleague or professional peer
    [2]__ publication from a trade association
    [3]__ California Public Utilities Commission
    [4]__ PG&E
    [5]__ a compressed air vendor
    [6]__ an energy efficiency service company
    [7]__ Other (Please Specify:____
    [-8]__ Don't Know
    [-9]__ Refused

21. How do you prefer to obtain that information? (CHECK ALL THAT APPLY) {Marketing}

    [1]__ by telephone
    [2]__ by E-mail
    [3]__ by regular mail
    [4]__ by in-person contact
    [5]__ by fax
    [6]__ by attending a trade show
    [7]__ by attending a seminar/workshop
    [8]__ Other (Please Specify:____
    [-8]__ Don't Know
    [-9]__ Refused

22. Do you feel that all firms offering energy efficiency services are usually tied to companies trying to sell you equipment?{Asymmetric Information}

    ___ Yes
    ___ No
    ___ Don't Know
    ___ Refused

23. Other than the compressed air system upgrades you recently performed, has your company invested in energy efficiency in recent years? {Organizational Practices}

    [1]___ Yes [CONTINUE]
    [2]___ No [SKIP TO Q27]
    [-8]___ Don't Know [SKIP TO Q27]
    [-9]___ Refused [SKIP TO Q27]

24. Was this investment viewed as successful? {Organizational Practices}

    [1] Yes
    [2] No
    [-8] Don't Know
    [-9] Refused

Spillover

25. Were at least some of these energy efficiency investments made after participating in the CAMP Program?{Spillover}

    [1]___ Yes [Continue]
    [2]___ No [Skip to Q27]
    [-8]___ Don't Know [Skip to Q27]
    [-9]___ Refused [Skip to Q27]

Please briefly describe: ____
____
____

26. On a scale of 1 to 4, with a one meaning "Not At All Influential: and a 4 meaning "Very Influential", to what extent was the installation of these additional energy efficient measures influenced by your experience with the CAMP Program? {Spillover}

    ___ Influence
    [-8] Don't Know
    [-9] Refused

Implementation of Recommendations

27. **ASK IF PARTICIPANT DID NOT IMPLEMENT ALL RECOMMENDATIONS – ELSE SKIP TO Q29**. I noticed from the audits that there were more hardware recommendations made than what the company actually implemented (list non-implemented measures is needed). Can you let me know why some of these were not implemented? {Reasons for non-adoption}

28. Are there plans to implement these measures within the next 3 years? {Reasons for non-adoption of recommended measures}

    [1]___ Yes
    [2]___ No
    [-8]___ Don't Know
    [-9]___ Refused

Maintenance Agreement

29. **ASK IF PARTICIPANT DID NOT SIGN ON FOR ORIGINAL *OR* SIMPLIFIED MAINTENANCE AGREEMENT – ELSE SKIP TO Q31**. The program offered a maintenance package, yet my notes indicated that you chose not to participate in this component. Can you discuss a bit about why you choose not to participate in this? {Reasons for non-adoption of maintenance agreement}

30. Is there anything that the program could have changed about the maintenance program that would have caused you to choose to adopt such an agreement? Reasons for non-adoption of maintenance agreement}

31. **FOR THOSE WHO ORIGINALLY DECIDED NOT TO PARTICIPATE IN THE ORIGINAL MAINTENANCE PROGRAM, BUT WHO LATER DECIDED TO PARTICIPATE IN THE SIMPLIFIED MAINTENANCE PROGRAM.** My records show that your company has chosen to participate in a somewhat simplified maintenance plan. Can you discuss a bit about why you choose not to participate in the original plan? {Reasons for non-adoption of maintenance agreement}

Positive and Negatives

32. What were the most positive parts of the program? {Customer Satisfaction}

33. What were the parts of the program that you were most unhappy with and why? {Customer Satisfaction }

34. What recommendations, if any, do you have for improving the CAMP Program? {Customer Satisfaction}

Incentives

35. Finally, I'd like to ask you about the importance of the information and the incentives provided by the CAMP Program. If there were no incentives and you only had the information contained in the initial Assessment Report, how likely do you think it would have been that your company made the recommended changes in your compressed air system? Please use a four point scale with 1 being very unlikely and 4 being very likely. {How/Why Join}

    [1]___ Very unlikely
    [2]___ Somewhat unlikely
    [3]___ Somewhat likely
    [4] __ Very likely
    [-8]___ Don't Know
    [-9]___ Refused

SAY: THANK YOU FOR TAKING TIME FOR THIS INTERVIEW

End Time: ________________

Frequencies
Participants

1. I would imagine that you are approached by several entities each year that attempt to provide you with services. Why did you choose to participate in this program?

Q1

N	Valid	14
	Missing	0

Q1

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	At the time, they were trying to save ways to save money for the plant. Can't remember how they got hold of SBW. Since it was free, they did it.	1	7.1	7.1	7.1
	Because he was asked to – management had found out about it	1	7.1	7.1	14.3
	Because his manager told him to. Don't know other than it had EE and had a rebate. EE is always of interest to the company. Convinced his boss and he was given the assignment	1	7.1	7.1	21.4
	Brought to his attention by someone in the office. The call to them helped them decide.	1	7.1	7.1	28.6
	It looked to be a good savings. Most people don't know what the air costs to product and we use a lot in their facility. Looked like a good program. Have seen good reductions.	1	7.1	7.1	35.7
	Our parent company was in the program and so SBW contacted them and was interested in it.	1	7.1	7.1	42.9
	Roger had already signed an agreement with their sister mill and he got to look at their assessment and recommendations. The benefits and incentives looked good for them and so he contacted Roger. Head of maintenance was impressed with SBW	1	7.1	7.1	50.0
	SBW was the only one that approached them about compressed air management.	1	7.1	7.1	57.1
	See if they could save a bit on energy and they said it was free	1	7.1	7.1	64.3

	Frequency	Percent	Valid Percent	Cumulative Percent
The benefits looked very promising and went along with some of their major objectives and goals at the establishment to control operating costs. Have an energy reduction program that are working on in other pieced of equipment.	1	7.1	7.1	71.4
The biggest reason is the incentive that the program offered. Had an opportunity that happened to be there at the same.	1	7.1	7.1	78.6
This one was the first one to come by and had read a bit about it in trade journals. Had worked with PG&E on other end uses.	1	7.1	7.1	85.7
Usually we undertake self-initiated efficiency through SPC or Express but with reduced overhead and layoffs, have less people resources to go after resources. They had the information and SBW got together the information that provided the report to make a financial justification. More time effective to use a third party than their in-house folks because it take a much more rigorous evaluation. Wanted to save $$ as well.	1	7.1	7.1	92.9
We happened to be looking for a program similar to that – knew they needed to make some changes in the compressor system. Happened to be the right timing.	1	7.1	7.1	100.0
Total	14	100.0	100.0	

2. Did you trust the information provided to you about the CAMP Program?

Q2

N	Valid	14
	Missing	0

Q2

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1=Yes	13	92.9	92.9	92.9
	2=No	1	7.1	7.1	100.0
	Total	14	100.0	100.0	

3. What could the CAMP Program have done that would have given you greater confidence in the information provided?

Q3

N	Valid	14
	Missing	0

Q3

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	.	13	92.9	92.9	92.9
	He just didn't know about them - made a few phone calls about some of their analysis assumptions. Once understood the assumptions, it wasn't too much of a problem. Maybe had an assumptions page that showed him about the operations at his site.	1	7.1	7.1	100.0
	Total	14	100.0	100.0	

4. Did you think that the CAMP Program was just trying to sell you something?

Q4

N	Valid	14
	Missing	0

Q4

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1=Yes	5	35.7	35.7	35.7
	2=No	9	64.3	64.3	100.0
	Total	14	100.0	100.0	

5. What procedures within your company were required to obtain permission to participate in the CAMP Program?

Q5

N	Valid	14
	Missing	0

Q5

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Boss made the decision and he was handed the project. Don't think that his boss had to clear it with anyone.	1	7.1	7.1	7.1
	Didn't have to ask for permission	1	7.1	7.1	14.3
	Facility manger (his) agreement and site manager (his boss) approval to proceed. Interpreted as a non-binding agreement. No penalty or consequence if failed to provide.	1	7.1	7.1	21.4
	Had a CAMP meeting presentation on what they could provide and convinced upper management that they should go forward. It was a professional presentation. Decision wasn't made right then, but staff meeting discussions caused them to go forward.	1	7.1	7.1	28.6
	Had to discuss it with plant controller, plant manager, and his boss. Required corporate approval to purchase the compressor.	1	7.1	7.1	35.7
	Had to go through several formal procedures for approval – define project and own cash flow and analysis.	1	7.1	7.1	42.9

	Frequency	Percent	Valid Percent	Cumulative Percent
Had to go to the director of saw mill operations who had to go to the VP to do it	1	7.1	7.1	50.0
Had to talk to himself – he was the decision maker	1	7.1	7.1	57.1
His OK. Talked to his boss about it. He is General manager of the company	1	7.1	7.1	64.3
I just reviewed it with his Boss (head of CA operations). Since it had already been completed at the other site, it was not big deal.	1	7.1	7.1	71.4
Ran it through the chief engineer and he ran it through the plant manager.	1	7.1	7.1	78.6
They had to get a capital project approval and used some of the CAMP savings as some of the justification for the project.	1	7.1	7.1	85.7
We did the evaluation since it was free, did it to see where the system was at. Once data compiled and could see where the savings were, they went to management to get capitol funds to do the project. Have been doing many other EE projects T8 and T5 and have see. Management required report to obtain the capital funds.	1	7.1	7.1	92.9
Went to the owners of the company and they decided	1	7.1	7.1	100.0
Total	14	100.0	100.0	

6A. I was very satisfied with the application procedures of the CAMP program

Q6A

N	Valid	14
	Missing	0

Q6A

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1=Disagree Strongly	1	7.1	7.1	7.1
	3=Agree Somewhat	6	42.9	42.9	50.0
	4=Agree Strongly	7	50.0	50.0	100.0
	Total	14	100.0	100.0	

6B. I found the savings estimates and payback information provided in the assessment report very believable.

Q6B

N	Valid	14
	Missing	0

Q6B

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2=Disagree Somewhat	1	7.1	7.1	7.1
	3=Agree Somewhat	9	64.3	64.3	71.4
	4=Agree Strongly	4	28.6	28.6	100.0
	Total	14	100.0	100.0	

6C. I found the savings estimates and payback information provided in the verification report very believable.

Q6C

N	Valid	14
	Missing	0

Q6C

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2=Disagree Somewhat	1	7.1	7.1	7.1
	3=Agree Somewhat	4	28.6	28.6	35.7
	4=Agree Strongly	9	64.3	64.3	100.0
	Total	14	100.0	100.0	

6D. Overall, I was very satisfied with the CAMP Program

Q6D

N	Valid	14
	Missing	0

Q6D

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2=Disagree Somewhat	1	7.1	7.1	7.1
	3=Agree Somewhat	4	28.6	28.6	35.7
	4=Agree Strongly	9	64.3	64.3	100.0
	Total	14	100.0	100.0	

6E. Repairing and upgrading my compressed air system was cost effective.

Q6E

N	Valid	12
	Missing	2

Q6E

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	3=Agree Somewhat	3	21.4	25.0	25.0
	4=Agree Strongly	9	64.3	75.0	100.0
	Total	12	85.7	100.0	
Missing	System	2	14.3		
Total		14	100.0		

6F. Since participating in the CAMP Program, I have a much better idea about the costs of operating my compressed air system

Q6F

N	Valid	14
	Missing	0

Q6F

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2=Disagree Somewhat	2	14.3	14.3	14.3
	3=Agree Somewhat	3	21.4	21.4	35.7
	4=Agree Strongly	9	64.3	64.3	100.0
	Total	14	100.0	100.0	

6G. Since participating in the CAMP Program, energy efficiency has become a greater priority for my company..

Q6G

N	Valid	14
	Missing	0

Q6G

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2=Disagree Somewhat	5	35.7	35.7	35.7
	3=Agree Somewhat	6	42.9	42.9	78.6
	4=Agree Strongly	3	21.4	21.4	100.0
	Total	14	100.0	100.0	

6OTH. Responses to Q6 answers.

Q6OTH

N	Valid	14
	Missing	0

Q6OTH

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	.	7	50.0	50.0	50.0
	A - initial requirements were not realized and neither did they recognize that the requirements were almost unachievable. At the end of the process, they figured it out (he is talking about the O&M procedures here) D - if had not come to agreement at the end, would have been very dissatisfied.	1	7.1	7.1	57.1
	For 6C, SBW did not factor in the variability of the system over the year, so he felt that the savings would be highly variable. For 6G, it was already a priority.	1	7.1	7.1	64.3
	For 6E, they did not implement anything, so this is NA. For 6G, it has always been a priority	1	7.1	7.1	71.4
	For 6G, it has always been a priority	3	21.4	21.4	92.9

		Frequency	Percent	Valid Percent	Cumulative Percent
	For 6G, it has always been a priority, for 6E, NA because didn't implement anything	1	7.1	7.1	100.0
	Total	14	100.0	100.0	

7. How aware are you of ways to reduce the energy consumption of your compressed air system?

Q7

N	Valid	14
	Missing	0

Q7

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	3=Somewhat Aware	6	42.9	42.9	42.9
	4=Very Aware	8	57.1	57.1	100.0
	Total	14	100.0	100.0	

8. As apart of the CAMP Program, the power consumption of your compressed air system was directly measured. Were you surprised by how much your company was spending on energy to drive your compressed air system?

Q8

N	Valid	14
	Missing	0

Q8

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1=Yes	9	64.3	64.3	64.3
	2=No	5	35.7	35.7	100.0
	Total	14	100.0	100.0	

9. Did this information help you decide to participate in the CAMP Program?

Q9

N	Valid	14
	Missing	0

Q9

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1=Yes	11	78.6	78.6	78.6
	2=No	3	21.4	21.4	100.0
	Total	14	100.0	100.0	

10. Did this information motivate your company to implement the recommended changes as soon as possible?

Q10

N	Valid	14
	Missing	0

Q10

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1=Yes	11	78.6	78.6	78.6
	2=No	3	21.4	21.4	100.0
	Total	14	100.0	100.0	

11. Why not?

Q11

N	Valid	14
	Missing	0

Q11

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	.	11	78.6	78.6	78.6
	Cost	1	7.1	7.1	85.7
	There were some changes that they didn't do.	1	7.1	7.1	92.9
	They were short of manpower at the time of the implementation and did not want to bring in outside folks. There was nothing that SBW could have done about it.	1	7.1	7.1	100.0
	Total	14	100.0	100.0	

12. How satisfied are you with the information you have on ways to reduce the energy consumption of your compressed air system?

Q12

N	Valid	14
	Missing	0

Q12

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2=Somewhat Dissatisfied	1	7.1	7.1	7.1
	3=Somewhat Satisfied	5	35.7	35.7	42.9
	4=Very Satisfied	8	57.1	57.1	100.0
	Total	14	100.0	100.0	

13. According to my records, your company took _____ months to implement the recommended changes. What could the CAMP Program have done to shorten this time period?

Q13

N	Valid	14
	Missing	0

Q13

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	.	9	64.3	64.3	64.3
	Could have called him back sooner. Told them that they had it piped in and SBW took a couple months to get out there. They did do some pressure reduction during that time. Did have a couple warranty issues that had to deal with that may have effected things in a couple ways and they needed to get it fixed. But they were minor.	1	7.1	7.1	71.4

		Frequency	Percent	Valid Percent	Cumulative Percent
	Nothing - they are a small sawmill and lost about 50% of their experienced maintenance staff right after they got involved with CAMP. And then they had some major equipment that they had to redo, to CAMP was lower priority. Had training going on with new employees. Would have been done sooner.	1	7.1	7.1	78.6
	There was a misunderstanding on the first part of it. He had delegated to a maintenance manager and he implemented things that were different from what was recommended in the program and they had to go back to re-do some things. If there could have been better communication that they were deviating from the proposed project that would have been helpful.	1	7.1	7.1	85.7
	They had some problems too, so they strung it out themselves. Not CAMP problem. SBW did a good job at letting them know what to do.	1	7.1	7.1	92.9
	They were doing the cylinders already and felt that CAMP was trying to take credit for that measure being installed.	1	7.1	7.1	100.0
	Total	14	100.0	100.0	

13Mon. Number of months it took to implement changes.

Q13MONTHS

N	Valid	14
	Missing	0

Q13MONTHS

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2	1	7.1	7.1	7.1
	3	3	21.4	21.4	28.6
	4	5	35.7	35.7	64.3
	6	1	7.1	7.1	71.4
	7	4	28.6	28.6	100.0
	Total	14	100.0	100.0	

14. Since participating in the CAMP Program, has your company made the recommended improvements to the operation and maintenance procedures for your compressed air system?

Q14

N	Valid	14
	Missing	0

Q14

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1=Yes	12	85.7	85.7	85.7
	2=No	2	14.3	14.3	100.0
	Total	14	100.0	100.0	

16. Does your company plan to make the recommended improvements with the next 12 months?

Q16

N	Valid	14
	Missing	0

Q16

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	.	12	85.7	85.7	85.7
	1	1	7.1	7.1	92.9
	See Q17	1	7.1	7.1	100.0
	Total	14	100.0	100.0	

17. Why not?

Q17

N	Valid	14
	Missing	0

Q17

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	.	13	92.9	92.9	92.9
	Already utilitizing before the switch over and continuing. They have a rigorous O&M already, so that aspect has quarterly PM with an outside contractor. They had a mismatched compressor and dryer and probably trying to drive the air too much, but not as much as suggested by SBW. Monitoring to see if causing disruptions	1	7.1	7.1	100.0
	Total	14	100.0	100.0	

18. Since participating in the CAMP Program, have you shared the benefits of making improvements to compressed air systems with colleagues in other businesses?

Q18

N	Valid	14
	Missing	0

Q18

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Don't Know	1	7.1	7.1	7.1
	1=Yes	4	28.6	28.6	35.7
	2=No	9	64.3	64.3	100.0
	Total	14	100.0	100.0	

18A. Responses to Q18 (responses from those where Q18=No or Don't Know)

Q18A

N	Valid	14
	Missing	0

Q18A

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	.	10	71.4	71.4	71.4
	But has shared it with 5-10 employees at that business.	1	7.1	7.1	78.6
	But shared it within the company and have another plant in Crescent City and have a trucking company.	1	7.1	7.1	85.7
	Manager may have, but he doesn't know.	1	7.1	7.1	92.9
	Won't because would help competitor with their bottom line.	1	7.1	7.1	100.0
	Total	14	100.0	100.0	

19. Approximately, with how many of your colleagues in other business have you shared this information?

Q19

N	Valid	14
	Missing	0

Q19

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	.	10	71.4	71.4	71.4
	Another division within the company (in another city - 5 200 hp in those sites).	1	7.1	7.1	78.6
	Friends in the business that have 3 compressors and a little mill down the road. Shared that they had continued energy savings and about the CAMP program. CAMP is helping one of them, but don't know about the other.	1	7.1	7.1	85.7
	Couldn't really say how many, but did indicate that he talked with others in the business about it	1	7.1	7.1	92.9

		Frequency	Percent	Valid Percent	Cumulative Percent
	3 or 4 (The program was relatively new - they were the 2nd to implement in California. He called the other person to see how it {I think he was talking about the VFD} was implemented - a few people have called him to verify the savings that they saw - A compressor manufacturer and other businesses to see how the VFD worked for them)	1	7.1	7.1	100.0
	Total	14	100.0	100.0	

20. Who do you trust to provide you with unbiased information about reducing the energy use of your compressed air system?

Q20

N	Valid	14
	Missing	0

Q20

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	1	7.1	7.1	7.1
	2	1	7.1	7.1	14.3
	4, 7	4	28.6	28.6	42.9
	4, 5	1	7.1	7.1	50.0
	5	1	7.1	7.1	57.1
	7	6	42.9	42.9	100.0
	Total	14	100.0	100.0	

Key: 1=business colleague or professional peer, 2=publication from a trade association, 4=PG&E, 5=a compressed air vendor, 7=other

20Oth. If Q20 has other selected.

Q20OTH

N	Valid	14
	Missing	0

Q20OTH

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	.	4	28.6	28.6	28.6
	A third party, someone not involved with the $$ part of it. Liked getting all the information from CAMP and not give them which to use.	1	7.1	7.1	35.7
	CAMP	1	7.1	7.1	42.9
	Consultants in PCUC programs	1	7.1	7.1	50.0
	EE Consultant	1	7.1	7.1	57.1
	Meters	1	7.1	7.1	64.3
	Not an exact science, can get differing flow amounts. SBW had a more rigorous approach, but the numbers were estimated. Vendors (suppliers) seem to be	1	7.1	7.1	71.4
	SBW	2	14.3	14.3	85.7
	SBW, manufacturers	1	7.1	7.1	92.9
	Whoever can convince him.	1	7.1	7.1	100.0
	Total	14	100.0	100.0	

21. How do you prefer to obtain that information?

Q21

N	Valid	14
	Missing	0

Q21

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1, 2, 3, 7, 8	1	7.1	7.1	7.1
	2	5	35.7	35.7	42.9
	2,4,8	1	7.1	7.1	50.0
	3	3	21.4	21.4	71.4
	4	1	7.1	7.1	78.6
	8	3	21.4	21.4	100.0
	Total	14	100.0	100.0	

Key: 1=telephone, 2=email, 3=regular mail, 4=in person contact, 7=seminar/workshop, 8=other

21Oth. If Q21 has other selected.

Q21OTH

N	Valid	14
	Missing	0

Q21OTH

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	.	9	64.3	64.3	64.3
	Magazine	1	7.1	7.1	71.4
	Not applicable to any categories	1	7.1	7.1	78.6
	PG&E person works with them quite a bit on ideas	1	7.1	7.1	85.7
	Research it through books	1	7.1	7.1	92.9
	Technical report with teleconference to cover findings - liked the executive overview (to finance) and tech part - that was unique and appreciated	1	7.1	7.1	100.0
	Total	14	100.0	100.0	

22. Do you feel that all firms offering energy efficiency services are usually tied to companies trying to sell you equipment?

