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PECI San Diego Retrocommissioning Program EM&V

SDG&E Service Area

Final Report

CPUC Evaluation ID #: 1381-4

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Executive Summary

ES.1 Background

The main goal of the Commercial Building San Diego Retrocommissioning (RCx) Program is to improve the performance of energy-using equipment in existing buildings in the San Diego Gas and Electric Company (SDG&E) service area by focusing on optimizing mechanical equipment and related controls. The three main market barriers the program addressed were a lack of awareness of the benefits of retrocommissioning services among building owners and managers, high first cost, and inconsistent approaches that leave building owners with an unclear sense of the product received. The program intended to alleviate barriers through an approach that included ensuring persistence of savings by requiring documentation and tracking.

ES.2 Methodology

The evaluation consists of a process evaluation and an impact evaluation (through review of provided data and methodologies) for the 2004 and 2005 program years. The evaluation objectives were the following:

- Assess the program's achievements,
- Evaluate the effectiveness of program design, outreach and delivery,
- Measure customer satisfaction,
- Provide recommendations for program enhancement,
- Review energy and peak demand savings, and
- Measure the cost-effectiveness of program activities.

The process evaluation consisted of telephone interviews with program administrators, commissioning providers, program participants, and program nonparticipants. Each of the four groups had survey instruments specifically designed for them.

As a result of budget limitations, the impact evaluation performed by Itron did not include gathering primary data. Rather, it consisted of a review of data and methodologies collected by PECI. Independent site verification efforts linked with evaluation-focused metering and testing are required to provide an accurate impact analysis of retrocommissioning programs. Because rigorous site verification efforts could not be conducted for this study, the findings should be considered significantly less reliable than those from a study that was conducted under the California Evaluation Protocols or that employed an on-site verification effort.

The steps involved in the impact analysis were as follows.

- The program implementers provided PECI and Itron with ex ante savings estimates, savings calculations, and supporting data for each measure to be implemented at the site.
- Based on the information provided, Itron verified the calculation of savings for each measure or group of measures identified. The verification included a review of the ex ante savings calculations and supporting data for each measure.
- Itron determined program cost-effectiveness by making appropriate modifications to the implementer's Program Report workbook.

ES.3 Results

Based on the results of the process evaluation, the overall satisfaction with the program was high among all groups of survey respondents. PECI was viewed as a good program administrator that maintained good levels of communication and tried to be flexible to the specific needs of different participants. The commissioning providers as a whole were thought to provide good recommendations and services. There were some issues regarding the timeliness of reports and in one case, a customer believing that the master list of findings could have been more detailed. The desire to have commissioning providers that were local was voiced by several survey respondents.

Review of supporting data and methodologies used to estimate the impact from the RCx program was often limited to reviewing the supporting spreadsheets and assumptions. Only a limited amount of post implementation trend data is available. However, the data, methodologies, and calculations reviewed appeared to be sound and were accepted.

Based on the self-reported data from the process evaluation, a net-to-gross (NTG) value of 1.0 was estimated for the program. The estimated TRC value for this program is calculated to be 3.933 when using this NTG value of 1.0. This 3.933 TRC value is much higher than the initial projected TRC value of 2.196. Based on this TRC, the RCx program appears to be very cost-effective.

The ex post net program savings were much higher than the ex ante projected program savings. The 20-year cumulative projected savings were 49,795 MWh with an estimated peak demand impact of 0.78 MW. The ex post 20-year cumulative savings estimate is 78,985 MWh with an estimated peak demand impact of 1.56 MW.

ES.4 Conclusions

From the perspectives of both the process and impact evaluations, PECI's RCx program appears to be very successful. It exceeded its energy savings and peak demand goals and its TRC is over 3.9.

Several useful program suggestions and lessons learned were provided by the respondents of the process evaluation. Among the most important include:

- A need for a closer relationship with SDG&E,
- A local presence by one of the administrative staff would be useful,
- Have local commissioning providers,
- Develop an "Executive Briefing Package" as part of the marketing materials,
- Extend the length of the program to accommodate typical building owner budget cycles,
- Allow program participation for smaller buildings,
- Provide a means for federal government buildings to participate, and
- Provide a higher incentive level.

1

Introduction

This report describes the results of a process evaluation and an impact evaluation of the Commercial Building San Diego Retrocommissioning (RCx) Program. This study was conducted by Itron, Inc. (Itron).

1.1 RCx Program Goals

The San Diego Retrocommissioning Program sought to improve the performance of energy-using equipment in existing buildings in the San Diego Gas and Electric Company (SDG&E) service area by focusing on optimizing mechanical equipment and related controls. The three main market barriers the program addressed were a lack of awareness of the benefits of retrocommissioning services among building owners and managers, high first cost, and inconsistent approaches that leave building owners with an unclear sense of the product received. The program intended to alleviate barriers through an approach that included ensuring persistence of savings by requiring documentation and tracking. Specific program goals are listed below. In parentheses are the program achievements. As can be seen, the program-affected floorspace was 87% of its goal but energy was about 50% more, and demand impacts were nearly double their goals.

- Goal of 6,224,400 kWh annual energy savings (achieved 9,888,836 net kWh),
- Goal of 780 kW peak demand reduction (achieved 1,465 net kW),
- Goal of retrocommissioning of 3,120,000 square feet (achieved 2,714,483),
- Improve the ability of building operations staff to identify wasteful energy use,
- Ensure that savings created persists over the expected lifetime,
- Ensure quality control to the owner, and
- Train providers to provide high caliber, cost-effective services.

A list of equipment and controls addressed by the program include the following:

- Equipment operating schedules,
- Optimum start and stop times,
- Demand-controlled ventilation,
- Sequencing of chiller loads,

- Over-ventilation,
- Simultaneous heating and cooling,
- Sensor and thermostat calibration,
- Actuator/damper operation,
- Duct static pressure set point,
- Hot water supply temperature reset or plant scheduling,
- Chilled water supply temperature reset,
- VFD retrofit for fans and pumps, and
- Supply air temperature reset.

1.2 Study Objectives

The evaluation consists of a process evaluation and an impact evaluation (through review of provided data and methodologies) for the 2004 and 2005 program years. The evaluation objectives were as follows:

- Assess the program's achievements,
- Evaluate the effectiveness of program design, outreach, and delivery,
- Measure customer satisfaction,
- Provide recommendations for program enhancement,
- Review energy and peak demand savings, and
- Measure the cost-effectiveness of program activities.

1.3 Evaluation Approach

Process Evaluation Approach

The objectives specific to the process evaluation were as follows:

- Assess the program's achievements,
- Evaluate the effectiveness of program design, outreach, and delivery,
- Measure customer satisfaction,
- Estimate a net-to-gross ratio based on self-reported freeridership, and
- Provide recommendations for program enhancement.

The approach included a review of the program materials and interviews of program administrative staff, RCx providers, program participants, and program nonparticipants (those who do not follow through all stages of the program). An analysis of the program materials and the detailed interviews were used to evaluate the program and make recommendations to improve the program.

The steps involved in the analysis are described below.

Review Program Materials

The approach used for the process evaluation included several steps. Itron first obtained copies of program materials and reviewed these materials to gain an initial understanding of the program flow and processes. A list of records and documents obtained include the following:

- RCx Program Toolkit,
- Contact and business information for current participants, participants who dropped out, and customers who inquired about program and declined participation,
- Audit reports and other deliverables provided to the customer, and
- Any additional customer information or auditor notes collected by the program.

Questionnaire Design

Itron developed four data collection instruments for telephone interviews of participant customers, nonparticipant customers, program administrative staff, and program commissioning providers. Survey topics included the following:

Participant Customers

- Plans for implementing or not implementing program recommendations.
- Reasons for not implementing recommended measures.
- Other barriers to implementation (e.g., economy, staff, equipment availability, etc.).
- Usefulness of program information, audit reports, and contractor bids.
- Areas of satisfaction and dissatisfaction with the program.
- Effectiveness of marketing and outreach activities by the program.
- Effectiveness of program administration.
- Perceptions and expectations of the program.
- Perceptions of benefits of energy efficiency measures.
- Business characteristics.
- Influence of program on implementation decisions.

Nonparticipant Customers

- Awareness of the program.
- Reasons for nonparticipating or leaving program.
- Areas of satisfaction and dissatisfaction with the program (to extent aware).

- Effectiveness of marketing and outreach activities by the program (to extent aware).
- Effectiveness of program administration (to extent aware).
- Perceptions and expectations of the program.
- Perceptions of benefits of energy efficiency measures.
- Business characteristics.

Administrative Program Staff

- Program goals.
- Program implementation procedures and issues.
- Administrative procedures and issues.
- Marketing and outreach activities.
- Perceptions on customer satisfaction and expectations.
- Problems encountered.
- Perceived market barriers and opportunities.
- Program accomplishments.
- Concerns about the program.
- Areas of desired change.