Q22

N	Valid	13
	Missing	1

Q22

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1=Yes	8	57.1	61.5	61.5
	2=No	5	35.7	38.5	100.0
	Total	13	92.9	100.0	
Missing	System	1	7.1		
Total		14	100.0		

22Oth. Responses to Q22. (unsolicited responses from Q22)

Q22OTH

N	Valid	14
	Missing	0

Q22OTH

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	.	7	50.0	50.0	50.0
	90 % have some linkage or joint alliance.	1	7.1	7.1	57.1
	But I hope not.	1	7.1	7.1	64.3
	Can usually tell by talking to them, probably 50% of the are, not sure.	1	7.1	7.1	71.4
	Don't want to get besieged by email.	1	7.1	7.1	78.6
	Exception was Ingersoll Rand who had called him and belittled SBW to try to get their business. He doesn't know how Ingersoll Rand got the information that SBW had a contract with him probably talking to a millwright. He had met with Roger and knew SBW's capabilities and so was turned off by Ingersoll Rand.	1	7.1	7.1	85.7

	Generally, the ones he has had experience with are just the opposite.	1	7.1	7.1	92.9
	Lots of government and CPUC programs.	1	7.1	7.1	100.0
	Total	14	100.0	100.0	

23. Other than the compressed air system upgrades you recently performed, has your company invested in energy efficiency in recent years?

Q23

N	Valid	14
	Missing	0

Q23

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1=Yes	13	92.9	92.9	92.9
	2=No	1	7.1	7.1	100.0
	Total	14	100.0	100.0	

24. Was this investment viewed as successful?

Q24

N	Valid	13
	Missing	1

Q24

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1=Yes	13	92.9	100.0	100.0
Missing	System	1	7.1		
Total		14	100.0		

25. Where at least some of these energy efficiency investments made after participating in the CAMP Program?

Q25

N	Valid	13
	Missing	1

Q25

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1=Yes	3	21.4	23.1	23.1
	2=No	10	71.4	76.9	100.0
	Total	13	92.9	100.0	
Missing	System	1	7.1		
Total		14	100.0		

25A. Please describe briefly.

Q25A

N	Valid	14
	Missing	0

Q25A

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	.	11	78.6	78.6	78.6
	Did CAMP and then went to PG&E for refrigeration compressors	1	7.1	7.1	85.7
	Premium efficiency motors are purchased at all times. They also have a big cat generator that runs the whole sawmill and run it in May to Oct during peak demand hours (in before CAMP). Has done some full spectrum lighting and helps them grade the lumber better - did the lighting after CAMP.	1	7.1	7.1	92.9
	VFD on different component in the plant – make the bottles	1	7.1	7.1	100.0
	Total	14	100.0	100.0	

26. On a scale of 1 to 4, with a one meaning "Not At All Influential: and a 4 meaning "Very Influential", to what extent was the installation of these additional energy efficient measures influenced by your experience with the CAMP Program?

Q26

N	Valid	3
	Missing	11

Q26

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2	1	7.1	33.3	33.3
	3	1	7.1	33.3	66.7
	4=Very Influential	1	7.1	33.3	100.0
	Total	3	21.4	100.0	
Missing	System	11	78.6		
Total		14	100.0		

27. I noticed from the audits that there were more hardware recommendations made than what the company actually implemented. Can you let me know why some of these were not implemented?

Q27

N	Valid	14
	Missing	0

Q27

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	.	5	35.7	35.7	35.7
	Air leakage being done on the weekends - so going after the leakage. In order for some of the machinery to be held up (like scissor lift), needs some compressed air. To modify the load control and still maintain 70 psi on the mill floor is a safety issue. However, they have a 24/7 operation on the mill floor.	1	7.1	7.1	42.9
	Cost was the reason that none of the measures were implemented	1	7.1	7.1	50.0
	Have so many connections around, will always have leakage – always fighting with it. Have put it into the PM.	1	7.1	7.1	57.1
	Implemented all but one - the one measure they didn't do was because it had to go through the air district to make the changes, but needed a permit application and chose not to do it.	1	7.1	7.1	64.3

		Frequency	Percent	Valid Percent	Cumulative Percent
	Leaks are always trying to fix - will continue to do this. May try to reduce the psig - may need to get a new compressor with the new controls, but in the hang on mode again because of the market.	1	7.1	7.1	71.4
	Our process has two parts - the face and core part. They implemented changes dealing with the face part of their process. Planned to do the core part as part of a Phase II, but doesn't look like the technology is there yet, so not currently going to do it.	1	7.1	7.1	78.6
	The head electrician was building that control himself and he retired right in the middle of it. They repaired some of the controls and got their vendor looking at it to figure what to do with it.	1	7.1	7.1	85.7
	There were a couple of different reasons. There was not sufficient payback to implement a couple of them and exceeded their original capitol request.	1	7.1	7.1	92.9
	They have two different systems, but could only do it on one system, but couldn't do it on the other machine.	1	7.1	7.1	100.0
	Total	14	100.0	100.0	

28. Are there plans to implement these measures within the next 3 years?

Q28

N	Valid	9
	Missing	5

Q28

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1=Yes	8	57.1	88.9	88.9
	2=No	1	7.1	11.1	100.0
	Total	9	64.3	100.0	
Missing	System	5	35.7		
Total		14	100.0		

28A. Responses to 28.

Q28A

N	Valid	14
	Missing	0

Q28A

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	.	7	50.0	50.0	50.0
	as they do any upgrades to their compressor systems	1	7.1	7.1	57.1
	hopefully first half of 2005	1	7.1	7.1	64.3
	if technology is available	1	7.1	7.1	71.4
	in the next year	1	7.1	7.1	78.6
	maybe if they get into trouble with air quality, may do it	1	7.1	7.1	85.7
	Maybe.	1	7.1	7.1	92.9
	possibly may do the shutting down of compressors, but is not a high priority	1	7.1	7.1	100.0
	Total	14	100.0	100.0	

29. The program offered a maintenance package, yet my notes indicated that you chose not to participate in this component. Can you discuss a bit about why you choose not to participate in this?

Q29

N	Valid	14
	Missing	0

Q29

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	.	8	57.1	57.1	57.1
	Because of their own ongoing maintenance. They have a standard changes of the compressors.	1	7.1	7.1	64.3
	Mainly because the payback wasn’t there, there was too much money up front	1	7.1	7.1	71.4
	Not to go with it because they are already doing it - came from corporate and don't know why they said not to do it. It was an upper corporate decision. At first rejected because they had to bring in other people to do the original part and didn't like the "pre-approved" folks because had their own folks they worked with. Even with the simplified part, they do their own in house work anyway.	1	7.1	7.1	78.6
	Paper trail portion – have enough with ammonia system and didn’t want to deal with it.	1	7.1	7.1	85.7
	Probably the owners decision on that.	1	7.1	7.1	92.9
	They chose not to go to an outside firm and the simplified one came about, but they decided not to do it without any good justification.	1	7.1	7.1	100.0
	Total	14	100.0	100.0	

30. Is there anything that the program could have changed about the maintenance program that would have caused you to choose to adopt such an agreement?

Q30

N	Valid	14
	Missing	0

Q30

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	.	9	64.3	64.3	64.3
	Don't think so – have a program in place, don't need another one.	1	7.1	7.1	71.4
	Don't think so. It was just a bunch of forms to fill out and nobody to verify it - just pushing paper to do it. That way would not feel guilty if didn't do it.	1	7.1	7.1	78.6
	Not that he could think of.	1	7.1	7.1	85.7
	Probably isn't – more the attitude there that don't do that sort of thing.	1	7.1	7.1	92.9
	They thought it was a good change, but decision was still no.	1	7.1	7.1	100.0
	Total	14	100.0	100.0	

31. My records show that your company has chosen to participate in a somewhat simplified maintenance plan. Can you discuss a bit about why you choose not to participate in the original plan?

Q31

N	Valid	14
	Missing	0

Q31

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	.	6	42.9	42.9	42.9
	Did sign the simplified O&M. Had done the original one as well, but by the time that the hardware was done, the O&M had changed, so they did that instead	1	7.1	7.1	50.0
	Drawing a blank. Simplified may have been easier to talk to his folks.	1	7.1	7.1	57.1
	Have signed it. The original had the requirement to be monitored by a third party on a list. The AirMaster person that was close to them was no longer there. After he tracked the person down (he had moved companies), that guy was willing to do the oversight, but the price was most of the incentive check. Decided it was an awful lot of work to break even.	1	7.1	7.1	64.3
	Not sure that they decided not to, but did not have time to respond to it. This makes it simpler, but would have probably done the other plan	1	7.1	7.1	71.4
	The problem was that the contract service provider to check their work. They are in a remote area and one guy around to hit Oregon to CA-Bakersfield and Nevada and he just could not do the oversight.	1	7.1	7.1	78.6

		Frequency	Percent	Valid Percent	Cumulative Percent
	Their company has a policy that they do not sign long term programs for services (nothing beyond a year). Would have had to sign one for three years in the original one.	1	7.1	7.1	85.7
	They did that.	1	7.1	7.1	92.9
	Time – manpower. First one, didn't have enough manpower to do all that was in it	1	7.1	7.1	100.0
	Total	14	100.0	100.0	

32. How are you integrating the recommended O&M practices into your current maintenance schedule?

Q32

N	Valid	14
	Missing	0

Q32

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	.	6	42.9	42.9	42.9
	Already in their PM.	1	7.1	7.1	50.0
	Into their PM	1	7.1	7.1	57.1
	Company has a contract with a contractor to do the maintenance with their compressors. They looked at the O&M documentation and have accepted that. They will do some of the checks, but feels that the recommendations from SBW are overkill.	1	7.1	7.1	64.3
	Modified their PM procedure	1	7.1	7.1	71.4

		Frequency	Percent	Valid Percent	Cumulative Percent
	Set into their PM and performing it on the weekends. Doing the filter switch as recommended by the manufacturer. 2 part time employees and do O&M Saturday and Sunday – asked for extra PT help to do this and asked for 1 more part time person and they gave him 2.	1	7.1	7.1	78.6
	They do that and have contracted with air compressor people as a factory person to do it.	1	7.1	7.1	85.7
	Used to have a computerized PM, but no longer functioning. They work off the timers on the compressors and do maintenance when the timer says to do it. They check every couple days and do the maintenance when needed.	1	7.1	7.1	92.9
	Work with a local vendor.	1	7.1	7.1	100.0
	Total	14	100.0	100.0	

33. What were the most positive parts of the program?

Q33

N	Valid	14
	Missing	0

Q33

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Being able to see in black and white the equipment monitored. Were impressed with that and how they captured the results. No disputing what they found.	1	7.1	7.1	7.1
	Can't say	1	7.1	7.1	14.3
	Getting a new compressor that runs all the time. Reduced the pressures and demand is lower due to leak repairs, so the compressor shuts off sometimes.	1	7.1	7.1	21.4
	Had actually hoped that there was some big problems, but when didn't it was kind of nice to know they were doing OK.	1	7.1	7.1	28.6
	Learned about how their system worked and how they could better utilize the system.	1	7.1	7.1	35.7
	Lynn Qualmann is a good individual and worked with them quite a bit. Got personal attention from Lynn.	1	7.1	7.1	42.9
	Made them look at a system that they had ignored for a while. It was working, so didn't look at it.	1	7.1	7.1	50.0
	Seeing the air dryer controls to watch them in action.	1	7.1	7.1	57.1
	The measuring of the equipment. Liked getting the information from it. Gave him a starting point to work from.	1	7.1	7.1	64.3

		Frequency	Percent	Valid Percent	Cumulative Percent
	The test that Roger did on their compressor load control that they currently have. Roger showed them a real easy way to check the actual kW of the motor with a laptop and CT. That way they know what the motor is pulling and not rely on the gauges. It was a big benefit for them.	1	7.1	7.1	71.4
	Trying to teach people what is going on other then himself and showing them what is going on and why and the savings.	1	7.1	7.1	78.6
	Viewing the time-of-most-use - to get that data and trying to figure out how to reduce their pressures at non-production times. Working with venders to put in PLCs to reduce pressures. Having the data was very helpful.	1	7.1	7.1	85.7
	Working with a technically qualified individual from SBW and an organization who approaches it without product bias, but looking for the best system solution. Not one name brand or manufacturer mentioned.	1	7.1	7.1	92.9
	Working with Roger Hunter with SBW. He was very knowledgeable and helpful. Savings to the bottom line.	1	7.1	7.1	100.0
	Total	14	100.0	100.0	

34. What were the parts of the program that you were most unhappy with and why?

Q34

N	Valid	14
	Missing	0

Q34

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Can't say was unhappy with any of it.	1	7.1	7.1	7.1
	Can't say was unhappy, but it did seem like they were trying to sell things that they didn't need or want.	1	7.1	7.1	14.3
	Didn't experience any problems with the program. But did have a bit of a problem with the unloading controls as supplied by the vendor – getting the system to work properly for them took a while. Machine went into blow down mode – some due to existing controls that had problems intermittently.	1	7.1	7.1	21.4
	I was not unhappy with any part of the program – time consuming, but was enthused about the program.	1	7.1	7.1	28.6
	Nothing really - it was all helpful.	1	7.1	7.1	35.7
	Original maintenance agreement, not with the modified one.	1	7.1	7.1	42.9
	Oversight on the O&M and had to chase down the AirMaster person and the cost was very high.	1	7.1	7.1	50.0
	Primarily that they felt that they were being consulted up front and when the project did not follow the SBW expectations and it was not communicated to him until it at the end of the project when it was too late.	1	7.1	7.1	57.1

		Frequency	Percent	Valid Percent	Cumulative Percent
	SBW was telling them initially that they needed only a 50 hp compressor but had measured peaks that would have required a 75 hp compressor. He decided to go to a 100 hp compressor because their plant has large swings in production. SBW predicted that leaks would have reduced use and would have needed a smaller compressor, but he knew that there are big swings in the plant use and that one week of data may not have caught that.	1	7.1	7.1	64.3
	The documentation (a little difficult to understand about what was offered and what was delivered) and the changing of the program. Always unsure until the last moment that would be getting an incentive check.. Had a good letter of intent at the beginning and relied on this that the state would not change things.	1	7.1	7.1	71.4
	The only thing that surprised them was that all the information came from out of the state of California (SBW). Couldn't figure out why a California firm wouldn't be doing state work.	1	7.1	7.1	78.6
	The paperwork part of it.	1	7.1	7.1	85.7
	The time it took them to implement the recommendations- had nothing to do with SBW. Totally happy with their professionalism and what they provided.	1	7.1	7.1	92.9
	Wasn't any part that he was displeased with	1	7.1	7.1	100.0
	Total	14	100.0	100.0	

35. What recommendations, if any, do you have for improving the CAMP Program?

Q35

N	Valid	14
	Missing	0

Q35

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Can't think of anything.	1	7.1	7.1	7.1
	Can't recommend anything	1	7.1	7.1	14.3
	Can't think of any.	1	7.1	7.1	21.4
	Don't know what they would be	1	7.1	7.1	28.6
	Don't have any – program Don't have any - program works well and satisfied with what they did. SBW worked hard for them even after found problems and SBW re-doubled efforts to help them out. Changed the incentive portion so that if they do the recommended change, but don't see the savings, still get the same incentive. They don't have to do the hard verification and they are no longer doing that. Feels this is a good thing for the program.	1	7.1	7.1	35.7
	Don't know – can't think of anything. Went pretty smooth.	1	7.1	7.1	42.9
	Don't know – think that when they do the initial assessment, do an overview to see if they need to do it, but not sure what one could do.	1	7.1	7.1	50.0
	Haven't thought of any	1	7.1	7.1	57.1

		Frequency	Percent	Valid Percent	Cumulative Percent
	If there are other systems or activities that they get involved with - DX chillers that are 15 years old and need energy studies about which portion of the gear set should be considered for retrofit, but don't have any engineering studies to look at to see what they could do. PG&E is starting a study on the same building, but don't have as much confidence in their engineering studies as SBW because they seemed more independent. PG&E seems to try to set up to benefit their needs first and the customers second. At no time, did they feel like SBW was biased or prejudiced. SBW was able to narrow down where to obtain savings and then they could take it from there.	1	7.1	7.1	64.3
	Maybe just me, but anytime you start dealing with government, I get an uneasy feeling that they are overseeing him. If could eliminate the state, people may be more attuned with the program. (Understood that it is public money and need to verify the use, but that is what he felt.)	1	7.1	7.1	71.4
	No - just to continue it.	1	7.1	7.1	78.6
	On the right track now.	1	7.1	7.1	85.7
	Spell out ahead of time that cannot cancel it and go to another program. Thought they could cancel and switch to another program (PG&E said a $0.08/kWh incentive and vendors were trying to get this to do that program).	1	7.1	7.1	92.9
	Would have to work with Roger to see what could be improved– they did a great job and a lot of data was taken did an excellent job.	1	7.1	7.1	100.0
	Total	14	100.0	100.0	

36. If there were no incentives and you only had the information contained in the initial Assessment Report, how likely do you think it would have been that your company made the recommended changes in your compressed air system?

Q36

N	Valid	14
	Missing	0

Q36

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1=Very Unlikely	1	7.1	7.1	7.1
	2-Somewhat Unlikely	3	21.4	21.4	28.6
	3=Somewhat Likely	6	42.9	42.9	71.4
	4=Very Likely	4	28.6	28.6	100.0
	Total	14	100.0	100.0	

36Oth. Responses to Q36.

Q36OTH

N	Valid	14
	Missing	0

Q36OTH

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	.	5	35.7	35.7	35.7
	Both compressors need $12,000 – $25,000 worth of work	1	7.1	7.1	42.9
	But not to the extent that they did.	1	7.1	7.1	50.0
	Definitely people behind it, but the incentives made it easier to do the request for capitol and the ROI became more attractive with the incentives.	1	7.1	7.1	57.1
	If it was of any monetary value to them (something big, not $2,000 per year type of thing as they spend $200,000/month on electricity)	1	7.1	7.1	64.3
	If SBW had had a list of customers that he could have called and SBW could have sold it as a service, he would have. Make local contacts and word-of-mouth will spread the fact that SBW is providing this service. The bottom line savings caught him - as a manager everyone should be looking at this and doing it without an incentive.	1	7.1	7.1	71.4
	Not worth having someone out there, "They know their system"	1	7.1	7.1	78.6
	On the ones with immediate payback (less than 1 month)	1	7.1	7.1	85.7
	their cost to implement was very low, but if their cost to implement had been substantial, the incentive would probably have played a bigger part.	1	7.1	7.1	92.9

		Frequency	Percent	Valid Percent	Cumulative Percent
	would have taken a lot longer to achieve. It helped to indicate the payback. It would have taken a lot of his time to do this, but with the business report and the information, it was a great payback. His boss found the 3rd party helpful in making sure that the information was not biased to trying to get the work done. The company was on a capital freeze, but they got this through based on the payback in the SBW reports.	1	7.1	7.1	100.0
	Total	14	100.0	100.0	

Appendix C

On-Site Inspection Instrument

Company Name: ____________________________
Address:___________________________________
Date:______________________________________
Project Number: CAMP_ _

Task	Comments
1) *By reviewing program documentation and interviewing appropriate plant staff, verify baseline and post-installation plant conditions.* a) Used in conjunction with SBW supplied Block Diagram of the facility i) Arrange for the appropriate plant personnel to provide a guided tour of the facility. ii) Develop a general understanding of the compressed air system and how it fits into overall plant operations – how the compressed air is used to support production. iii) Observe: (1) Inappropriate air use (2) Point of use connections (3) High volume intermittent demands b) Visit sites when post installation/commissioning metering and monitoring equipment are in place so that placement of the equipment can be identified and reviewed.	
2) *Using block diagrams supplied by SBW, verify all SBW installations.* a) Identify that true power is measured on all the compressors in the system. b) Identify where pressure measurements are being taken in the supply side. c) Identify other areas in the system where a pressure measurement might be taken.	

3) *Identify any issues that may relate to air quality, compressor reliability, or energy concerns that may affect SBW-estimated savings.* a) Observe items such as: i) Human error ii) Connection to the system iii) Ambient conditions iv) Maintenance issues	
4) *Locate and review the placement of all monitoring equipment installed by SBW.* a) Review of task # 2 items.	
5) Note feasibility of locations picked by SBW for logging and sample rates used. a) *Measurements at 3-second intervals can uncover changes in the compressed air system that occurs very quickly.* i) *Observe if any spot pressure measurements are sampled correctly.* ii) *Based on Nyquist Theorem of at least 3 data points for the shortest event being measured.*	

Block Diagram of the Compressed Air System Goes Here

Appendix D

Engineering Review Instrument

Company Name: ______________________________
Address:______________________________________
Date:____
Project Number: CAMP_ _

Task	Comments
1) *For each of the sites visited, we will review the completed AIRMaster+ mdb files submitted by SBW.* a) For each of the six AIRMaster+ modules we will review the information entered by SBW. i) Verify that all information has been correctly input into AIRMaster+ files (1) Company (a) Verify company information. (2) Utility (a) Verify utility company data or rate schedules (3) Facility (a) Review facility data, facility utility rate assignment, and a summary of the air compressors on site for the selected company. (4) System (a) Verify system-level information, including design and performance parameters, automatic sequencer control pressure set points, daytypes, and end uses. (5) Compressor (a) Verify air compressor information, including detailed specifications. (6) Profile (a) Review hourly average airflow or power information and operating schedules. (b) Verify system baseline airflow requirements and associated energy and demand costs for the selected system and daytype.	
2) Examine the possible EEM's (energy efficiency measures), which were analyzed using	

AIRMaster+, and verify their feasibility. a) Evaluate air system energy savings potential from the selected Energy Efficiency Measures, considering interactive effects of EEMs: (1) Reduce Air Leaks (2) Improve End Use Efficiency (3) Reduce System Air Pressure (4) Use Unloading Controls (5) Adjust Cascading Set Points (6) Use Automatic Sequencer (7) Reduce Run Time (8) Add Primary Receiver Volume	

Appendix E

On-Site Inspection and Engineering Review Results

Project Number: CAMP01	
Audit Date:	September, 2003
SBW Verified kWh:	301,211
Evaluation Verified kWh :	301,211
SBW Verified kW :	57.8
Evaluation Verified kW	57.8
Site Gross kWh Realization Rate: 100%	
Site Gross kW Realization Rate: 100%	

I. On-Site Inspections

A. Background

In the winter of 2003, SBW Consulting performed an assessment of the compressed air system at a bakery in California. Following implementation of energy conservation measures by the customer, SBW returned to the site in September of 2003 to measure the performance of the retrofitted system. The performance data were analyzed to determine the actual energy savings achieved by the retrofits.