Commissioning Providers

- Quality of PECI training.
- Helpfulness of PECI staff.
- Program implementation procedures and issues.
- Administrative procedures and issues.
- Marketing and outreach activities.
- Perceptions on customer satisfaction and expectations.
- Problems encountered.
- Perceived market barriers and opportunities.
- Concerns about the program.
- Areas of desired change.

Draft survey instruments were submitted to the PECI Project Manager for review and comment. Copies of these instruments are provided in Appendices A–D.

Impact Evaluation Approach

As a result of budget limitations, the impact evaluation performed by Itron did not include gathering primary data. Rather, it consisted of a review of data and methodologies collected by PECI. Independent site verification efforts linked with evaluation-focused metering and testing are required to provide an accurate impact analysis of retrocommissioning programs. Because rigorous site verification efforts could not be conducted for this study, the findings should be considered significantly less reliable than those from a study that was conducted under the California Evaluation Protocols or that employed an on-site verification effort.

The steps involved in the impact analysis were as follows.

- Review measure energy and peak demand savings, and
- Measure the cost-effectiveness of program activities.

The program itself possesses all of the Measurement and Verification (M&V) elements required for an adequate evaluation. These M&V elements are one of the unique components of the program designed to address the persistence of savings. As a result, Itron's primary responsibilities in verifying the energy goals of the program are to 1) verify the baseline information developed for participants and 2) assess the accuracy of the retrocommissioning measure information.

As customers enter the program they move through a series of stages. First is the screening stage where building owners are screened for motivation and financial ability. Second is the scoping study stage where a walk-through is performed to determine if there is an acceptable level of savings potential. Third is the investigation study stage where the RCx Provider performs a detailed survey of the building's systems, performs baseline monitoring, identifies energy saving improvements, and estimates savings. Fourth is the implementation stage where the customer implements the identified improvements. The final stage is the persistence of savings stage where, among other things, a performance tracking system is put into place.

The data collected post-implementation were used by PECI to verify actual savings and be compared to the RCx Provider's estimate of savings from the investigation study. For each of the identified performance improvements, Itron assessed the estimated energy and demand estimates by reviewing the underlying assumptions and by reviewing the post-implementation measurement data collected. Persistence of savings could not be assessed because of the short term of the evaluation project.

The realized savings will be entered in the program implementer's PIP workbook and a new TRC ratio will be computed to determine the cost-effectiveness.

The steps involved in the impact analysis were as follows.

- After the building owner selected RCx measures to implement, the program implementer provided Itron with ex ante savings estimates, savings calculations, and supporting data for each measure to be implemented at the site.
- Based on the information provided, Itron verified the calculation of savings for each measure or group of measures identified. The verification included a review of the ex ante savings calculations and supporting data for each measure.
- Once post-implementation data were available, Itron completed the evaluation of savings and identified final evaluation estimates of energy and peak demand savings for each program participant. A net-to-gross ratio, developed from self reports from participant interviews, was applied to estimate the net impacts of the program.
- Itron determined program cost-effectiveness by making appropriate modifications to the implementer's PIP workbook.

1.4 Organization of Report

The remainder of this report is organized as follows:

- Section 2 provides the results of the process evaluation,
- Section 3 provides the results of the impact evaluation,
- Appendix A provides a copy of the Program Administrator survey,
- Appendix B provides a copy of the Commissioning Provider survey,
- Appendix C provides a copy of the Program Participant survey, and
- Appendix D provides a copy of the Program Nonparticipant survey.

2

Process Evaluation

The results of the process evaluation interviews are presented by type of respondent. Sections below detail results from interviews with program administrators, commissioning providers, participants, and nonparticipants.

2.1 Program Administrators

Interviews were conducted with each of the four key administrators of the RCx program. Findings from those interviews are presented by topic below.

Program Goals and Accomplishments

Each of the program administrators reported that the primary goals of the program are to save energy and reduce peak demand within the SDG&E service territory. In addition, other goals of the project included:

- Achieve persistent savings,
- Ensure consistent program quality by establishing and implementing protocols for quality control, and
- Create an infrastructure for the retrocommissioning industry.