On October 5th 2004, a member of the Evaluation Team visited the site to verify baseline and post-installation plant conditions. He met with a member of the company's maintenance staff who was present during SBW's visits. This person provided a very thorough tour of the facility as a way of providing a general understanding of the compressed air system and how it fits into overall plant operations and how the compressed air is used to support production. During the tour, we paid special attention to: 1) inappropriate air use, 2) point of use connections, and 3) high volume intermittent demands. We were shown all the installation taps used by SBW.

B. Baseline

The compressed air system at this Baking facility consisted of four rotary screw compressors an air-cooled after-cooler, a refrigerated dryer, and a receiver. Three of the compressors are 60-hp Quincy dual control, Model QSI 235 units and the fourth is a 40-hp Joy Model TAO-30 compressor. The Joy compressor uses simple on/off pressure switch control. The QSI 235's all have both modulation and unloading controls. An internal pressure switch controls each compressor. Normal operation for the compressors is for AC1 to be the lead machine followed in order by AC2, AC3, and AC4. During non-production times when only maintenance is being done, AC4 is used exclusively and AC1 – 3 are not run. However, metering indicated that one of the 60-hp compressors was operating continuously during non-production days. There was also a baghouse serving the flour storage silo that has the bags blown down continuously for 15 minutes of every hour, 24 hours daily, 7 days per week.

C. Recommended Improvements

SBW recommended that the company

- Reduce leakage.
- Install controls so the baghouse does not blow down continually.
- Repair or replace the components in the clean-up equipment causing the large pressure drop, thus allowing all the compressor pressures to be reduced by at least 5 psig.
- Adjust controls to shut off compressors when not needed.

D. Implemented Improvements

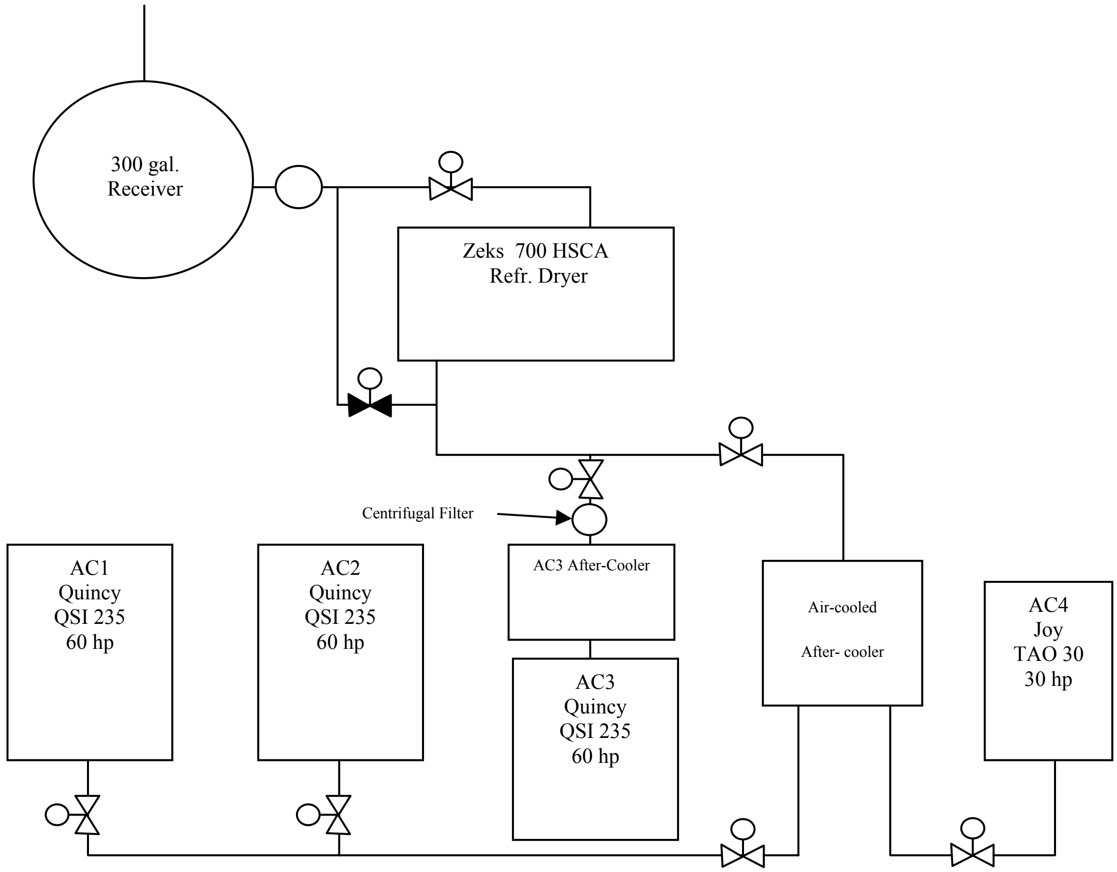
The company reduced leakage, which is on-going project.

The company also installed controls on the flour silo baghouse so the bags are blown down only when it is necessary to do so. The silo only needs to have the dust collector pulsing operate when flour is transferred into the silo. The customer installed a sensor that only operates the silo pulsing when a transfer hose is installed. They adjusted controls to shut off compressors when not needed. They installed a 3/8 inch sensing line so all compressors will see the same signal pressure.
Using block diagram in Figure 1 supplied by SBW, we verified all SBW installations. As part of this verification, we identified:

b) That true power is measured on all the compressors in the system.
c) where pressure measurements are being taken in the supply side.
d) Other areas of the system where a pressure measurement might be taken.

We were able to verify that all measuring devices installed on the supply side were correctly used for true power measurement and pressure. We also verified that the block diagram was accurate.

Figure 1. Block Diagram of the Compressed Air System



E. Maintenance issues

We also identified any issues, such as human error, connection to the system, ambient conditions, and maintenance that may relate to air quality, compressor reliability, or energy concerns that may affect SBW-estimated savings. The maintenance staff of this facility is maintaining the compressor per the instructions left by SBW. They see the benefits of better control of the cascade settings on compressors. There is one other issue which could impact the savings per SBW's verification report;

One issue of concern that could affect the total savings is the fact that the compressors are controlled manually and can overlap as shown below. All can be running at part load and this will change the kW per cfm value. Note chart below. I recommended a sequencer to aid in controlling the online hp.

There is a reported 10 psi pressure drop through cleanup equipment. It is still present. The Bakery has relocated the signal pressure line of each compressor to the receiver (per SBW's recommendations) which is downstream of the cleanup equipment. There is a chance that all compressors can now run 10 psi higher than design permits.

F. Monitoring Equipment

We also located and reviewed the placement of all monitoring equipment installed by SBW. We found that the placement of all monitoring equipment installed by SBW was correct.

G. Logging and Sample Rates

Finally, we noted the feasibility of locations picked by SBW for logging and sample rates used. We note whether the measurements were at three-second intervals[10], if any of the spot pressure measurements were sampled incorrectly. We found that the three-second intervals were being used and that the sample rates were correct for the events taking place on the supply side.

II. Engineering Review

A. Review of AIRMaster+ mdb Files

For each of the sites visited, we reviewed the completed AIRMaster+ mdb files submitted by SBW. For each of the AIRMaster+ modules, we attempted to verify that all information, for both the baseline and post-retrofit conditions, had been correctly input into AIRMaster+ files, including the following:

(1) company name
(2) utility
(3) facility data including utility rate assignment,
(4) a summary of the air compressors on site,
(5) system-level information, including design and performance parameters, automatic sequencer control pressure set points, daytypes, and end uses.
(6) air compressor information, including detailed specifications.
(7) hourly average airflow or power information and operating schedules.
(8) system baseline airflow requirements and associated energy and demand costs for the selected system and daytype.

We found that all the information was correctly entered.

B. Savings Potential

We also examined the possible EEM's (energy efficiency measures), which were analyzed using AIRMaster+, and verified their feasibility. This also involved evaluating the air system energy savings potential from the selected Energy Efficiency Measures, considering interactive effects of EEMs, including:

- Reduce Air Leaks
- Improve End Use Efficiency

[10] Based on Nyquist Theorem of at least 3 data points for the shortest event being measured

- Reduce System Air Pressure
- Use Unloading Controls
- Adjust Cascading Set Points
- Use Automatic Sequencer
- Reduce Run Time
- Add Primary Receiver Volume

Three EEM's was used:

- Reduce Air Leaks -- *ongoing project*
- Improve End Use Efficiency
    1. Installed a control on the flour silo bag house which would allow the pulse cleaning to occur only when flour was being transferred into the silo. A sensor in the cap was installed to start or stop the pulsing.
- Reduce Run Time
    2. Installed a single sensing line for all compressors and re-adjusted the controls to create a better cascade and allow for a compressor to timeout and shut off.

C. Conclusions

Based on the on-site visits and engineering review, we were able to verify that allowing the compressor to unload resulted in an annual utility savings of 301,211 kWh, and a demand reduction of 57.8 kW. SBW reported that equates to a $40,645 annual savings.

Project Number: CAMP02	
Audit Date:	May, 2004
SBW Verified kWh:	58,666
Evaluation Verified kWh :	58,666
SBW Verified kW :	2.0
Evaluation Verified kW	2.0
Site Gross kWh Realization Rate: 100%	
Site Gross kW Realization Rate: 100%	

I. On-Site Inspections

A. Background

In the autumn of 2003, SBW Consulting performed an assessment of the compressed air system at a lumber sawmill in northern, California. Following implementation of energy conservation measures by the customer, SBW returned to the site in May of 2004 to measure the performance of the retrofitted system. The performance data were analyzed to determine the actual energy savings achieved by the retrofits.

On October 12th 2004, a member of the Evaluation Team visited the site to verify baseline and post-installation plant conditions. He met with a member of the company's maintenance staff who was present during SBW's visits. This person provided a very thorough tour of the facility as a way of providing a general understanding of the compressed air system and how it fits into overall plant operations and how the compressed air is used to support production. During the tour, we paid special attention to: 1) inappropriate air use, 2) point of use connections, and 3) high volume intermittent demands. We were shown all the installation taps and from SBW.

B. Baseline

Prior to the verification visit by SBW, the compressed air system at this lumber company consisted of three air compressors, three receivers, and the distribution system. There are no dryers in the compressed air system.

The three compressors are:

1. Compressor #1: Model QNW 1500D, **300-hp**, 1,417 cfm @ 100 psig (AM+ rating*), air-cooled with 5-hp aftercooler fan, modulating control.
2. Compressor #2: Model QNW 1500D, **300-hp**, 1,417 cfm @ 100 psig (AM+ rating*), air-cooled with 10-hp aftercooler fan, modulating control. This is a new machine with 3.2 hours on the run time meter at the time of the initial data collection.
3. Compressor #3: Model QNW 740B, **150-hp**, 729 cfm @ 100 psig (AM+ rating*), air-cooled with 5-hp aftercooler fan, modulating control.

*AirMaster+ air compressor modeling software

Compressor #1 and compressor #3 (each 300hp) are in the same location, and compressor #2 (150hp) is remotely located.

Compressor #1 and compressor #3 cannot be operated simultaneously because the electrical supply wiring has insufficient ampacity. They run only one at a time. Compressor #3 (150hp) is primarily used on weekends and for maintenance support.

There are three receivers on site of the following sizes: 112 gallons, 600 gallons, and 7,000 gallons, for a total volume of 7,712 gallons. The 7,000-gallon receiver is located immediately downstream of the #2 compressor, the other two receivers are not located near compressors.

Due to the mill's operating schedule, mill personnel did the leak testing. The results indicate an average leak rate estimated at 230 cfm.

The mill operates Monday though Friday with first shift from 6 a.m. to 2:30 p.m. and second shift from 3 p.m. to 11:30 p.m.

At least one compressor is operating 24 hours/day Monday though Friday, but all compressors are manually turned off during weekends.

C. Recommended Improvements

SBW recommended that the company;

- Repair compressed air leaks
- Install load/unload controls on compressors #2 and #3
- Connect the compressor rooms with a 4-inch line

D. Implemented Improvements

All recommended measures were at least partially implemented.

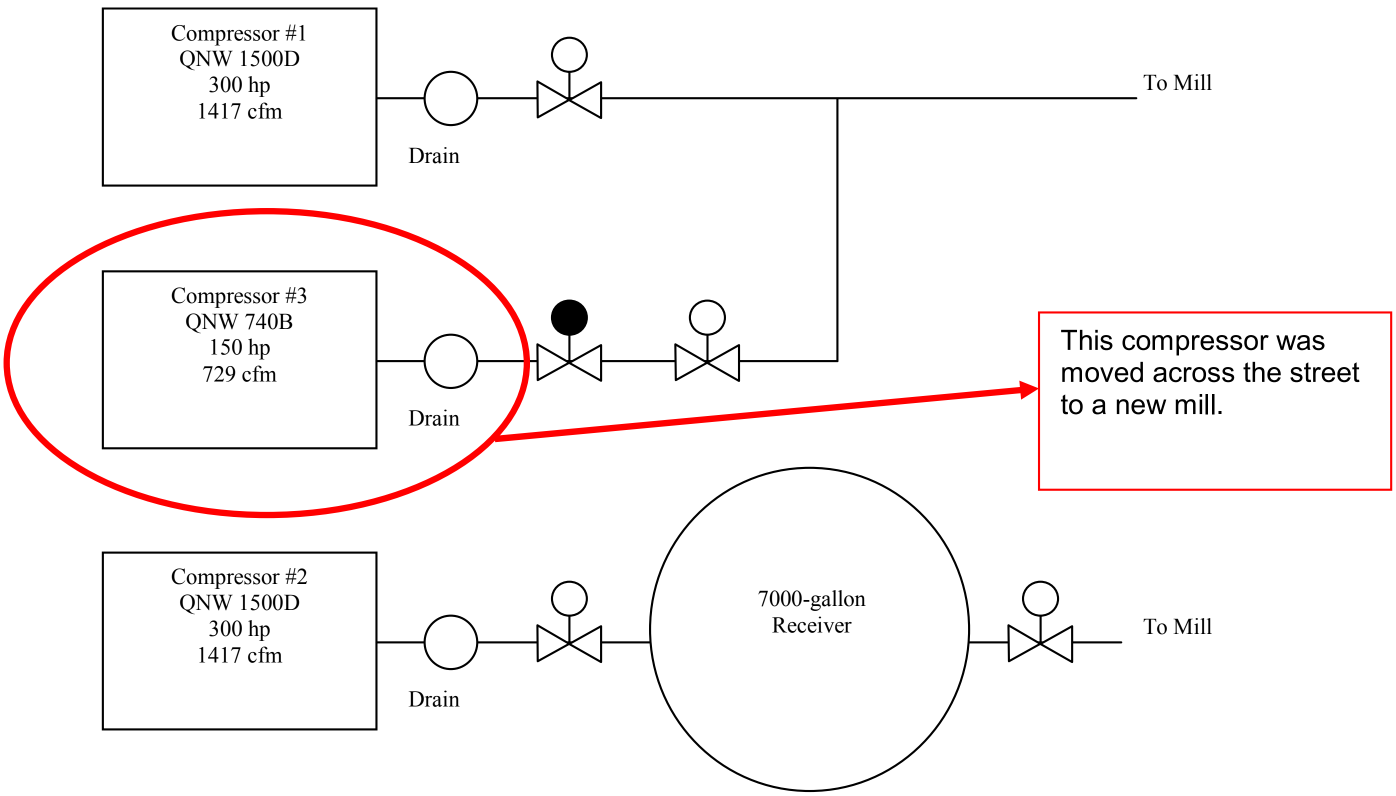
Unloading controls were installed on compressor #2. The #3 compressor was moved to a new mill at this facility. The controls on the #3 compressor, and the 4-inch pipeline, have not been installed.

Using block diagram in Figure 1 supplied by SBW, we verified all SBW installations.

As part of this verification, we identified:

e) That true power is measured on all the compressors in the system.
f) where pressure measurements are being taken in the supply side.
g) Other areas of the system where a pressure measurement might be taken.

Figure 1. Block Diagram of the Compressed Air System



We were able to verify that all measuring devices installed on the supply side were correctly used for true power measurement and pressure. We also verified that the block diagram was accurate,

E. Maintenance issues

We also identified any issues, such as human error, connection to the system, ambient conditions, and maintenance that may relate to air quality, compressor reliability, or energy concerns that may affect SBW-estimated savings. The mill now operates on number (1) 300 hp compressor as base load since it has no controls; it is not such a problem. It must run during production anyway. The number (2) does have the controls and unloads and shuts down when not needed.

F. Monitoring Equipment

We also located and reviewed the placement of all monitoring equipment installed by SBW. We found that the placement of all monitoring equipment installed by SBW was correct.

G. Logging and Sample Rates

Finally, we noted the feasibility of locations picked by SBW for logging and sample rates used. We note whether the measurements were at three-second intervals[11], if any of the spot pressure measurements were sampled incorrectly. We found that the three-second intervals were being used and that the sample rates were correct for the events taking place on the supply side.

II. Engineering Review

A. Review of AIRMaster+ mdb Files

For each of the sites visited, we reviewed the completed AIRMaster+ mdb files submitted by SBW. For each of the AIRMaster+ modules, we attempted to verify that all information, for both the baseline and post-retrofit conditions, had been correctly input into AIRMaster+ files, including the following:

(1) company name
(2) utility
(3) facility data including utility rate assignment,
(4) a summary of the air compressors on site,
(5) system-level information, including design and performance parameters, automatic sequencer control pressure set points, daytypes, and end uses.
(6) air compressor information, including detailed specifications.
(7) hourly average airflow or power information and operating schedules.
(8) system baseline airflow requirements and associated energy and demand costs for the selected system and daytype.

We found that all the information was correctly entered.

B. Savings Potential

We also examined the possible EEM's (energy efficiency measures), which were analyzed using AIRMaster+, and verified their feasibility. This also involved evaluating the air system energy savings potential from the selected Energy Efficiency Measures, considering interactive effects of EEMs, including:

- Reduce Air Leaks
- Improve End Use Efficiency
- Reduce System Air Pressure
- Use Unloading Controls
- Adjust Cascading Set Points
- Use Automatic Sequencer

[11] Based on Nyquist Theorem of at least 3 data points for the shortest event being measured

- Reduce Run Time
- Add Primary Receiver Volume

Tow EEM's were used:

Used unloading controls –

- Installed on number one 300 hp compressor only

Reduced Air Leaks

- The measure was generally implemented as proposed. Unfortunately, for reasons not known and despite a good faith effort by the mill staff and management, the leak rate at the time of verification was actually greater than during the baseline measurement.

C. Conclusions

Based on the on-site visits and engineering review, we were able to verify that allowing the compressor to unload resulted in an annual utility savings of 58,666 kWh, and a demand reduction of 2 kW. SBW reported that equates to a $ 5,674 annual savings.

The savings were less than projected in SBW's Assessment Report because not all measures were implemented and the leak rate actually increased in spite of the efforts of the mill. The operating schedule changed, with production increasing from eight hours per day to nine hours per day, Monday through Friday, between the baseline and verification periods, as well as working every other Saturday. These operational changes were initially considered when calculating the energy consumption differential between the baseline and verification periods.

Project Number: CAMP 03	
Audit Date:	November, 2003
SBW Verified kWh:	103,573
Evaluation Verified kWh :	103,573
SBW Verified kW :	32.9
Evaluation Verified kW	32.9
Site Gross kWh Realization Rate: 100%	
Site Gross kW Realization Rate: 100%	

The purpose of the on-sites and the engineering review of AIRMaster+ files were to verify the installations and the kWh and kW impacts reported by SBW in their Verification Reports.

I. On-Site Inspections

A. Background

In the winter of 2003, SBW Consulting performed an assessment of the compressed air system at a foundry in northern California. Following implementation of energy conservation measures by the customer, SBW returned to the site in November of 2003 to measure the performance of the retrofitted system. The performance data were analyzed to determine the actual energy savings achieved by the retrofit.

On May 4th 2004, a member of the Evaluation Team visited the site to verify baseline and post-installation plant conditions. He met with a member of the company's maintenance staff who was present during SBW's visits. This person provided a very thorough tour of the facility as a way of providing a general understanding of the compressed air system and how it fits into overall plant operations and how the compressed air is used to support production. During the tour, we paid special attention to: 1) inappropriate air use, 2) point of use connections, and 3) high volume intermittent demands. We were shown all the installation taps used by SBW.

B. Baseline

Prior to the verification visit by SBW, the compressed air system at the foundry consisted of four compressors. Two Ingersol Rand 50-hp reciprocating compressors that are nearly 60 years old. One Ingersol Rand 50-hp modulating screw compressor and a Sullair 150-hp modulating screw compressor. Plant operators would match the compressors to the existing demands of production, resulting in excess hp always being online. Since this is an aluminum cast shop, the environment was dirty, with numerous air leaks, open blowing, excess pressure with no regulation, and inappropriate use of air for cooling furnaces.

C. Recommended Improvements

SBW recommended that the company purchase one good compressor, lower and control air pressure at supply and points of use, use dedicated metered storage for a high volume intermittent "Rollover"[12] operation.

D. Implemented Improvements

A new 200 hp RollAir compressor was purchased, the pressure was reduced by 10 psig, a metered storage tank was installed at the Rollover machine and a leak repair was started although not quantified as yet.

The foundry now operates all week on the new 200 hp and only turns on the 75 hp SSR rotary in the evening. All other compressors are offline.

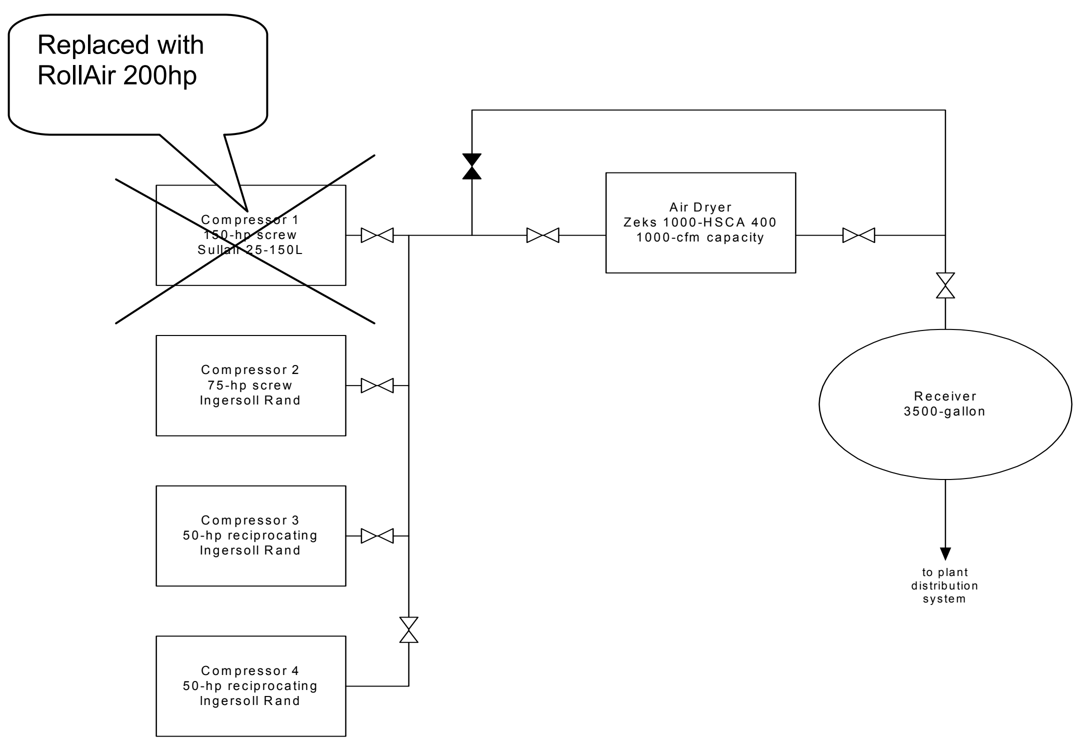
Using block diagram in Figure 1 supplied by SBW, we verified all SBW installations. As part of this, we verified:

h) that true power is measured on all the compressors in the system.

i) where pressure measurements are being taken in the supply side.

j) other areas in the system where a pressure measurement might be taken.

Figure 1. Block Diagram of the Compressed Air System at Foundry



We also verified that the block diagram was accurate.

E. Maintenance issues

We also identified any issues, such as human error, connection to the system, ambient conditions, and maintenance that may relate to air quality, compressor reliability, or energy concerns that may affect SBW-estimated savings. The maintenance staff at Castco is maintaining the compressors per the instructions left by SBW. They see the benefits of not having all compressors running unloaded. There are no other issues which will impact the savings per SBW's verification report.

F. Monitoring Equipment

We also located and reviewed the placement of all monitoring equipment installed by SBW. We found that the placement of all monitoring equipment installed by SBW was correct.

G. Logging and Sample Rates

Finally, we noted the feasibility of locations picked by SBW for logging and sample rates used. We note whether the measurements were at three-second intervals[13], if any of the spot pressure measurements were sampled incorrectly. We found that the three-second intervals were being used and that the sample rates were correct for the events taking place on the supply side.

II. Engineering Review

A. Review of AIRMaster+ mdb Files

For each of the sites visited, we reviewed the completed AIRMaster+ mdb files submitted by SBW. For each of the AIRMaster+ modules, we determined whether all information, for both the baseline and post-retrofit conditions, had been correctly input into AIRMaster+ files, including the following:

(1) company name
(2) utility
(3) facility data including utility rate assignment,
(4) a summary of the air compressors on site,
(5) system-level information, including design and performance parameters, automatic sequencer control pressure set points, daytypes, and end uses.
(6) air compressor information, including detailed specifications.
(7) hourly average airflow or power information and operating schedules.
(8) system baseline airflow requirements and associated energy and demand costs for the selected system and daytype.

[12] Rollover machine is production machine that used to suffer from low pressure. It is located at the furthest point in the air distribution system and requires a large flow and sustained pressure 80-85 psig.
[13] Based on Nyquist Theorem of at least 3 data points for the shortest event being measured

We found that all the information was correctly entered.

B. Savings Potential

We also examined the possible EEM's (energy efficiency measures), which were analyzed using AIRMaster+, and verified their feasibility.

The following EEM's were modeled in AIRMaster+:

- Reduce Air Leaks (amount not quantified)
    - *Repair 45% (104 cfm) of the leaks in the compressed air distribution system.*

- Reduce System Air Pressure by 10 psi)
    - *The 10-psig pressure reduction was implemented and a small air receiver was added for the large rollover. The receiver tank with storage dedicated for the large rollover is not yet equipped with a metered inlet device. The addition of this metered inlet will improve performance of the reduced pressure distribution system during periods of heavy usage in the plant.*

- Shut Off Unneeded Compressor)
    - *The reciprocating compressors are not used. The replacement compressor is larger than the compressor that was anticipated to be operating, however, and uses inefficient capacity controls. As a result, the operating compressor runs with a significantly modulated inlet, which is very inefficient.*

The savings estimated match the savings reported in SBW's Verification Report.

C. Conclusions

Based on the on-site visits and engineering review, we were able to verify that allowing the compressor to unload resulted in an annual utility savings of 103,573 kWh, and a demand reduction of 32.9 kW. SBW reported that equates to a $12,594 annual savings.

Project Number: CAMP04	
Audit Date:	September, 2003
SBW Verified kWh:	36,472
Evaluation Verified kWh :	36,472
SBW Verified kW :	9.0
Evaluation Verified kW	9.0
Site Gross kWh Realization Rate: 100%	
Site Gross kW Realization Rate: 100%	

I. On-Site Inspections

A. Background

In the winter of 2003, SBW Consulting performed an assessment of the compressed air system at a dairy plant in California. Following implementation of energy conservation measures by the customer, SBW returned to the site in September of 2003 to measure the performance of the retrofitted system.

On October 5th 2004, a member of the Evaluation Team visited the site to verify baseline and post-installation plant conditions. He met with a member of the company's maintenance staff who was present during SBW's visits. This person provided a very thorough tour of the facility as a way of providing a general understanding of the compressed air system and how it fits into overall plant operations and how the compressed air is used to support production. During the tour, we paid special attention to: 1) inappropriate air use, 2) point of use connections, and 3) high volume intermittent demands. We were shown all the installation taps and from SBW.

B. Baseline

The compressed air system at the Dairy consisted of three single stage rotary screw compressors, an aftercooler, a receiver, and miscellaneous filters and valves. The system does not have a dryer, but instead uses 40 degree chilled water through an after-cooler which acts just like a dryer to bring the dewpoint down. Water in the lines is not an issue.

The main air consumption at this facility is for three blowmold machines, which make plastic milk and juice containers in three different sizes. These require air at approximately 80 psig to blow melted plastic into the molds, creating the bottles. Other applications include typical pneumatic cylinder and controls equipment.

Current production utilizes one of the 100 HP compressors online while the other 100 HP trims at part load. Since all controls are suction throttle, the energy is very high on the part loaded 100 HP. During the verification visit (full production was in progress), there was one compressor fully loaded (100HP) and the other 100HP was at 40% output. The inlet butterfly on this compressor was visible for flow measurements. Customer stated that the 40 HP acting as the trim cannot keep up with the pressure requirements in production so they run both 100's. The 40 HP is used by itself on Saturday shift for maintenance routines.

C. Recommended Improvements

SBW recommended that the company reduce leakage by 100 scfm and lower the pressure by 5 psig.

D. Implemented Improvements

They were able to reduced system pressure by 12 psig but only minimal leak repair was achieved. This is an ongoing project.

Using block diagram in Figure 1 supplied by SBW, we verified all SBW installations. As part of this verification, we identified:

k) That true power is measured on all the compressors in the system.
l) where pressure measurements are being taken in the supply side.
m) Other areas of the system where a pressure measurement might be taken.

We were able to verify that all measuring devices installed on the supply side were correctly used for true power measurement and pressure. We also verified that the block diagram was accurate,

E. Maintenance issues

We also identified any issues, such as human error, connection to the system, ambient conditions, and maintenance that may relate to air quality, compressor reliability, or energy concerns that may affect SBW-estimated savings. The maintenance staff of this facility is maintaining the compressor per the instructions left by SBW. There are no other issues which could impact the savings per SBW's verification report;

F. Monitoring Equipment

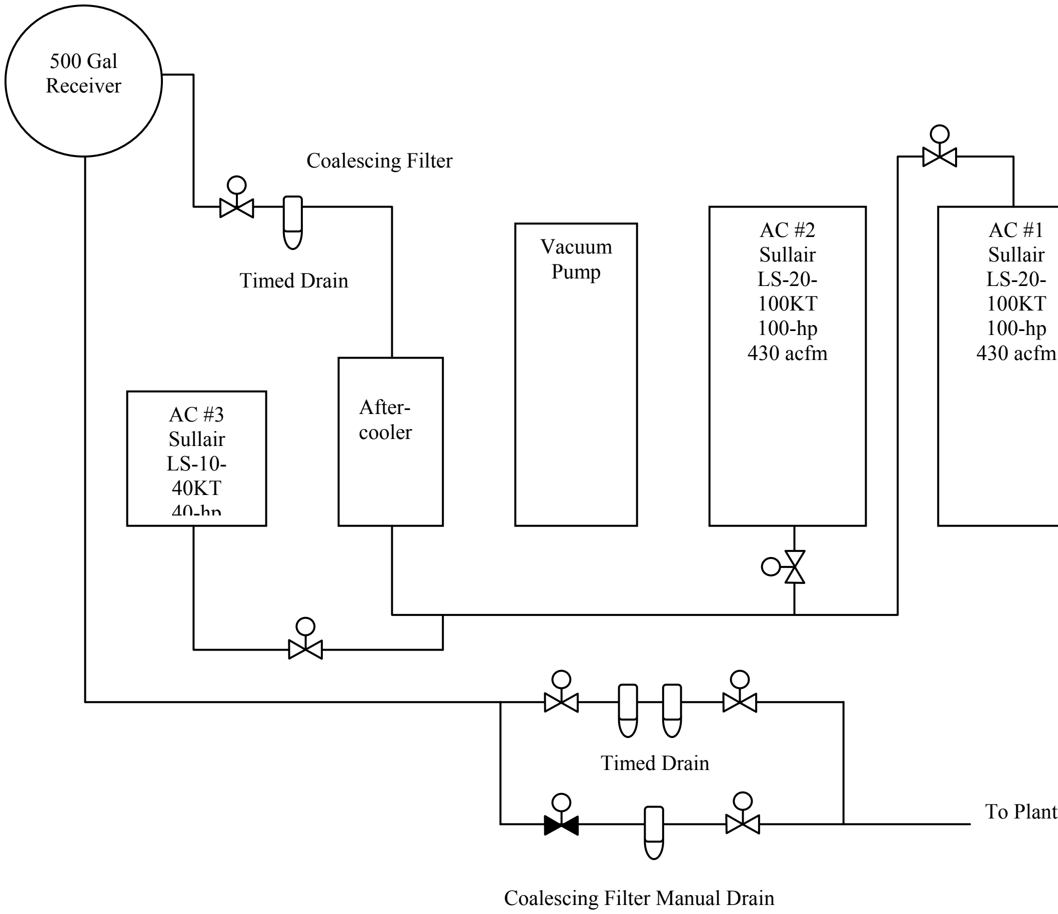
We also located and reviewed the placement of all monitoring equipment installed by SBW. We found that the placement of all monitoring equipment installed by SBW was correct.

G. Logging and Sample Rates

Finally, we noted the feasibility of locations picked by SBW for logging and sample rates used. We note whether the measurements were at three-second intervals[14], if any of the spot pressure measurements were sampled incorrectly. We found that the three-second intervals were being used and that the sample rates were correct for the events taking place on the supply side.

[14] Based on Nyquist Theorem of at least 3 data points for the shortest event being measured

Figure 1. Block Diagram of the Compressed Air System



II. Engineering Review

A. Review of AIRMaster+ mdb Files

For each of the sites visited, we reviewed the completed AIRMaster+ mdb files submitted by SBW. For each of the AIRMaster+ modules, we attempted to verify that all information, for both the baseline and post-retrofit conditions, had been correctly input into AIRMaster+ files, including the following:

(1) company name
(2) utility
(3) facility data including utility rate assignment,
(4) a summary of the air compressors on site,
(5) system-level information, including design and performance parameters, automatic sequencer control pressure set points, daytypes, and end uses.
(6) air compressor information, including detailed specifications.
(7) hourly average airflow or power information and operating schedules.

(8) system baseline airflow requirements and associated energy and demand costs for the selected system and daytype.

We found that all the information was correctly entered.

B. Savings Potential

We also examined the possible EEM's (energy efficiency measures), which were analyzed using AIRMaster+, and verified their feasibility. This also involved evaluating the air system energy savings potential from the selected Energy Efficiency Measures, considering interactive effects of EEMs, including:

- Reduce Air Leaks
- Improve End Use Efficiency
- Reduce System Air Pressure
- Use Unloading Controls
- Adjust Cascading Set Points
- Use Automatic Sequencer
- Reduce Run Time
- Add Primary Receiver Volume

Only one EEM was used:

- Reduce System Pressure
- In the absence of interactive effects, the "rule of thumb" is a ½% efficiency improvement for each 1 psig pressure reduction for air compressors. The anticipated savings for the 12-psig pressure reduction measured at the dairy would yield approximately 70,000 kWh/year in energy savings based on their annual compressed air energy use of 1.1 million kWh/year.
- Leak repair was not quantified and is an ongoing project.

C. Conclusions

Based on the on-site visits and engineering review, we were able to verify that allowing the compressor to unload resulted in an annual utility savings of 36,472 kWh, and a demand reduction of 9 kW. SBW reported that equates to a $4,099 annual savings.

Project Number: CAMP05	
Audit Date:	October, 2004
SBW Verified kWh:	301,092
Evaluation Verified kWh :	301,092
SBW Verified kW :	3.1
Evaluation Verified kW	3.1
Site Gross kWh Realization Rate: 100%	
Site Gross kW Realization Rate: 100%	

I. On-Site Inspections

A. Background

In late May of 2003, SBW Consulting performed an assessment of the compressed air system at a printing company in California. Following implementation of energy conservation measures by the customer, SBW returned to the site in December of 2003 and again in February of 2004 to measure the performance of the retrofitted system.

SBW returned to measure system performance in February because of inefficient compressor operation noted in the December visit. The performance data were analyzed to determine the actual energy savings achieved by the retrofits.

On October 5th 2004, a member of the Evaluation Team visited the site to verify baseline and post-installation plant conditions. He met with a member of the company's maintenance staff who was present during SBW's visits. This person provided a very thorough tour of the facility as a way of providing a general understanding of the compressed air system and how it fits into overall plant operations and how the compressed air is used to support production. During the tour, we paid special attention to: 1) inappropriate air use, 2) point of use connections, and 3) high volume intermittent demands. We were shown all the installation taps and from SBW.

B. Baseline

Prior to the verification visit by SBW, the compressed air system at the printing company was comprised of three Gardner Denver air compressors. The three compressors were 75-hp, water-cooled, screw compressors (Gardner Denver Electra Saver II Model 200ECP). These compressors have the capability of operating in either modulation or unload capacity control. Each compressor discharged into one of three refrigerated dryers (Hankison 80500). At the time of the first SBW visit, one dryer was not operating. This was repaired upon SBW's recommendations. All three dryers discharge into a common header with a 2180-gallon receiver tank. From the receiver tank, air flows into the looped distribution system. Two 560 scfm heatless desiccant dyers were also part of the air quality scheme.

The compressed air system at this printing company operates 24/7. Printing operations vary through the week, but the compressors are always providing pressure since the distribution system serves solenoid valves in the printing presses. These solenoids must always be pressurized.

C. Recommended Improvements

SBW recommended that the company reduce air leaks, remove the redundant desiccant dryers and replace one compressor with a variable speed type for trimming.

D. Implemented Improvements

The company reduced air leaks, valved off the redundant desiccant dryers and replaced one compressor with a variable speed type for trimming.

Using block diagram in Figure 1 supplied by SBW, we verified all SBW installations. As part of this verification, we identified:

1. That true power is measured on all the compressors in the system.
2. Where pressure measurements are being taken in the supply side.
3. Other areas of the system where a pressure measurement might be taken.

We were able to verify that all measuring devices installed on the supply side were correctly used for true power measurement and pressure. We also verified that the block diagram was accurate. **Figure 2.** shows modifications.

E. Maintenance issues

We also identified any issues, such as human error, connection to the system, ambient conditions, and maintenance that may relate to air quality, compressor reliability, or energy concerns that may affect SBW-estimated savings. The maintenance staff of this facility is maintaining the compressor per the instructions left by SBW. There is one other issue which could impact the savings per SBW's verification report;

The baseloaded compressor is still operating part load and is fighting the other compressors because of pressure settings overlap. The customer needs to further adjust the compressors control bands so they do not overlap.

Figure 1. Block Diagram of the Compressed Air System

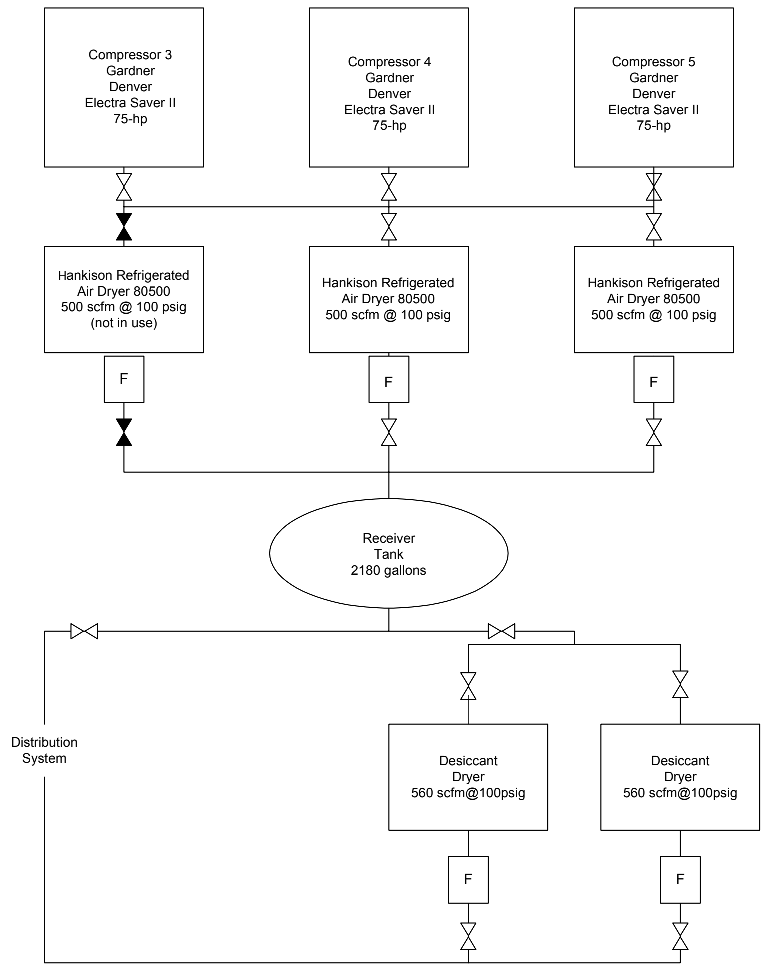
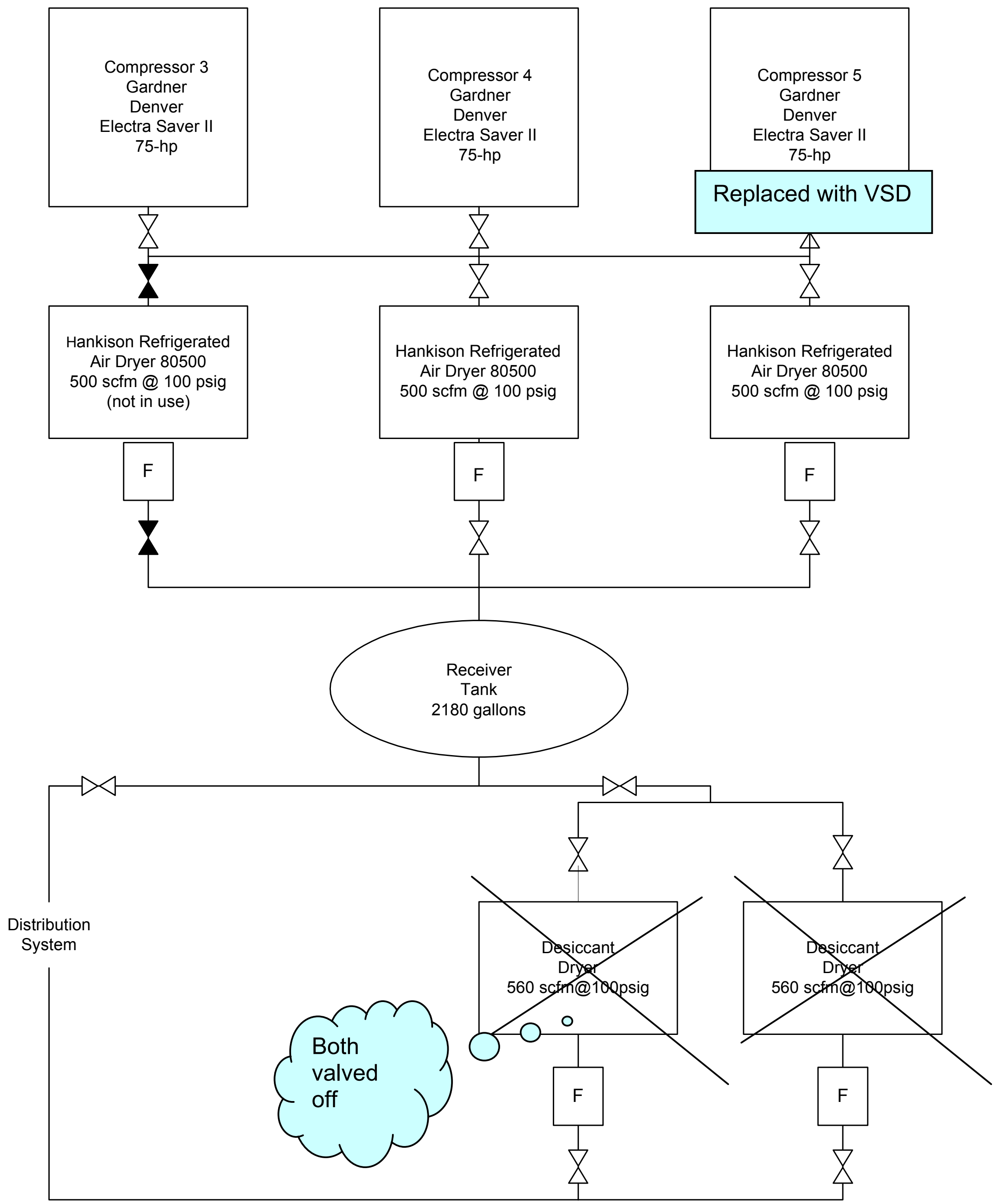


Figure 2 . Block Diagram of the Compressed Air System after Changes



F. Monitoring Equipment

We also located and reviewed the placement of all monitoring equipment installed by SBW. We found that the placement of all monitoring equipment installed by SBW was correct.