When asked how the program had performed to date, the administrators reported that the targeted amount of square feet may fall a little short, but that energy savings and peak demand reductions should be greater than expected. Two of the administrators thought that the program timeframe was not long enough, although the program extension helped significantly. One administrator thought that program startup took longer than anticipated but once the program got going, it went well. A statement by this same administrator captures well some of the difficulties encountered during program implementation. She said, “It takes time to build relationships with large building owners and property management firms and sell RCx up in these organizations. Often the sale is made to several individuals beginning with the facilities staff, then up to the financial decision maker. This multi-tiered sales process, along with the long project time that RCx requires, is a challenge under short timeline programs. Creating good relationships is the key to program success. There is a need for a lot of one-on-one attention."

Another key to success reported by administrators is that their past experience with the retrocommissioning process helped them greatly in knowing what will work and what will not work. They knew that the combination of establishing strong protocols, creating a useful workbook for the commissioning providers, and providing good training would be an early key to success.

Program Changes

Administrators were asked about changes in various components of the program since its initiation. Their responses are presented below by topic.

Program Staff

The only change of significance in this area was with the PECI Project Manager position. The original Project Manager went on maternity leave early in the project, and this led to a change in Project Managers. By all reports, including the surveys of participants and commissioning providers, this transition was very smooth and the Project Management throughout the project was very sound.

Program Marketing

Originally, marketing was to be a function of the utility. However, the interest level at the utility in helping promote this program appeared low and little marketing was being performed. The marketing function was soon transferred to PECI.

Program Tracking and Reporting

No changes were reported in this area.

Program Services

There were two primary changes. Both were implemented to overcome participation barriers and both were seen as successful changes by the administrators. The first eliminated a contracting and reimbursing step that was deemed unpopular in the early stages of the program. PECI began to directly contract with the commissioning providers instead of having the building owners contract with the providers and then receive reimbursement from PECI. This change was made with the condition that the owner would reimburse PECI if they did not proceed to implementation.

The second involved a change in the utilization of the incentive budget. The incentive budget was modified so as to allow for the retention of the commissioning provider beyond the implementation stage. This change allowed the commissioning providers to stay on the project and help with the actual implementation as well as assist the building owner with the final reporting and verification as required by the program for incentive payments.

Program Implementation and Recommended Changes

Administrators' comments on various aspects of the program are described below.

Marketing and Outreach

Originally, marketing was to be a utility function through direct customer contact with the utility account representatives. However, PECI did not receive very much support from the account representatives. The impression received by the PECI representative was that because the program was not a utility program, the account representative felt there was little need to be actively involved. The marketing function then became a PECI responsibility.

A number of marketing efforts and methods were tried with varying success. The least successful was a mass mailing of information to building owners and managers. An advertisement in the local business journal was tried with no responses received. The most successful marketing was face to face through networking opportunities such as through the Chamber of Commerce or through leads provided by organizations such as the San Diego Regional Energy Office (SDREO). SDREO was the source of most leads received.

In the later stages of the program, program staff began working more with utility representatives. The administrators believe a key element for future success and a lesson learned is that PECI needs to spend significant time locally to promote the program and that coordination and assistance from utility representatives will greatly increase participation levels. Another important lesson is the need to develop an executive briefing package. This package would give a brief explanation of the program and its benefits, local contact information, and a step-by-step outline of program participation and receiving the final incentive.

Program Training

The administrators perceived that the program training and the Program Toolkit developed to assist the commissioning providers was a major element in the success of the program. Itron staff attended a training session and found it well conducted and the information provided very useful. The Program Toolkit is a very good source document for the commissioning providers. The Toolkit provided the commissioning providers a detailed program overview with a useful process overview flowchart along with chapters designed to help the commissioning providers with each step of the program process. Examples and forms are included in each section of the Toolkit.

Each of the administrators believed that the training session and the Toolkit were very successful. The only recommended changes to this portion of the program are reducing the training from one-and-a-half days to just one day, and possibly adding to the Toolkit a specific example of a project plan with specific sample calculations.

Program Tracking

Administrators reported satisfaction with the tracking system and Itron concurs that it appeared very effective in tracking program progress. The tracking system is a series of Excel worksheets that identify specific measures, provide timelines and accomplishment dates, outline the underlying methodological assumptions for the energy savings calculations, and show the energy savings calculations themselves (and/or tracking data).

Program Administration and Delivery

Administrators commented on four areas of program delivery: project screening, the Memorandum of Understanding (MOU), the investigation stage, and customer follow-up.