G. Logging and Sample Rates

Finally, we noted the feasibility of locations picked by SBW for logging and sample rates used. We note whether the measurements were at three-second intervals[15], if any of the spot pressure measurements were sampled incorrectly. We found that the three-second intervals were being used and that the sample rates were correct for the events taking place on the supply side.

II. Engineering Review

A. Review of AIRMaster+ mdb Files

For each of the sites visited, we reviewed the completed AIRMaster+ mdb files submitted by SBW. For each of the AIRMaster+ modules, we attempted to verify that all information had been correctly input into AIRMaster+ files, including the following:

1. Company Name
2. Utility
3. Facility data including utility rate assignment, and a summary of the air compressors on site.
4. System-level information, including design and performance parameters, automatic sequencer control pressure set points, daytypes, and end uses.
5. Air compressor information, including detailed specifications.
6. Hourly average airflow or power information and operating schedules.
7. System baseline airflow requirements and associated energy and demand costs for the selected system and daytype.

We found that all the following information was correct per the onsite visit of May 4th 2004 and items 4 through 7 are identified in Section I, paragraph B under Baseline

B. Savings Potential

We also examined the possible EEM's (energy efficiency measures), which were analyzed using AIRMaster+, and verified their feasibility. This also involved evaluating the air system energy savings potential from the selected Energy Efficiency Measures, considering interactive effects of EEMs, including:

- Reduce Air Leaks
- Improve End Use Efficiency

[15] Based on Nyquist Theorem of at least 3 data points for the shortest event being measured

- Reduce System Air Pressure
- Use Unloading Controls
- Adjust Cascading Set Points
- Use Automatic Sequencer
- Reduce Run Time
- Add Primary Receiver Volume

Only two EEM's were used:

- Reduce air leaks
- Reduce run time
    - *At present, the new VSD compressor is running as the trim machine during all hours*

C. Conclusions

Based on the on-site visits and engineering review, we were able to verify that allowing the compressor to unload resulted in an annual utility savings of 301,092 kWh, and a demand reduction of 3.1 kW. SBW reported that equates to a $33,663 annual savings.

The original analysis assumed that when the older modulating compressors were running, they would be base loaded and the VSD would run as a trim machine to meet the load. Limitations on controls of the old existing compressors cause them to operate at partial load during some running periods. Maintenance savings that are reported here come from the removal from service of the desiccant dryers. SBW had gone back to perform a re-analysis which proved that production levels had increased from the time the baseline data was collected to the time the verification was done. Unfortunately, this amount of increase was not provided so it is not possible to quantify the effect of the increase.
The only two facts are that production has increased and the elimination of the desiccant dryers reduced kW by 6.2.

Project Number: CAMP06	
Audit Date:	April, 2004
SBW Verified kWh:	23,733
Evaluation Verified kWh :	23,733
SBW Verified kW :	4.6
Evaluation Verified kW	4.6
Site Gross kWh Realization Rate:	100%
Site Gross kW Realization Rate:	100%

I. On-Site Inspections

A. Background

In the summer of 2003, SBW Consulting performed an assessment of the compressed air system at a Saw Mill in northern California. Following implementation of energy conservation measures by the customer, SBW returned to the site in April 2004 to measure the performance of the retrofitted system. The performance data were analyzed to determine the actual energy savings achieved by the retrofits.

On October 11th 2004, a member of the Evaluation Team visited the site to verify baseline and post-installation plant conditions. He met with a member of the company's maintenance staff who was present during SBW's visits. This person provided a very thorough tour of the facility as a way of providing a general understanding of the compressed air system and how it fits into overall plant operations and how the compressed air is used to support production. During the tour, we paid special attention to: 1) inappropriate air use, 2) point of use connections, and 3) high volume intermittent demands. We were shown all the installation taps and from SBW.

B. Baseline

Prior to the verification visit by SBW, the compressed air system at this saw mill consisted of three QNW compressors, several receivers, and the distribution system. Compressors #1 and #2 are Quincy models QNW 740 B 150-hp compressors with capacities of 729 cfm at 100 psig, and are located adjacent to one another. Compressor #3 is also a QNW 150-hp compressor with a capacity of 729 cfm at 100 psig. It is remotely located on the opposite side of the mill. All compressors have modulating controls only: they do not unload or time out. Compressors #1 and #2 are air-cooled and have a 1,100-gallon capacity dedicated receiver. Compressor #3 is water-cooled and has a 635 gallon dedicated receiver. There are no air dryers in the system, but the air-cooled aftercoolers on #1 and #2 appear to be new. Water is a constant problem and scale and rust frequently cause production interruptions and down time.

At least one compressor is required to be online at all times to keep the dry-pipe fire protection sprinkler system charged with compressed air. This requires compressor operation when the mill is otherwise unoccupied.

There are two other compressors on the sawmill compressed air distribution system but they are not in service and so are not included in this analysis.

The distribution system leaks at approximately 390 cfm, about 18% of system capacity. The plant was built in the 1950s and it looks like all the original components of the compressed air system are still from that era. The high pressure requirements that they ***think*** they need are do to old pneumatics that only ran at higher pressures back in the days.. Newer controls and valves would allow a lower pressure to be achievable.

C. Recommended Improvements

SBW recommended to the company that pressure requirements in the mill can be met with lower pressure than is currently being supplied. For purposes of estimating the energy and cost savings it was assumed that the pressure could be reduced by at least 5 psig. Subsequent recommendations were to improve compressor controls and reduce pressure fluctuations presently occurring in the mill. Given that the mill operated during the data collection for extended periods at reduced pressures, no ill effects are anticipated from controlled pressure reduction. However, all necessary precautions should be taken to ensure that end use equipment continues to function properly and safely.

D. Implemented Improvements

A description of **the only implemented energy conservation measure** is provided below in number 1.;

1. Replace Pneumatic Cylinders with Hydraulic Cylinders
   - *Large pneumatic cylinders that were used to drive the mechanism for turning the logs for initial cutting in the head rig were replaced with hydraulic cylinders.*
2. Descriptions of the recommended energy conservation measures that **were not** implemented are provided below in number 2.;
   - *Reduce system air pressure by 5 psig. --- There was concern that this would have an adverse effect on production.*
   - *Reduce system leakage. --- Other activities were given higher priority due to budget and man-power issues.*
   - *Turn off the 150-hp compressors when the mill is not in operation. Install a small compressor to maintain the compressed air charge in the dry-pipe fire protection system. --- This measure has been installed in another area in the mill and may yet be installed in the sawmill with support from subsequent CAMP programs.*
   - *Install unloading and time-out controls on compressors #1 and #2, and an additional 2,000-gallon receiver. --- Other activities were given higher priority due to budget and man-power issues.*

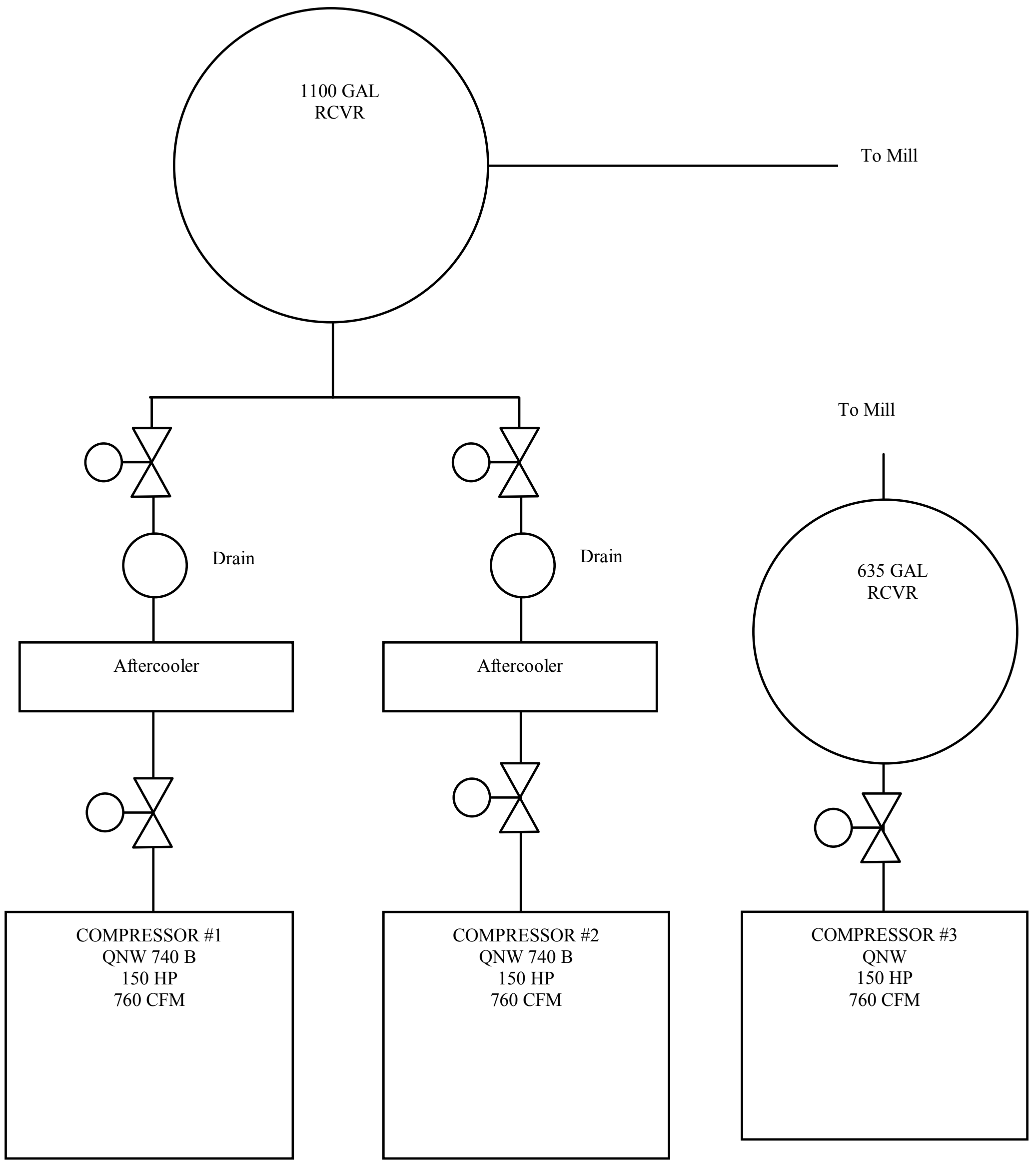
Using block diagram in Figure 1 supplied by SBW, we verified all SBW installations.

As part of this verification, we identified:

n) That true power is measured on all the compressors in the system.

o) where pressure measurements are being taken in the supply side.
p) Other areas of the system where a pressure measurement might be taken.

Figure 1. Block Diagram of the Compressed Air System



We were able to verify that all measuring devices installed on the supply side were correctly used for true power measurement and pressure. We also verified that the block diagram was accurate,

E. Maintenance issues

We also identified any issues, such as human error, connection to the system, ambient conditions, and maintenance that may relate to air quality, compressor reliability, or energy concerns that may affect SBW-estimated savings. The maintenance staff of this facility is very busy maintaining the saw mill equipment which is constantly breaking down due to water in the lines, pipes breaking from rust, and old valves and components all dating from the 1950's. Leaks are everywhere.

F. Monitoring Equipment

We also located and reviewed the placement of all monitoring equipment installed by SBW. We found that the placement of all monitoring equipment installed by SBW was correct.

G. Logging and Sample Rates

Finally, we noted the feasibility of locations picked by SBW for logging and sample rates used. We note whether the measurements were at three-second intervals[16], if any of the spot pressure measurements were sampled incorrectly. We found that the three-second intervals were being used and that the sample rates were correct for the events taking place on the supply side.

II. Engineering Review

A. Review of AIRMaster+ mdb Files

For each of the sites visited, we reviewed the completed AIRMaster+ mdb files submitted by SBW. For each of the AIRMaster+ modules, we attempted to verify that all information had been correctly input into AIRMaster+ files, including the following:

(1) Company Name
(2) Utility
(3) Facility data including utility rate assignment, and a summary of the air compressors on site.
(4) System-level information, including design and performance parameters, automatic sequencer control pressure set points, daytypes, and end uses.
(5) Air compressor information, including detailed specifications.
(6) Hourly average airflow or power information and operating schedules.
(7) System baseline airflow requirements and associated energy and demand costs for the selected system and daytype.

We found that all the following information was correct per the onsite visit of Oct 11th 2004 and items 4 through 7 are identified in Section I, paragraph B under Baseline

[16] Based on Nyquist Theorem of at least 3 data points for the shortest event being measured

B. Savings Potential

We also examined the possible EEM's (energy efficiency measures), which were analyzed using AIRMaster+, and verified their feasibility. This also involved evaluating the air system energy savings potential from the selected Energy Efficiency Measures, considering interactive effects of EEMs, including:

- Reduce Air Leaks
- Improve End Use Efficiency
- Reduce System Air Pressure
- Use Unloading Controls
- Adjust Cascading Set Points
- Use Automatic Sequencer
- Reduce Run Time
- Add Primary Receiver Volume

Only one EEM was used:

- Improve end use efficiency
    - *Large pneumatic cylinders that were used to drive the mechanism for turning the logs for initial cutting in the head rig were replaced with hydraulic cylinders.*

C. Conclusions

Based on the on-site visits and engineering review, we were able to verify that allowing the compressor to unload resulted in an annual utility savings of 23,733kWh, and a demand reduction of 4.6 kW. SBW reported that equates to a $ 1,057 annual savings.

Project cost for the one implementation at this mill was not reported and was therefore unknown to SBW. Given this, the Net Cost and Simple Payback are also not meaningful.

The savings are minimal because the mill opted not to implement the recommended measures. The mill is to be commended for changing the pneumatic cylinders to hydraulic cylinders on the heel turner, but the amount of compressed air consumed by pneumatic cylinders in comparison to the total consumption of the mill is relatively small.

Project Number: CAMP07	
Audit Date:	November, 2003
SBW Verified kWh:	327,228
Evaluation Verified kWh :	327,228
SBW Verified kW :	52.7
Evaluation Verified kW	52.7
Site Gross kWh Realization Rate: 100%	
Site Gross kW Realization Rate: 100%	

I. On-Site Inspections

A. Background

In Spring of 2003, SBW Consulting performed an assessment of the compressed air system at a bakery in California. Following implementation of energy conservation measures by the customer, SBW returned to the site in November of 2003 to measure the performance of the retrofitted system. The performance data were analyzed to determine the actual energy savings achieved by the retrofit.

On May 4th 2004, a member of the Evaluation Team visited the site to verify baseline and post-installation plant conditions. He met with a member of the company's maintenance staff who was present during SBW's visits. This person provided a very thorough tour of the facility as a way of providing a general understanding of the compressed air system and how it fits into overall plant operations and how the compressed air is used to support production. During the tour, we paid special attention to: 1) inappropriate air use, 2) point of use connections, and 3) high volume intermittent demands. We were shown all the installation taps and from SBW.

B. Baseline

As typical of all baking facilities, the product is de-panned or loosened by a shot of compressed air thru a nozzle. This open blowing is the bulk of air usage at this facility. Other air usage comes from leaks, generating vacuum, and a water treatment facility that uses diaphragm pumps. The main compressed air is supplied by one of two compressors. The first of these compressors is a 300-hp Quincy screw compressor. This compressor is a variable displacement machine that meets the variable air demand of the plant by altering the size of the compressor chamber using poppet valves. The second is a 300-hp Sullair two stage or "tandem" screw compressor. Capacity control of this compressor is accomplished with inlet modulation and unloading. There are two additional compressors which are 75 hp and 50 hp. They are tied into the compressed air distribution after passing through their own receiver, dryer and filtration system. Because there is no sequencer controlling any of the four compressors, there are times when an abundance of horsepower could be on when not necessary.

C. Recommended Improvements

SBW recommended that the company install engineered nozzles on the production lines where needed for de-panning product and repair leaks and initiate a leak monitoring and repair program.

D. Implemented Improvements

Sixty-five engineered nozzles were installed and site personnel contracted with a service provider to perform a leak survey and repair.

The open blowing issue was controlled by the nozzles and leaks are being repaired. However there are two additional compressors (see figure 1 below) that could run and influence production. They are turned on and off manually as the pressure might require.

Using block diagram in Figure 2 supplied by SBW, we verified all SBW installations. As part of this verification, we identified:

1. that true power is measured on all the compressors in the system.
2. where pressure measurements are being taken in the supply side.
3. other areas in the system where a pressure measurement might be taken.

Figure 1. Block Diagram of the Compressed Air System at the Bakery

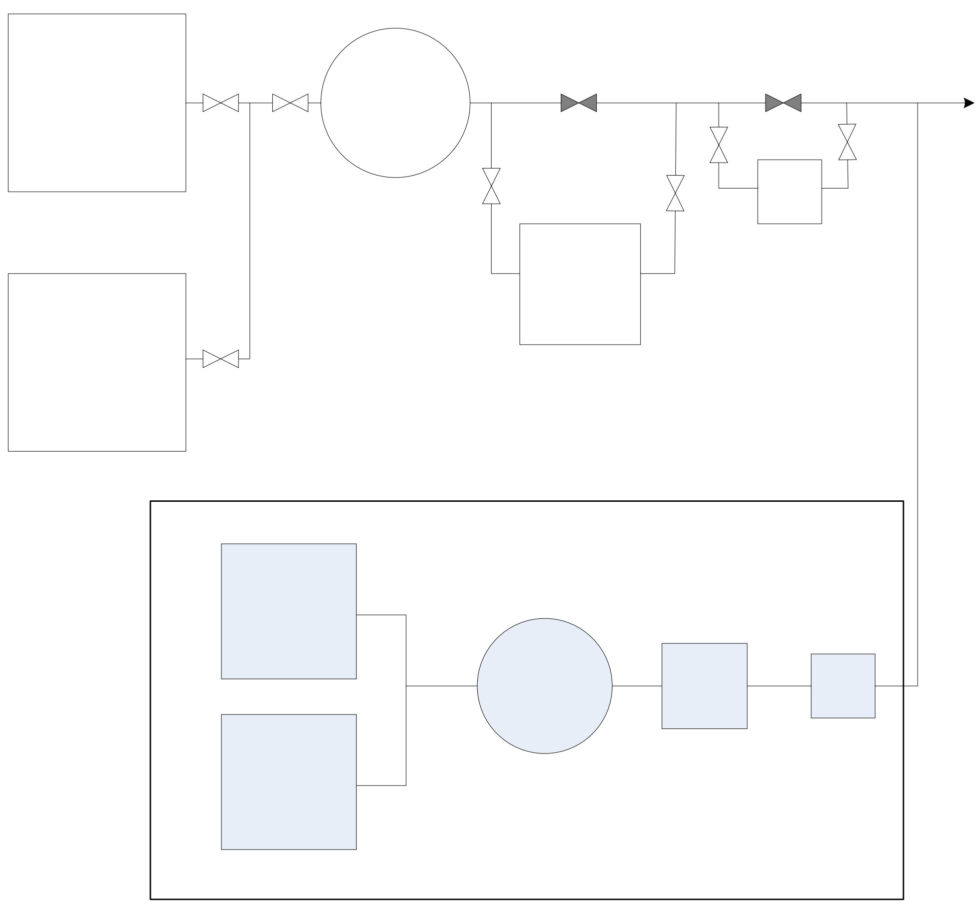
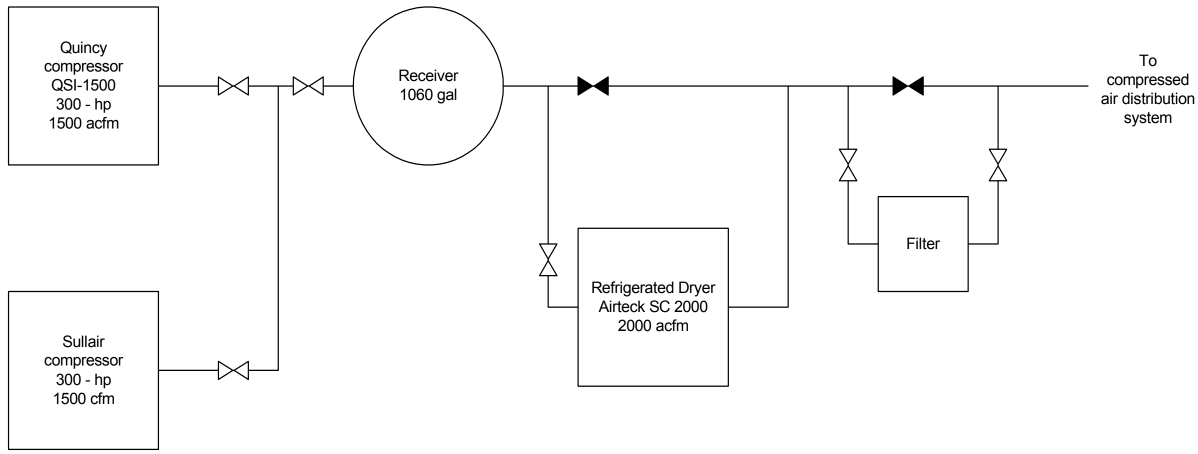


Figure 2. Original Block Diagram of the Compressed Air System at the Bakery



We were able to verify that all measuring devices installed on the supply side were correctly used for true power measurement and pressure. We also verified that the block diagram was not accurate, since two other compressors, a 75 and 50 hp could also run and feed production.

E. Maintenance issues

We also identified any issues, such as human error, connection to the system, ambient conditions, and maintenance that may relate to air quality, compressor reliability, or energy concerns that may affect SBW-estimated savings. The maintenance staff at this Bakery is maintaining the compressors per the instructions left by SBW. They see the benefits leak repair and controlling open blowing. There are no other maintenance issues which will impact the savings per SBW's verification report.

F. Monitoring Equipment

We also located and reviewed the placement of all monitoring equipment installed by SBW. We found that the placement of all monitoring equipment installed by SBW was correct.

G. Logging and Sample Rates

Finally, we noted the feasibility of locations picked by SBW for logging and sample rates used. We note whether the measurements were at three-second intervals[17], if any of the spot pressure measurements were sampled incorrectly. We found that the three-second intervals were being used and that the sample rates were correct for the events taking place on the supply side.

[17] Based on Nyquist Theorem of at least 3 data points for the shortest event being measured

II. Engineering Review

A. Review of AIRMaster+ mdb Files

For each of the sites visited, we reviewed the completed AIRMaster+ mdb files submitted by SBW. For each of the AIRMaster+ modules, we attempted to verify that all information, for both the baseline and post-retrofit conditions, had been correctly input into AIRMaster+ files, including the following:

1. company name
2. utility
3. facility data including utility rate assignment,
4. a summary of the air compressors on site,
5. system-level information, including design and performance parameters, automatic sequencer control pressure set points, daytypes, and end uses.
6. air compressor information, including detailed specifications.
7. hourly average airflow or power information and operating schedules.
8. system baseline airflow requirements and associated energy and demand costs for the selected system and daytype.

We found that all the information was correctly entered.

B. Savings Potential

We also examined the possible EEM's (energy efficiency measures), which were analyzed using AIRMaster+, and verified their feasibility. This also involved evaluating the air system energy savings potential from the selected Energy Efficiency Measures, considering interactive effects of EEMs, including:

- Reduce Air Leaks
- Improve End Use Efficiency
- Reduce System Air Pressure
- Use Unloading Controls
- Adjust Cascading Set Points
- Use Automatic Sequencer
- Reduce Run Time
- Add Primary Receiver Volume

Only two EEM's were used:

- Reduce Air Leaks: Site personnel contracted with a service provider to perform a leak survey and repair.

- Improve end use efficiency (engineered nozzles): All open tubes were provided with nozzles to lower air consumption. There were 65 nozzle locations that were installed.

C. Conclusions

Based on the on-site visits and engineering review, we were able to verify that allowing the compressor to unload resulted in an annual utility savings of 327,228 kWh, and a demand reduction of 52.7 kW. SBW reported that equates to a $35,279 annual savings.

Project Number: CAMP08	
Audit Date:	July, 2003
SBW Verified kWh:	722,262
Evaluation Verified kWh :	722,262
SBW Verified kW :	83.7
Evaluation Verified kW	83.7
Site Gross kWh Realization Rate: 100%	
Site Gross kW Realization Rate: 100%	

I. On-Site Inspections

A. Background

In the spring of 2003, SBW Consulting performed an assessment of the compressed air system at an electronics plant in California. Following implementation of the recommended energy conservation measure by the customer, SBW returned to the site in July of 2003 to measure the performance of the retrofitted system. The performance data were analyzed to determine the actual energy savings achieved by the retrofit.

On April 23rd 2004, a member of the Evaluation Team visited the site to verify baseline and post-installation plant conditions. He met with a member of the company's maintenance staff who was present during SBW's visits. This person provided a very thorough tour of the facility as a way of providing a general understanding of the compressed air system and how it fits into overall plant operations and how the compressed air is used to support production. During the tour, we paid special attention to: 1) inappropriate air use, 2) point of use connections, and 3) high volume intermittent demands. We were shown all the installation taps and from SBW.

B. Baseline

Only one building was audited. Three compressors serve the compressed air system in this particular area of the plant: a Cooper TA2000 200-horsepower centrifugal compressor, a 100-horsepower Ingersoll Rand flooded screw compressor and a 35-horsepower 2-stage reciprocating compressor. The centrifugal compressor operates continuously and is the only compressor that is online. Normal loads on the system average approximately 14% of the compressor's rated capacity; the full capacity of the compressor is required only for very short periods each year. The compressed air is used for HVAC controls, valves, air lifts and miscellaneous testing. Since this facility is a top security installation, no demand side measurement was taken, nor was access allowed inside the building.

C. Recommended Improvements

SBW recommended that the company change the operating mode of the centrifugal compressor from constant pressure to auto-dual.

D. Implemented Improvements

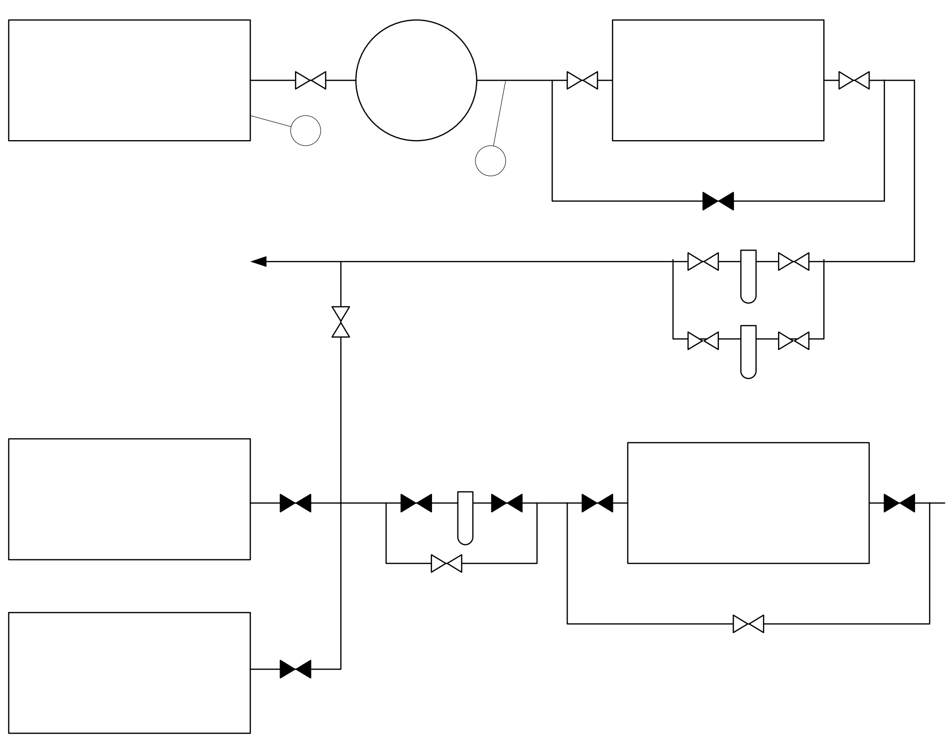
They changed the operating mode of the centrifugal compressor from constant pressure to auto-dual.

When a centrifugal compressor is allowed to unload, the power drops to typically 15% of full load. Before the compressor would by-pass and require 80-85% of full power with now flow out to production.

Using block diagram in Figure 1 supplied by SBW, we verified all SBW installations. As part of this verification, we identified:

1. that true power is measured on all the compressors in the system.
2. where pressure measurements are being taken in the supply side.
3. Demand side measurements were not allowed

Figure 1. Block Diagram of the Compressed Air System



We were able to verify that all measuring devices installed on the supply side were correctly used for true power measurement and pressure. We also verified that the block diagram was accurate,

E. Maintenance issues

We also identified any issues, such as human error, connection to the system, ambient conditions, and maintenance that may relate to air quality, compressor reliability, or energy concerns that may affect SBW-estimated savings. The maintenance staff of this facility is maintaining the compressor per the instructions left by SBW. They see the benefits of allowing the compressor to unload rather then bypass the compressed air. There are no other issues which will impact the savings per SBW's verification report.

F. Monitoring Equipment

We also located and reviewed the placement of all monitoring equipment installed by SBW. We found that the placement of all monitoring equipment installed by SBW was correct.

G. Logging and Sample Rates

Finally, we noted the feasibility of locations picked by SBW for logging and sample rates used. We note whether the measurements were at three-second intervals[18], if any of the spot pressure measurements were sampled incorrectly. We found that the three-second intervals were being used and that the sample rates were correct for the events taking place on the supply side.

II. Engineering Review

A. Review of AIRMaster+ mdb Files

For each of the sites visited, we reviewed the completed AIRMaster+ mdb files submitted by SBW. For each of the AIRMaster+ modules, we attempted to verify that all information, for both the baseline and post-retrofit conditions, had been correctly input into AIRMaster+ files, including the following:

1. company name
2. utility
3. facility data including utility rate assignment,
4. a summary of the air compressors on site,
5. system-level information, including design and performance parameters, automatic sequencer control pressure set points, daytypes, and end uses.
6. air compressor information, including detailed specifications.
7. hourly average airflow or power information and operating schedules.
8. system baseline airflow requirements and associated energy and demand costs for the selected system and daytype.

[18] Based on Nyquist Theorem of at least 3 data points for the shortest event being measured

We found that all the information was correctly entered.

B. Savings Potential

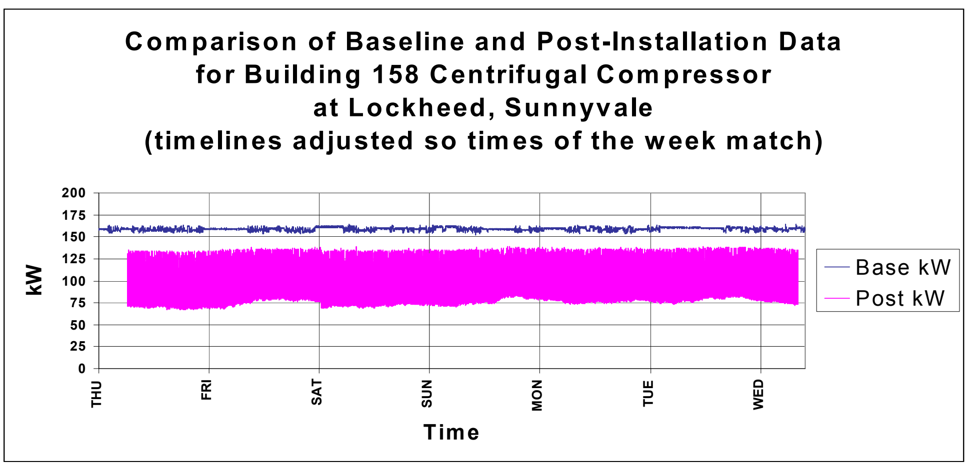
We also examined the possible EEM's (energy efficiency measures), which were analyzed using AIRMaster+, and verified their feasibility. This also involved evaluating the air system energy savings potential from the selected Energy Efficiency Measures, considering interactive effects of EEMs, including:

- Reduce Air Leaks
- Improve End Use Efficiency
- Reduce System Air Pressure
- Use Unloading Controls
- Adjust Cascading Set Points
- Use Automatic Sequencer
- Reduce Run Time
- Add Primary Receiver Volume

Only one EEM was used:

- Use unloading controls

This plot below clearly shows the reduction in power draw and the difference between



the baseline and post-installation modes of operation.

C. Conclusions

Based on the on-site visits and engineering review, we were able to verify that allowing the compressor to unload resulted in an annual utility savings of 722,262 kWh, and a demand reduction of 83.7 kW. SBW reported that equates to a $71,589 annual savings.

The control mode of the TA2000 was changed from constant pressure to auto-dual, which allowed the compressor to unload when the plant demand dropped below the fully modulated output of the compressor. Whereas before the compressor operated in bypass and nearly 80% power all the time.

Project Number: CAMP10	
Audit Date:	July, 2004
SBW Verified kWh:	655,314
Evaluation Verified kWh :	655,314
SBW Verified kW :	36.4
Evaluation Verified kW	36.4
Site Gross kWh Realization Rate: 100%	
Site Gross kW Realization Rate: 100%	

I. On-Site Inspections

A. Background

In the spring of 2003, SBW Consulting, Inc. (SBW) performed an assessment of the compressed air system at saw mill in Northern, California. Following implementation of energy conservation measures by the customer, SBW returned to the site in July of 2004 to measure the performance of the retrofitted system. The performance data were analyzed to determine the actual energy savings achieved by the retrofits.

On October 11th 2004, a member of the Evaluation Team visited the site to verify baseline and post-installation plant conditions. He met with a member of the company's maintenance staff who was present during SBW's visits. This person provided a very thorough tour of the facility as a way of providing a general understanding of the compressed air system and how it fits into overall plant operations and how the compressed air is used to support production. During the tour, we paid special attention to: 1) inappropriate air use, 2) point of use connections, and 3) high volume intermittent demands. We were shown all the installation taps and from SBW.

B. Baseline

Prior to the verification visit by SBW, the compressed air system at this saw mill consisted of two compressors, a heatless regenerative desiccant dryer, several receivers, and the distribution system. The compressors are a Quincy model QNW 1251 250-hp compressor with a capacity of 1,185 cfm at 110 psig, and a Quincy model QNW 740 150-hp compressor with a capacity of 760 cfm at 110 psig. The compressors have modulating controls only: they do not unload or time out. Additionally the QNW 740, when operating alone, will not come up to full load since its butterfly valve assembly is malfunctioning. The dryer is a Pneumatech brand model PH-2100, 2,100 cfm capacity heatless regenerative desiccant dryer that uses activated alumina as a desiccant. The purge rate is a constant 350 scfm. There is a 1,020-gallon wet receiver between the compressors and the dryer, and a pre-filter and after-filter upstream and downstream of the dryer, respectively. The system operates at a nominal 100 psig.

C. Recommended Improvements

SBW recommended that the company install unloading and time-out controls on the compressors. Also install a 2,000-gallon receiver adjacent to the existing 1,020-gallon receiver to prevent short cycling of the compressors when the unloading controls are installed. Unloading controls will allow the compressor to operate at about 20% of the motor full-load capacity, much less than when in modulation mode, when the load on the compressor is sufficiently reduced. Also recommended was to reduce the purge air from the desiccant dryer buy installing purge controls on the unit.

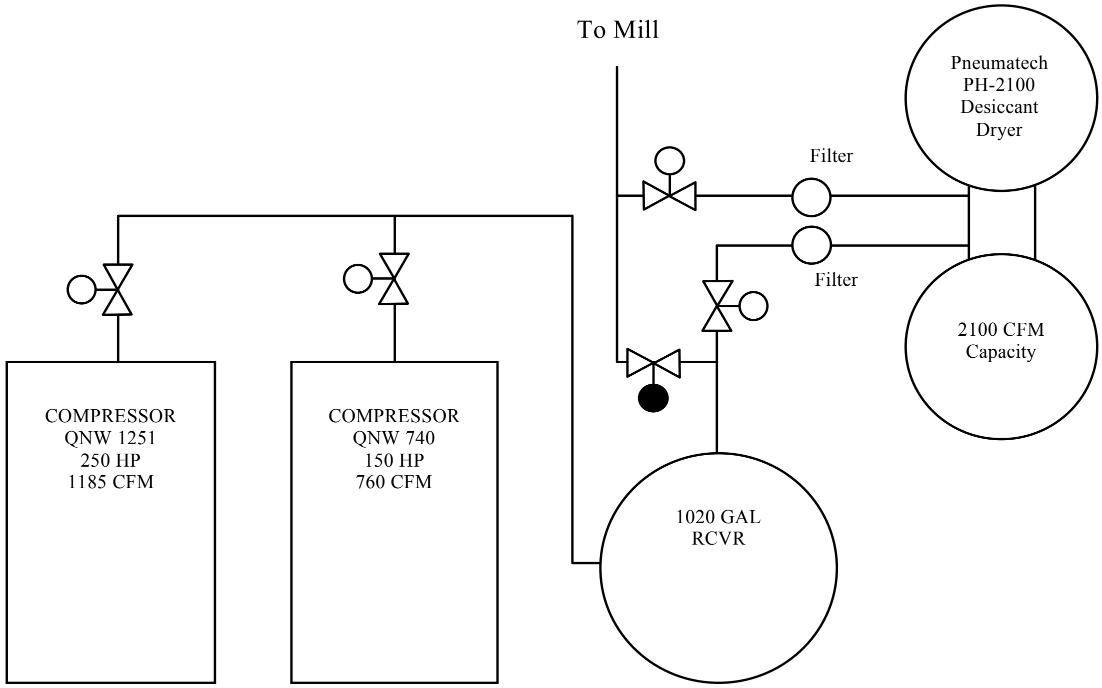
D. Implemented Improvements

Unloading controls were installed only on the smaller compressor since the larger compressor must stay baseloaded all the time. Now the smaller compressor will unload timeout and shut off during low demand times. Additional receiver capacity was installed A dewpoint control system was installed on the dryer which reduced the purge considerably. Using block diagram in Figure 1 supplied by SBW, we verified all SBW installations.

As part of this verification, we identified:

q) That true power is measured on all the compressors in the system.
r) where pressure measurements are being taken in the supply side.
s) Other areas of the system where a pressure measurement might be taken.

Figure 1. Block Diagram of the Compressed Air System



We were able to verify that all measuring devices installed on the supply side were correctly used for true power measurement and pressure. We also verified that the block diagram was accurate,

E. Maintenance issues

We also identified any issues, such as human error, connection to the system, ambient conditions, and maintenance that may relate to air quality, compressor reliability, or energy concerns that may affect SBW-estimated savings. The maintenance staff of this facility is maintaining the compressor per the instructions left by SBW. There are no other issues which could impact the savings per SBW's verification report;

F. Monitoring Equipment

We also located and reviewed the placement of all monitoring equipment installed by SBW. We found that the placement of all monitoring equipment installed by SBW was correct.

G. Logging and Sample Rates

Finally, we noted the feasibility of locations picked by SBW for logging and sample rates used. We note whether the measurements were at three-second intervals[19], if any of the spot pressure measurements were sampled incorrectly. We found that the three-second intervals were being used and that the sample rates were correct for the events taking place on the supply side.

II. Engineering Review

A. Review of AIRMaster+ mdb Files

For each of the sites visited, we reviewed the completed AIRMaster+ mdb files submitted by SBW. For each of the AIRMaster+ modules, we attempted to verify that all information, for both the baseline and post-retrofit conditions, had been correctly input into AIRMaster+ files, including the following:

(1) company name
(2) utility
(3) facility data including utility rate assignment,
(4) a summary of the air compressors on site,
(5) system-level information, including design and performance parameters, automatic sequencer control pressure set points, daytypes, and end uses.
(6) air compressor information, including detailed specifications.
(7) hourly average airflow or power information and operating schedules.
(8) system baseline airflow requirements and associated energy and demand costs for the selected system and daytype.

[19] Based on Nyquist Theorem of at least 3 data points for the shortest event being measured

We found that all the information was correctly entered.

B. Savings Potential

We also examined the possible EEM's (energy efficiency measures), which were analyzed using AIRMaster+, and verified their feasibility. This also involved evaluating the air system energy savings potential from the selected Energy Efficiency Measures, considering interactive effects of EEMs, including:

- Reduce Air Leaks
- Improve End Use Efficiency
- Reduce System Air Pressure
- Use Unloading Controls
- Adjust Cascading Set Points
- Use Automatic Sequencer
- Reduce Run Time
- Add Primary Receiver Volume

Only two EEMs were used:

- Install unloading controls
- Improve end use efficiency (The dryer purge of 15-18% typical of heatless dryers was cut in half by the addition of purge controls).

C. Conclusions

Based on the on-site visits and engineering review, we were able to verify that allowing the compressor to unload resulted in an annual utility savings of 655,314 kWh, and a demand reduction of 36.4 kW. SBW reported that equates to a $68,130 annual savings.

The savings for the measures recommended were approximately 85% greater than originally estimated in SBW's Assessment Report. This is largely due to the unloading controls, in combination with the improved dryer purge controls, allowing the smaller QNW 740 compressor to completely shut down during the maintenance shifts and low demand times. These controls also allowed the QNW 740 compressor to unload for longer periods of lower air demand than anticipated during the production day, further contributing to the energy savings.

Project Number: CAMP11	
Audit Date:	February, 2004
SBW Verified kWh:	396,396
Evaluation Verified kWh :	396,396
SBW Verified kW :	79.3
Evaluation Verified kW	79.3
Site Gross kWh Realization Rate: 100%	
Site Gross kW Realization Rate: 100%	

I. On-Site Inspections

A. Background

In the summer of 2003, SBW Consulting performed an assessment of the compressed air system at a lumber company in northern California. Following implementation of energy conservation measures by the customer, SBW returned to the site in February of 2004 to measure the performance of the retrofitted system. The performance data was analyzed to determine the actual energy savings achieved by the retrofits.

On October 12th 2004, a member of the Evaluation Team visited the site to verify baseline and post-installation plant conditions. He met with a member of the company's maintenance staff who was present during SBW's visits. This person provided a very thorough tour of the facility as a way of providing a general understanding of the compressed air system and how it fits into overall plant operations and how the compressed air is used to support production. During the tour, we paid special attention to: 1) inappropriate air use, 2) point of use connections, and 3) high volume intermittent demands. We were shown all the installation taps and from SBW.

B. Baseline

Prior to the verification visit by SBW, The compressed air System at this saw mill consisted of three compressors, two refrigerated dryers, three receivers, and the distribution system. The compressors are:

1. QNW 1000D, 200-hp, air-cooled with 5-hp cooling fan, modulating controls, 963 acfm capacity at 100 psig (AirMaster+ rating)
2. QNW 740B, 150-hp, air-cooled with 5-hp cooling fan, modulating controls, 729 acfm capacity at 100 psig (AirMaster+ rating)
3. QNW 490B, 125-hp, air-cooled with 5-hp cooling fan, modulating controls, 551 acfm capacity at 100 psig (AirMaster+ rating)

All are QNW rotaries with no unloading or time out controls and all suction throttle control. No sequencer is used. Prior to the arrival of the CAMP engineer, this mill typically operated all three compressors during production hours. As a result of a problem discovered by the CAMP engineer and quickly remedied by a mill contractor, it was feasible to shut off the QNW 490B compressor.

The QNW 1000D (200hp) and the QNW 740B (150hp) compressors are located in a compressor room in the sawmill and the QNW 490B (125hp) is located in the planer mill. All three compressors feed a common distribution system.

The refrigerated dryers are:

1. Pneumatech Model AD1700, 1700 scfm capacity, located near the QNW 1000D and the QNW 740B compressors, and a
2. Zurn "General" brand, Model R-120-A, 600 scfm capacity, located near the QNW 490B compressor in the planer mill, presently valved out of service

There are three receivers with a total volume of approximately 154 cu.ft. (1,100 gallons), located in the maintenance shop near the compressor room with the QNW 1000D and QNW 740B compressors in the planer mill near the QNW 490B compressor

C. Recommended Improvements

SBW recommended to the company turn off compressors that are not needed such as the QNW 490 in the planer mill. Add unloading controls and timed shut off to the other two compressors in the saw mill area. Repair leaks

D. Implemented Improvements

They found and repaired a bad suction inlet valve on the 200 hp QNW which prevented it from fully loading the compressor. This is why all three compressors were needed. Once fixed, the 125 hp QNW in the planer mill was able to be shut down. They no longer use this compressor and are thinking of selling it.

Recommended energy conservation **measures that were not implemented** are provided below;

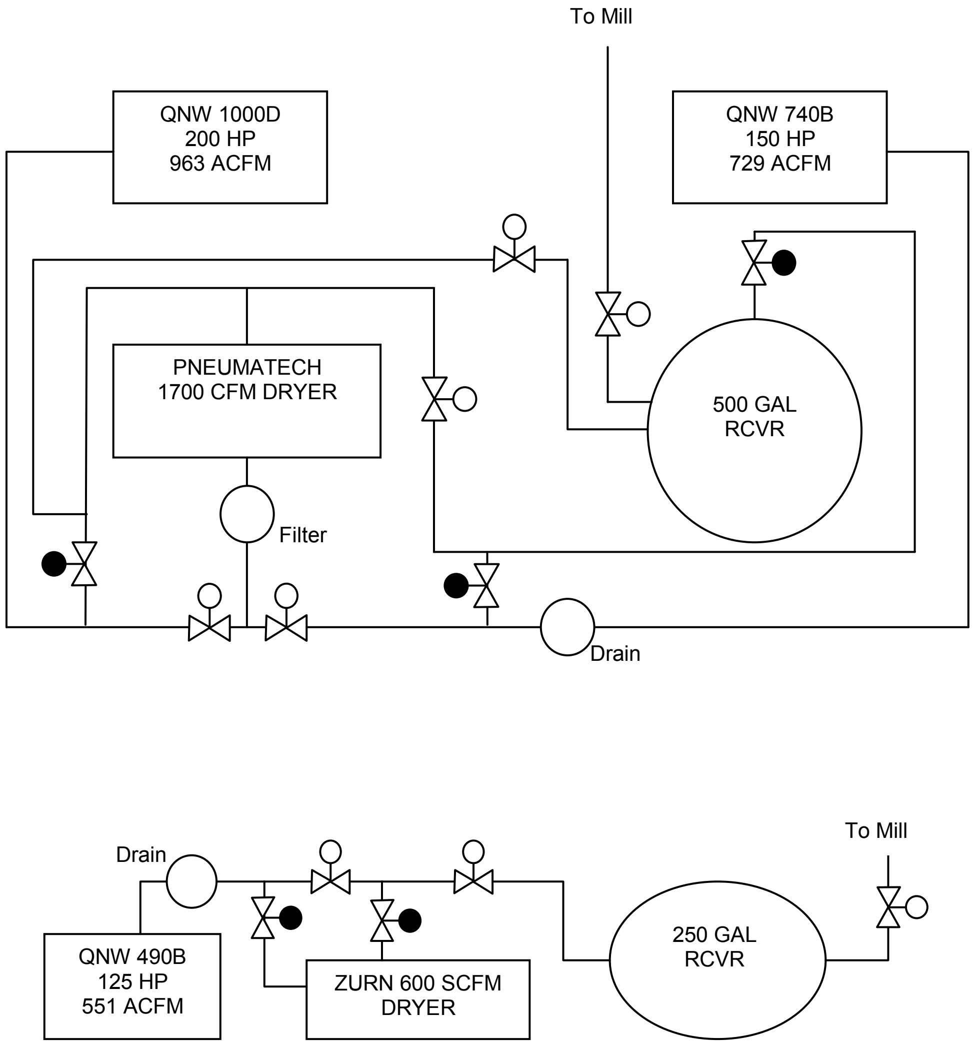
- Reduce Compressed Air Leak Load due to a lack of funding and manpower
- Install Unloading Controls and Receiver due to lack of funding

Using block diagram in Figure 1 supplied by SBW, we verified all SBW installations.

As part of this verification, we identified:

t) That true power is measured on all the compressors in the system.
u) where pressure measurements are being taken in the supply side.
v) Other areas of the system where a pressure measurement might be taken.

Figure 1. Block Diagram of the Compressed Air System



We were able to verify that all measuring devices installed on the supply side were correctly used for true power measurement and pressure. We also verified that the block diagram was accurate,

E. Maintenance issues

We also identified any issues, such as human error, connection to the system, ambient conditions, and maintenance that may relate to air quality, compressor reliability, or energy concerns that may affect SBW-estimated savings. There budget is preventing them from installing shut down timers on the 200hp and 150hp. This is unfortunate sicne this would certainly decrease their energy usage even further. I witnessed both compressors running unloaded during a lunch break where one could have easily timed out and shut off if they had the proper controls.

F. Monitoring Equipment

We also located and reviewed the placement of all monitoring equipment installed by SBW. We found that the placement of all monitoring equipment installed by SBW was correct.

G. Logging and Sample Rates

Finally, we noted the feasibility of locations picked by SBW for logging and sample rates used. We note whether the measurements were at three-second intervals[20], if any of the spot pressure measurements were sampled incorrectly. We found that the three-second intervals were being used and that the sample rates were correct for the events taking place on the supply side.

II. Engineering Review

A. Review of AIRMaster+ mdb Files

For each of the sites visited, we reviewed the completed AIRMaster+ mdb files submitted by SBW. For each of the AIRMaster+ modules, we attempted to verify that all information, for both the baseline and post-retrofit conditions, had been correctly input into AIRMaster+ files, including the following:

(1) company name
(2) utility
(3) facility data including utility rate assignment,
(4) a summary of the air compressors on site,
(5) system-level information, including design and performance parameters, automatic sequencer control pressure set points, daytypes, and end uses.
(6) air compressor information, including detailed specifications.
(7) hourly average airflow or power information and operating schedules.
(8) system baseline airflow requirements and associated energy and demand costs for the selected system and daytype.

We found that all the information was correctly entered.

B. Savings Potential

We also examined the possible EEM's (energy efficiency measures), which were analyzed using AIRMaster+, and verified their feasibility. This also involved evaluating the air system energy savings potential from the selected Energy Efficiency Measures, considering interactive effects of EEMs, including:

- Reduce Air Leaks
- Improve End Use Efficiency
- Reduce System Air Pressure

[20] Based on Nyquist Theorem of at least 3 data points for the shortest event being measured

- Use Unloading Controls
- Adjust Cascading Set Points
- Use Automatic Sequencer
- Reduce Run Time
- Add Primary Receiver Volume

Only one EEM was used:

- Reduce run time – comes from shutting off the 125 hp compressor in the planer mill

Note that funding was not available to perform the other energy efficiency measures, such as adding the shut down timers or repair of major leaks

C. Conclusions

Based on the on-site visits and engineering review, we were able to verify that allowing the compressor to unload resulted in an annual utility savings of 396,396 kWh, and a demand reduction of 79.3 kW. SBW reported that equates to a $ 40,993 annual savings.

The reason that the savings were less than originally estimated in SBW's Assessment Report is that two of the three recommended measures were not implemented. The savings are 34.6% of the projected amount and the project cost is less than 6% of the estimate. This yields a payback of approximately five days, still quite cost-effective.

When SBW conducted the post-installation verification, it was discovered that the air pressure had been increased from an average of 91 psig during the baseline period to an average 102 psig during the post-installation period. To account for this difference the model used to establish the baseline energy consumption was adjusted to reflect the higher air pressure.

Additionally, the baseline model used for the Assessment phase of this project assumed that the QNW 490B would operate fully modulated prior to the influence of CAMP.

Upon further review of the baseline data it was determined that the QNW 490B compressor would have operated at nearly full load prior to the influence of CAMP. An adjustment was also made to correct this error. This is the reason for the difference between the baseline estimate in the Assessment Report of 317,949 kWh/yr energy savings for shutting this compressor off and the savings of 396,396 kWh/yr energy savings verified in the Verification Report.

Project Number: CAMP 14	
Audit Date:	April, 2004
SBW Verified kWh:	1,411,901
Evaluation Verified kWh :	1,411,901
SBW Verified kW :	140.2
Evaluation Verified kW	140.2
Site Gross kWh Realization Rate: 100%	
Site Gross kW Realization Rate: 100%	

I. On-Site Inspections

A. Background

In the summer of 2003, SBW Consulting performed an assessment of the compressed air system at a wood products plant in northern California. Following implementation of energy conservation measures by the customer, SBW returned to the site in April, 2004 to measure the performance of the retrofitted system. The performance data were analyzed to determine the actual energy savings achieved by the retrofits.

On October 13th 2004, a member of the Evaluation Team visited the site to verify baseline and post-installation plant conditions. He met with a member of the company's maintenance staff who was present during SBW's visits. This person provided a very thorough tour of the facility as a way of providing a general understanding of the compressed air system and how it fits into overall plant operations and how the compressed air is used to support production. During the tour, we paid special attention to: 1) inappropriate air use, 2) point of use connections, and 3) high volume intermittent demands. We were shown all the installation taps and from SBW.

B. Baseline

Prior to the verification visit by SBW, this woodworking plant used four primary compressors, all of which are manufactured by Kaeser. There are three model ES 290, 200-hp air-cooled screw compressors with a nominal capacity of 1,014 cfm at 110 psig. All three of these compressors are located in a compressor room and each has a 1,500-gallon receiver and a Kaeser model KRD 1200 refrigerated dryer. This dryer has a capacity of 1,200 cfm at 100 psig, 100 degrees F. There is also a model ES 300W, 220-hp, 1,127-cfm capacity water-cooled compressor located in the hydraulics room, separate from the other compressors but on the same distribution system. It has no dedicated receiver, but does have the same model KRD 1200 dryer. All of the compressors have load/unload controls only. The line pressure is approximately 90 psig, According to plant personnel the compressors are all set at the same pressure, not staged to operate at different pressures.

Open blowing was prevalent and used to clean sawdust from tools and belts. Leaks are abundant; bearings are cooled with compressed air. Only one of the Kaeser compressors (the newest) has PLC controls while the rest are older and have analog gauges and controls. The older compressors are turned on and off manually by plant personal to match the production schedule.

C. Recommended Improvements

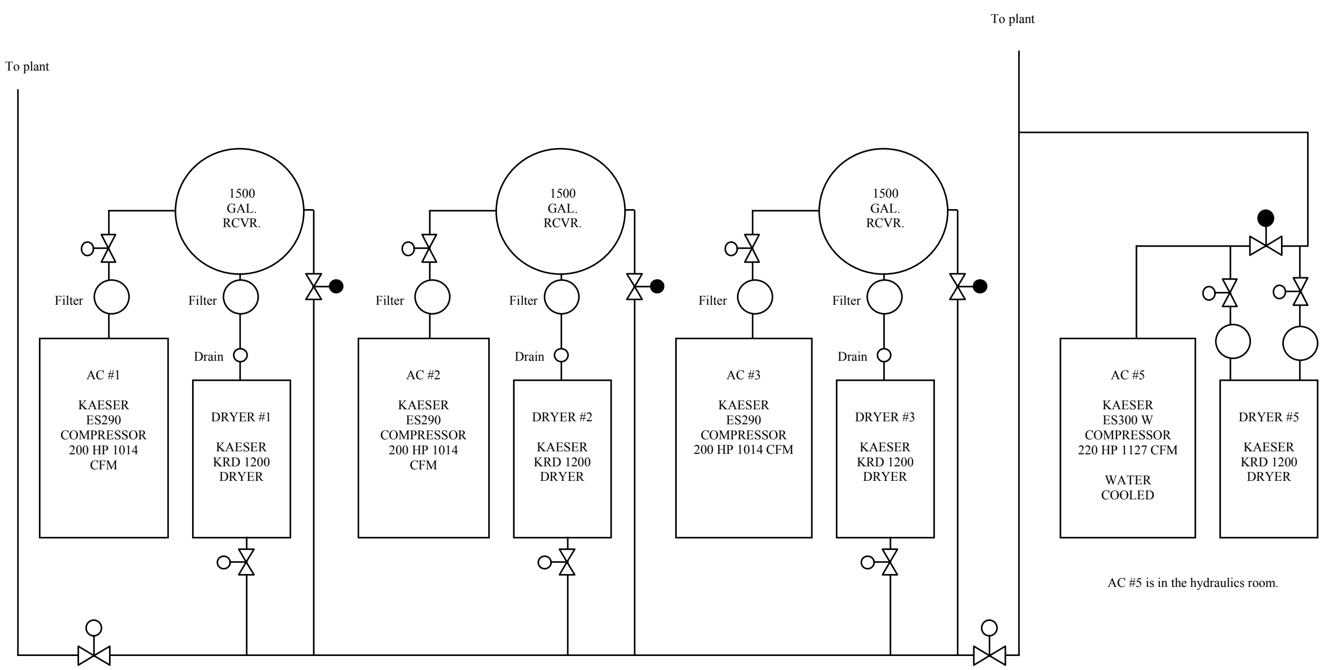
SBW recommended that the company;

- Repair compressed air leaks
- Install engineered nozzles and air knives to replace open blowing and drilled pipes
- Replace belt cleaning system with a blower
- **D. Implemented Improvements**
- Repaired compressed air leaks
- Installed engineered nozzles and air knives to replace open blowing and drilled pipes
- Installed a blower to replace the air knives that cleaned the belt. Originally both air knives consumed over 300 scfm of compressed air.

Using block diagram in Figure 1 supplied by SBW, we verified all SBW installations. As part of this verification, we identified:

w) That true power is measured on all the compressors in the system.
x) where pressure measurements are being taken in the supply side.
y) Other areas of the system where a pressure measurement might be taken.

Figure 1. Block Diagram of the Compressed Air System



We were able to verify that all measuring devices installed on the supply side were correctly used for true power measurement and pressure. We also verified that the block diagram was accurate,

E. Maintenance issues

We also identified any issues, such as human error, connection to the system, ambient conditions, and maintenance that may relate to air quality, compressor reliability, or energy concerns that may affect SBW-estimated savings. The plant has contracted with the local Kaeser compressor vendor to take care of all the major maintenance. The maintenance employees in the plant take care of all other issues as far as cleaning, and small adjustments. They use cycling dryers and zero air loss drains. The storage is more than adequate for the load noload style of control. The supply side of this plant is in excellent repair with energy saving products already installed. On the demand side, the blowers have replaced large compressed air usage. The air used to cool bearings has been removed, leaks are being aggressively repaired.

F. Monitoring Equipment

We also located and reviewed the placement of all monitoring equipment installed by SBW. We found that the placement of all monitoring equipment installed by SBW was correct.

G. Logging and Sample Rates

Finally, we noted the feasibility of locations picked by SBW for logging and sample rates used. We note whether the measurements were at three-second intervals[21], if any of the spot pressure measurements were sampled incorrectly. We found that the three-second intervals were being used and that the sample rates were correct for the events taking place on the supply side.

II. Engineering Review

A. Review of AIRMaster+ mdb Files

For each of the sites visited, we reviewed the completed AIRMaster+ mdb files submitted by SBW. For each of the AIRMaster+ modules, we attempted to verify that all information, for both the baseline and post-retrofit conditions, had been correctly input into AIRMaster+ files, including the following:

(1) company name
(2) utility
(3) facility data including utility rate assignment,
(4) a summary of the air compressors on site,
(5) system-level information, including design and performance parameters, automatic sequencer control pressure set points, daytypes, and end uses.

[21] Based on Nyquist Theorem of at least 3 data points for the shortest event being measured

(6) air compressor information, including detailed specifications.
(7) hourly average airflow or power information and operating schedules.
(8) system baseline airflow requirements and associated energy and demand costs for the selected system and daytype.

We found that all the information was correctly entered.

B. Savings Potential

We also examined the possible EEM's (energy efficiency measures), which were analyzed using AIRMaster+, and verified their feasibility. This also involved evaluating the air system energy savings potential from the selected Energy Efficiency Measures, considering interactive effects of EEMs, including:

- Reduce Air Leaks
- Improve End Use Efficiency
- Reduce System Air Pressure
- Use Unloading Controls
- Adjust Cascading Set Points
- Use Automatic Sequencer
- Reduce Run Time
- Add Primary Receiver Volume

Two EEM's were used:

Improve end use efficiency –

- The engineered nozzles were installed as recommended. The other measure was implemented by installing air knives using blowers rather than compressed air. This effectively eliminated the use of compressed air for this purpose, replacing the compressor utilization with a 10-hp and a 7.5-hp blower. The original 300 scfm would have required at least an additional 75 hp of compressed air.

Reduced Air Leaks

- The measure was generally implemented as proposed.

C. Conclusions

Based on the on-site visits and engineering review, we were able to verify that allowing the compressor to unload resulted in an annual utility savings of 1,411,901 kWh, and a demand reduction of 140.2 kW. SBW reported that these reductions equate to a $ 68,095 annual savings.

The original baseline kW measurements in the SBW Assessment Report did not represent the full load demand of the 200-hp compressors. In order to correct this, the original kW values were adjusted based on the percent capacity of the compressors. The capacity as recorded in the baseline was used to establish the percent full load power based on the performance graphs from AirMaster+, using the verification data, which was deemed accurate. The baseline capacity data was used as a scale by developing an equation for the slope and offset from each of the compressor's verification performance graphs and using that equation to modify the baseline kW so it would reflect the level at which the compressor was actually operating. This modified kW was then entered into AirMaster and a revised baseline calculated. Amperage independently measured in 2003 by plant personnel confirmed that the compressors were operating at the demand levels recorded during verification in 2004.

Appendix F

Savings Calculations

CAMP_01

			kW for Hour																							
Daytype	Hours/ Day Type	EEM Title	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Non-Production	104	Baseline	31.7	30.6	30.7	30.7	30.5	30.2	30.1	30.1	30.1	30.6	30.5	30.3	30	30.2	30.4	30.4	30.2	39.3	80.1	86.9	80.2	82.8	87.6	88.5
Non-Production	104	As-Built	49	45.9	50.1	47.1	32.2	29.3	23.1	15.8	13.1	13	13.1	13.8	13.2	13.3	13.1	13.5	13.9	13.4	13.3	13	10.8	0	0	0
Production	183	Baseline	116	118.9	111.9	114.8	112.9	118.4	121.6	116.5	114.6	120.1	118.8	118.1	111.9	106.2	98.3	83.9	122.8	125.5	143.7	132.9	98.1	86.5	99.6	92.1
Production	183	As-Built	72.6	77.8	82.8	90.4	80.5	89.9	85.6	81.1	72.7	53.8	69.1	61.2	56.7	60.7	59.7	58.6	70.8	85.5	74.4	89.1	89.7	94.5	92.2	85.2
Peak Production	78	Baseline	136.3	139.7	131.6	135	132.8	139.2	143	136.9	134.7	141.1	139.7	138.8	131.6	124.8	115.5	98.7	144.3	147.5	168.9	156.2	115.4	101.7	117.1	108.3
Peak Production	78	As-Built	85.4	91.4	97.4	106.2	94.6	105.7	100.6	95.3	85.5	63.2	81.2	71.9	66.7	71.4	70.2	68.9	83.3	100.5	87.5	104.7	105.4	111.1	108.4	100.2

			kWh for Hour																								
Daytype	Hours/ Day Type	EEM Title	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	**Total kWh**
Non-Production	104	Baseline	3296.8	3182.4	3192.8	3192.8	3172	3140.8	3130.4	3130.4	3130.4	3182.4	3172	3151.2	3120	3140.8	3161.6	3161.6	3140.8	4087.2	8330.4	9037.6	8340.8	8611.2	9110.4	9204	110,521
Non-Production	104	As-Built	5096	4773.6	5210.4	4898.4	3348.8	3047.2	2402.4	1643.2	1362.4	1352	1362.4	1435.2	1372.8	1383.2	1362.4	1404	1445.6	1393.6	1383.2	1352	1123.2	0	0	0	48,152
Production	183	Baseline	21228	21759	20478	21008	20661	21667	22253	21320	20972	21978	21740	21612	20478	19435	17989	15354	22472	22967	26297	24321	17952.3	15830	18227	16854	494,850
Production	183	As-Built	13286	14237	15152	16543	14732	16452	15665	14841	13304	9845.4	12645	11200	10376	11108	10925	10724	12956	15647	13615	16305	16415.1	17294	16873	15592	335,732
Peak Production	78	Baseline	10631	10897	10265	10530	10358	10858	11154	10678	10507	11006	10897	10826	10265	9734.4	9009	7698.6	11255	11505	13174	12184	9001.2	7932.6	9133.8	8447.4	247,946
Peak Production	78	As-Built	6661.2	7129.2	7597.2	8283.6	7378.8	8244.6	7846.8	7433.4	6669	4929.6	6333.6	5608.2	5202.6	5569.2	5475.6	5374.2	6497.4	7839	6825	8166.6	8221.2	8665.8	8455.2	7815.6	168,223

Evaluation Team Savings	301,211
Verification Report Savings	301,211

CAMP_02

			kW for Hour																							
Daytype	Hours/ Day Type	EEM Title	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Summer Production	130	Baseline	238.2	120.8	118.6	104.4	106	0	0	0	0	0	0	0	0	0	0	0	0	0	0	234.4	211	235.4	243.4	226.6
Summer Production	130	As-Built	232.8	136.3	131.5	100.1	103.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	225.4	176.2	227.3	241.1	209.5
Winter Production	156	Baseline	238.2	120.8	118.6	104.4	106	206.8	239.8	239.1	225.6	234.4	207.5	237.4	236.8	221.6	239.5	215.5	236.8	239.2	225.1	234.4	211	235.4	243.4	226.6
Winter Production	156	As-Built	232.8	136.3	131.5	100.1	103.6	166.8	235.8	234.5	207.5	225.3	168.5	231.2	230	199.2	235.4	186.1	230.1	234.8	206.5	225.4	176.2	227.3	241	209.5
Saturday	26	Baseline	243.4	198.3	198.3	200.2	198.1	120.9	106.8	107.6	104.7	77.3	104.9	104.3	102.5	104.6	104.7	104.9	77.3	0	0	0	0	0	0	0
Saturday	26	As-Built	241.4	147	147	151.5	146.7	136.4	105.5	107.2	100.7	27.2	101.3	99.8	95.7	100.5	100.7	101.3	33.5	0	0	0	0	0	0	0
Sunday	52	Baseline	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	89.3	105.6
Sunday	52	As-Built	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	64.6	102.8

			kWh for Hour																								
Daytype	Hours/ Day Type	EEM Title	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	**Total kWh**
Summer Production	130	Baseline	30966	15704	15418	13572	13780	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30472	27430	30602	31642	29458	239044
Summer Production	130	As-Built	30264	17719	17095	13013	13468	0	0	0	0	0	0	0	0	0	0	0	0	0	0	29302	22906	29549	31343	27235	231894
Winter Production	156	Baseline	37159	18845	18502	16286	16536	32261	37409	37300	35194	36566	32370	37034	36941	34570	37362	33618	36941	37315	35116	36566	32916	36722	37970	35350	786848.4
Winter Production	156	As-Built	36317	21263	20514	15616	16162	26021	36785	36582	32370	35147	26286	36067	35880	31075	36722	29032	35896	36629	32214	35162	27487	35459	37596	32682	744962.4
Saturday	26	Baseline	6328.4	5155.8	5155.8	5205.2	5150.6	3143.4	2776.8	2797.6	2722.2	2009.8	2727.4	2711.8	2665	2719.6	2722.2	2727.4	2009.8	0	0	0	0	0	0	0	58728.8
Saturday	26	As-Built	6276.4	3822	3822	3939	3814.2	3546.4	2743	2787.2	2618.2	707.2	2633.8	2594.8	2488.2	2613	2618.2	2633.8	871	0	0	0	0	0	0	0	50528.4
Sunday	52	Baseline	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4643.6	5491.2	10134.8
Sunday	52	As-Built	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3359.2	5345.6	8704.8

Evaluation Team Savings	58,666
Verification Report Savings	58,666

CAMP_03

			kW for Hour																							
Daytype	Hours/ Day Type	EEM Title	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Production	364	Baseline	0	0	0	0	0	159.9	157.8	151.7	157.7	157.2	153.5	154.6	152.1	92.85	44.09	0	0	0	0	0	0	0	0	0
Production	364	As-Built	0	0	0	0	0	25.97	115.8	123.9	127	121.5	126.5	116.5	124.4	125.4	89.8	0	0	0	0	0	0	0	0	0

			kWh for Hour																								
Daytype	Hours/ Day Type	EEM Title	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	**Total kWh**
Production	364	Baseline	0	0	0	0	0	58196	57430	55225	57386	57212	55869	56258	55377	33798	16049	0	0	0	0	0	0	0	0	0	502,799
Production	364	As-Built	0	0	0	0	0	9454	42151	45100	46228	44226	46046	42406	45282	45646	32687	0	0	0	0	0	0	0	0	0	399,225

Evaluation Team Savings	103,573
Verification Report Savings	103,573

CAMP_04

Daytype	Total OpHrs	Avg Airflow, acfm	Avg Airflow, %Cs.	Peak Demand, kW	Load Factor, %	Annual Energy, kWh
Production	7,512	623	58.8	159.6	73.9	1,075,700
Non-Production	1,248	388	36.6	82.8	42.3	102,351
System Totals	8,760	506	47.7	159.6	58.1	1,178,050

Daytype	Total OpHrs	Avg Airflow, acfm	Avg Airflow, %Cs.	Peak Demand, kW	Load Factor, %	Annual Energy, kWh
Production	7512	535	50.5	150.6	71.7	1,043,451
Non-Production	1248	338	31.9	80.3	40.5	98,060
System Totals	8760	436	41.2	150.6	56.1	1,141,511

Evaluation Team Savings	36,539
Verification Report Savings	36,472

CAMP05

Daytype	Hours/ Day Type	EEM Title	kW for Day 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Weekday	312	Baseline	105	104	81	69	70	69	98	102	105	105	105	106	105	103	104	104	106	104	106	107	108	109	108	108
Weekday	312	As-Built	93	92	52	34	34	41	53	58	58	57	54	56	55	57	58	56	50	56	56	96	98	94	93	95
Sunday	52	Baseline	107	108	98	73	69	68	68	68	70	70	64	65	67	67	70	67	74	91	100	102	103	101	105	105
Sunday	52	As-Built	104	106	86	41	35	34	33	36	37	35	36	38	38	38	38	38	38	41	51	66	68	68	73	91

Daytype	Hours/ Day Type		kWh for Day 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Total kWH
Weekday	312	Baseline	32682	32456	25362	21584	21877	21378	30486	31843	32622	32889	32835	33182	32910	32273	32330	32427	33127	32562	32926	33535	33666	33898	33752	33685	746290
Weekday	312	As-Built	28868	28616	16218	10457	10553	12651	16636	18191	18107	17897	16998	17367	17169	17857	18240	17610	15621	17330	17542	29814	30545	29243	29086	29582	482199
Sunday	52	Baseline	5565	5595	5099	3801	3588	3543	3518	3517	3638	3618	3345	3360	3474	3504	3619	3477	3836	4752	5215	5283	5345	5264	5446	5482	102883
Sunday	52	As-Built	5410	5487	4453	2121	1797	1755	1710	1860	1905	1804	1878	1963	1962	1967	1973	1967	1991	2138	2667	3425	3554	3556	3814	4727	65882

Evaluation Team Savings	301,092
Verification Report Savings	301,092

CAMP_06

Daytype	Hours/ Day Type	EEM Title	kW for Hours 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Production	154	Baseline	242.8	227	205	205.3	205.7	240.3	245.1	234.7	244	241.7	219.9	230.8	232.1	204.9	195.7	191.8	186.2	232.4	234.8	234.9	237.6	233.3	210	234
Production	154	As-Built	232.9	197.5	193.8	194.1	199	250.7	254.4	251.6	227.2	250.3	224.8	250.2	226.1	197.8	195.5	195.2	197.8	247.4	244.3	247.5	248.4	249.5	249.6	226.2
Saturday	47	Baseline	238.6	237.2	143.5	124.3	124.3	113.7	111.1	116.2	119	118.5	105.4	123.1	122.9	122.5	121.5	122.1	120.7	120.6	120.7	119.3	119.4	119.5	119.7	119.9
Saturday	47	As-Built	250.6	212.8	110.5	109.6	109.7	109.8	111	110.5	109.8	110.4	107.3	106.4	106.5	124.1	120.5	123.2	117.7	116.3	116.1	116.5	117.7	117.9	118.2	118.7
Sunday	92	Baseline	122	122	122.1	122.1	121.9	119.3	118.4	121.7	123.4	122.5	122.2	121.4	119.3	122.7	123.5	123.8	122.2	123	122.6	120.8	120.8	117.8	117	117.1
Sunday	92	As-Built	119.2	119.5	119.8	119.9	120	120.1	120.6	119.1	118.4	117.3	116.4	115.8	116.7	115.6	116	115.8	115.8	115.8	115.9	116.2	116.7	117.2	117.6	117.9
Monday	52	Baseline	114.2	114.4	114.6	115.5	110.9	121.6	122.8	123.1	114.6	121.2	109.8	112.5	120.3	118.7	115.5	109.4	180.4	232.2	233.8	237.1	233.1	230.1	233	204.1
Monday	52	As-Built	107	107.1	107.3	107.5	107.7	108.5	108	108.1	107.7	106.9	105.9	105.4	105.1	105.2	104.9	105.1	142	240.4	245.4	243.5	242.5	203.9	195.4	218.7
High Use Wknd	5	Baseline	193.4	193.8	195	197.3	197.8	204.8	202	201.9	200.4	196.2	196.5	195.6	196.2	199.7	200.2	197.3	196	196	196.1	196.2	196.5	192.3	192.2	192.3
High Use Wknd	5	As-Built	193.4	193.8	195	197.3	197.8	204.8	202	201.9	200.4	196.2	196.5	195.6	196.2	199.7	200.2	197.3	196	196	196.1	196.2	196.5	192.3	192.2	192.3

	Hours/ Day Type	EEM Title	kWh for Hours 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Total kWh
Production	154	Baseline	37391	34958	31570	31616	31678	37006	37745	36144	37576	37222	33865	35543	35743	31555	30138	29537	28675	35790	36159	36175	36590	35928	32340	36036	826980
Production	154	As-Built	35867	30415	29845	29891	30646	38608	39178	38746	34989	38546	34619	38531	34819	30461	30107	30061	30461	38100	37622	38115	38254	38423	38438	34835	839577
Saturday	47	Baseline	11214	11148	6745	5842	5842	5344	5222	5461	5593	5570	4954	5786	5776	5758	5711	5739	5673	5668	5673	5607	5612	5617	5626	5635	146814
Saturday	47	As-Built	11778	10002	5194	5151	5156	5161	5217	5194	5161	5189	5043	5001	5006	5833	5664	5790	5532	5466	5457	5476	5532	5541	5555	5579	139675
Sunday	92	Baseline	11224	11224	11233	11233	11215	10976	10893	11196	11353	11270	11242	11169	10976	11288	11362	11390	11242	11316	11279	11114	11114	10838	10764	10773	267683
Sunday	92	As-Built	10966	10994	11022	11031	11040	11049	11095	10957	10893	10792	10709	10654	10736	10635	10672	10654	10654	10654	10663	10690	10736	10782	10819	10847	259744
Monday	52	Baseline	5938	5949	5959	6006	5767	6323	6386	6401	5959	6302	5710	5850	6256	6172	6006	5689	9381	12074	12158	12329	12121	11965	12116	10613	189431
Monday	52	As-Built	5564	5569	5580	5590	5600	5642	5616	5621	5600	5559	5507	5481	5465	5470	5455	5465	7384	12501	12761	12662	12610	10603	10161	11372	178838
High Use Wknd	5	Baseline	967	969	975	986.5	989	1024	1010	1010	1002	981	982.5	978	981	998.5	1001	986.5	980	980	980.5	981	982.5	961.5	961	961.5	23629
High Use Wknd	5	As-Built	967	969	975	986.5	989	1024	1010	1010	1002	981	982.5	978	981	998.5	1001	986.5	980	980	980.5	981	982.5	961.5	961	961.5	23629

Evaluation Team Savings	13,074
Verification Report Savings	13,156

CAMP_07

		kW for Hours																							
Daytype	EEM Title	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Production	Baseline	222.79	222.98	222.92	222.4	222.02	222.99	223.19	223.37	229.11	221.31	220.71	215.63	210.76	218.2	231.21	226	220.98	224.83	224.69	225.15	224.92	225.68	226.13	223.41
Production	As-Built	167.57	167.75	166.96	167.63	167.19	165.95	166.96	170.87	176.82	173.43	178.34	178.52	172.09	176.23	176.54	171.00	172.94	173.51	171.52	171.33	170.99	169.28	150.17	169.22

			kWh for Hours																								
Daytype	Hours/ Day Type	EEM Title	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	**Total kWH**
Production	260	Baseline	57925	57975	57959	57824	57725	57977	58029	58076	59569	57541	57385	56064	54798	56732	60115	58760	57455	58456	58419	58539	58479.2	58677	58794	58087	1391358.8
Production	260	As-Built	43567	43615	43409	43583	43470	43148	43408	44427	45974	45092	46369	46414	44742	45820	45900	44460	44965	45112	44596	44545	44458.41	44013	39044	43997	1064129.326

Evaluation Team Savings	327,229
Verification Report Savings	327,228

CAMP_08

			kW for Hours																						
Daytype	Hours/ Day Type	EEM Title	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Typical	365	Baseline	158.9	160	160	160	160.2	159.7	158.9	158.8	158.6	159.1	158.5	159	159	158.9	158.8	159	158.8	158.9	158.5	158.4	157.6	158.1	158.4	158.7
Typical	365	As-Built	76.5	76.5	76.5	76.5	76.5	76.5	76.5	76.5	76.5	76.5	76.5	76.5	76.5	76.5	76.5	76.5	76.5	76.5	76.5	76.5	76.5	76.5	76.5	76.5

			kWh for Hour																								
Daytype	Hours/ Day Type	EEM Title	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	**Total kWh**
Typical	365	Baseline	57999	58400	58400	58400	58473	58291	57999	57962	57889	58072	57853	58035	58035	57999	57962	58035	57962	57999	57853	57816	57524	57707	57816	57926	1392402
Typical	365	As-Built	27923	27923	27923	27923	27923	27923	27923	27923	27923	27923	27923	27923	27923	27923	27923	27923	27923	27923	27923	27923	27923	27923	27923	27923	670140

Evaluation Team Savings	722,262
Verification Report Savings	722,262

CAMP_10

Daytype	Hours/ Day Type	EEM Title	kW for Hours 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
PRODUCTION	251	Baseline	0	0	0	121.2	304.7	323.6	322.5	316.7	317.2	303.2	317.8	311.9	319	295.3	287.2	285.4	284.6	286.3	281.7	282.1	275.6	286.8	272.6	0
PRODUCTION	251	As-Built	0	0	0	57.5	158.1	168	195.8	195	279.2	287.2	204.4	258.9	279.9	273	215.4	171.8	175.5	157.6	159.8	160.7	157.3	156.3	139.7	0
MAINTENANCE	62	Baseline	0	0	0	121.2	293.3	287.2	285.4	284.6	286.3	281.7	282.1	275.6	286.8	272.6	272.3	272.2	271	274.9	266.5	0	0	0	0	0
MAINTENANCE	62	As-Built	0	0	0	0	0	117.3	159.2	154.9	106.9	87.5	95.4	94	88.7	94.4	91.4	93.4	90.8	91.1	92	85.9	72.5	0	0	0

Daytype	Hours/ Day Type	EEM Title	kWh for Hours 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Total kWH
PRODUCTION	251	Baseline	0	0	0	30421	76480	81224	80948	79492	79617	76103	79768	78287	80069	74120	72087	71635	71435	71861	70707	70807	69176	71987	68423	0	1454645.4
PRODUCTION	251	As-Built	0	0	0	14433	39683	42168	49146	48945	70079	72087	51304	64984	70255	68523	54065	43122	44051	39558	40110	40336	39482	39231	35065	0	966626.1
MAINTENANCE	62	Baseline	0	0	0	7514.4	18185	17806	17695	17645	17751	17465	17490	17087	17782	16901	16883	16876	16802	17044	16523	0	0	0	0	0	267449.4
MAINTENANCE	62	As-Built	0	0	0	0	0	7272.6	9870.4	9603.8	6627.8	5425	5914.8	5828	5499.4	5852.8	5666.8	5790.8	5629.6	5648.2	5704	5325.8	4495	0	0	0	100154.8

Evaluation Team Savings	655,314
Verification Report Savings	655,314

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Daytype	EEM Title	kW for Hours 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Productior	Baseline	362.6	354.4	363.2	335.6	315.8	318.4	363.2	363.3	362.9	356.5	352.9	0	0	0	0	0	0	0	0	0	355	360.3	343.6	362.4
Productior	As-Built	283.3	274.7	284	255	234.1	236.9	284	284	283.6	276.9	273.2	0	0	0	0	0	0	0	0	0	275.3	280.9	263.4	283.1
Productior	Baseline	362.6	354.4	363.2	335.6	315.8	318.4	363.2	363.3	362.9	356.5	352.9	344.1	364.6	363.7	358.1	364.1	340.9	364.3	363.9	345.3	355	360.3	343.6	362.4
Productior	As-Built	283.3	274.7	284	255	234.1	236.9	284	284	283.6	276.9	273.2	263.9	285.5	284.5	278.5	284.8	260.6	285.1	284.6	265.1	275.3	280.9	263.4	283.1
Saturday	Baseline	283.8	272.4	282.8	252.6	225	119.7	119.3	120	119.3	118.8	118.8	118.5	118.5	118.5	118.4	118.3	237.6	281.6	280.8	275.4	279.5	280.6	254.1	281.6
Saturday	As-Built	283.8	272.4	282.8	252.6	225	119.7	119.3	120	119.3	118.8	118.8	118.5	118.5	118.5	118.4	118.3	237.6	281.6	280.8	275.4	279.5	280.6	254.1	281.6
Sunday	Baseline	282.1	276.7	278.4	251.6	233.2	233.6	233.3	233.2	233.2	231.7	228.5	228	228.7	228	228.2	228.4	231.8	282.6	280.6	281.6	277.9	277.6	261.8	282
Sunday	As-Built	282.1	276.7	278.4	251.6	233.2	233.6	233.3	233.2	233.2	231.7	228.5	228	228.7	228	228.2	228.4	231.8	282.6	280.6	281.6	277.9	277.6	261.8	282

Daytype	Hours/ Day Type	EEM Title	kWh for Hours 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Total kWh
Production 1	128	Baseline	46413	45363	46490	42957	40422	40755	46490	46502	46451	45632	45171	0	0	0	0	0	0	0	0	0	45440	46118	43981	46387	674573
Production 1	128	As-Built	36262	35162	36352	32640	29965	30323	36352	36352	36301	35443	34970	0	0	0	0	0	0	0	0	0	35238	35955	33715	36237	521267
Production 2	127	Baseline	46050	45009	46126	42621	40107	40437	46126	46139	46088	45276	44818	43701	46304	46190	45479	46241	43294	46266	46215	43853	45085	45758	43637	46025	1076846
Production 2	127	As-Built	35979	34887	36068	32385	29731	30086	36068	36068	36017	35166	34696	33515	36259	36132	35370	36170	33096	36208	36144	33668	34963	35674	33452	35954	833755
Saturday	51	Baseline	14474	13892	14423	12883	11475	6104.7	6084.3	6120	6084.3	6058.8	6058.8	6043.5	6043.5	6043.5	6038.4	6033.3	12118	14362	14321	14045	14255	14311	12959	14362	244591
Saturday	51	As-Built	14474	13892	14423	12883	11475	6104.7	6084.3	6120	6084.3	6058.8	6058.8	6043.5	6043.5	6043.5	6038.4	6033.3	12118	14362	14321	14045	14255	14311	12959	14362	244591
Sunday	51	Baseline	14387	14112	14198	12832	11893	11914	11898	11893	11893	11817	11654	11628	11664	11628	11638	11648	11822	14413	14311	14362	14173	14158	13352	14382	307668
Sunday	51	As-Built	14387	14112	14198	12832	11893	11914	11898	11893	11893	11817	11654	11628	11664	11628	11638	11648	11822	14413	14311	14362	14173	14158	13352	14382	307668

Evaluation Team Savings	396,396
Verification Report Savings	396,396

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		kW for Hours																							
Daytype	EEM Title	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
PRODUCTION	Baseline	612.7	610.5	604.6	607.6	604.5	609.2	598.4	606.9	610.3	610	602.8	604.9	607.1	610.5	607.5	606.5	614.3	608.9	609.3	608.6	606.2	616	609.9	608.3
PRODUCTION	As-Built	455.06	452.96	453.26	461.56	432.16	469.06	464.96	462.76	475.76	467.26	470.36	459.86	453.66	453.36	446.06	446.96	415.96	457.36	448.46	457.46	445.76	453.96	444.46	451.66
MAINTENANCE	Baseline	591.8	595.4	584.7	587.8	581.4	598.1	595.3	559	593.7	602.6	598.4	596.8	595.3	593.9	595	482.7	343.8	240.8	201.8	201.8	161.5	201.8	161.5	201.8
MAINTENANCE	As-Built	416.9	424.1	428.8	433.2	380.5	413	315.8	200.1	184.6	186.2	178.2	184.2	181.9	183	183.6	180.4	184.6	178.7	176.7	182	181.1	177.9	185.4	204.6

		kWh for Hours																								
Daytype	EEM Title	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	**Total kWh**
PRODUCTION	Baseline	189937	189255	187426	188356	187395	188852	185504	188139	189193	189100	186868	187519	188201	189255	188325	188015	190433	188759	188883	188666	187922	190960	189069	188573	4524605
PRODUCTION	As-Built	141067	140416	140509	143082	133968	145407	144136	143454	147484	144849	145810	142555	140633	140540	138277	138556	128946	141780	139021	141811	138184	140726	137781	140013	3379006
MAINTENANCE	Baseline	30774	30961	30404	30566	30233	31101	30956	29068	30872	31335	31117	31034	30956	30883	30940	25100	17878	12522	10494	10494	8398	10494	8398	10494	575468
MAINTENANCE	As-Built	21679	22053	22298	22526	19786	21476	16422	10405	9599.2	9682.4	9266.4	9578.4	9458.8	9516	9547.2	9380.8	9599.2	9292.4	9188.4	9464	9417.2	9250.8	9640.8	10639	309166

Evaluation Team Savings	1,411,901
Verification Report Savings	1,411,901

Appendix G

References

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