Project Screening. Current screening comes from review of a "Program Application Form" submitted by the building owners with some basic information on building and energy system characteristics and energy consumption values. These applications were reviewed by program engineers and, based on this review, initial screening was completed. Several administrators stated that now, when they look back on what they did, they know that it would have been beneficial to work more closely with SDG&E in the initial efforts to identify potential participants and perform the initial screening. In any future efforts, they would like to gain access to metered data through SDG&E so that initial screening could also be based on actual end-use energy consumption values. The administrators would also like to have more face-to-face interaction with potential participants and include in the initial screening process a facility walkthrough. It was the administrators' belief that more information earlier in the process, along with personal contact, would increase likely participation.

MOU. The Memorandum of Understanding is signed by the building owner after the owner has reviewed the scoping report and the commissioning provider has developed a scope of work and cost proposal. The administrators stated that the MOU is needed in order to provide assurance that there are dollars budgeted to implement the agreed-to recommendations. A difficulty encountered in several projects was the budget cycle process that the building owners adhere to. Most of the administrators stated that the MOU needs to be flexible. Budget cycles did not necessarily match well with the program timeframe and it would be beneficial to stretch the program timeframe window to better accommodate building owner budget cycles.

Investigation Stage. The program administrators overall felt that the "master list of findings" report prepared by the commissioning providers for the building owners was a strong element of the program. It was considered the primary deliverable of the program and the administrators felt that the information provided was detailed, well laid out, and well received by the building owners.

Customer Followup. Each of the administrators indicated that the PECI Project Manager is the lead person performing this function and each believed she was doing it well. There is much interaction between the customers and the PECI Project Manager to help insure that issues are resolved quickly, misunderstandings cleared up, and projects moved forward.

Program Incentives

The only significant comment on program incentives by the program administrators was a desire to have incentives cover more than just measure savings. They felt incentives should also cover the process of implementing the measures and the shepherding of the implementation process from start to finish. This change was made part-way through the program.

Customer Response

The administrators found that most building owners are still not familiar with the retrocommissioning process, or if they think they are familiar, they have some misperceptions about the process. The earlier-mentioned "Executive Briefing Packages" would help alleviate this issue by providing a quick reference about the program.

An element that caused implementation delays was the occasional need to go through several layers of building contacts before projects could move forward. The engineering staff was usually the first level of customer contact. If the customer response was good at this level, often the program would then need to be considered by a decision maker at a higher level. It would also be necessary for these decision makers to be willing to participate in order for the project to move forward.

It was sometimes found that potential customers were also very protective of their building characterization and energy use data. These particular potential customers thought that releasing such data may somehow lead to a competitive disadvantage if the information were made public and accessed by their competitors. This reluctance to share data made investigation impossible until trust could be established.

Reasons for Customers Not Proceeding

One of the difficulties administrators found for some projects or measures not going forward was the multi-layered decision-making that was encountered. Many of the retrocommissioning recommendations are operational in nature and administrators sometimes found that it was difficult for the final decision makers to think beyond the "widget" type of implementation. The engineering staff may recognize the value of the recommendation but the financial decision maker sometimes had difficulty. Future efforts need to either have financial decision makers involved in the process earlier when technical discussions occur or have the engineers stay involved in the process during discussions with the financial decision makers.

Lessons Learned

Several lessons learned were identified by the administrators. The number one lesson is to recognize that each building situation will be different and must be handled differently. Flexibility is critical. Building owners/contacts must be made comfortable with the fact that program approval and implementation takes time and that there will always be hurdles. The process of developing technical recommendations can take several weeks and internal budget cycles within the building establishment can delay implementation for many months. Close communication between administrators and building owners/contacts is essential, and in retrospect, they believe that this may have been better accomplished if PECI had had a direct local presence. Building owners/contacts were found to be much more comfortable with in-person interaction as opposed to telephone or email interaction.

Along with PECI local presence, utility cooperation was also seen as a key ingredient for future success of these types of programs. The education of non-technical decision makers, especially toward operational measures, was also viewed as necessary. Development of a quick reference "Executive Briefing Package" may be a good step in that direction. Finally, the administrators felt that a retrocommissioning program needs to be a long-term effort. Being longer term in view will allow the program to promote recommendations that may not be funded until later budget cycles. The budgeting cycle coupled with short program time frames appears to be a significant barrier.

2.2 Commissioning Providers

PECI provided Itron with a contact list that included 14 commissioning providers. Two of these were no longer with their commissioning firms by the time Itron completed the telephone surveys. Of the remaining 12, five were identified as "active" in the program and the remaining seven as not being very active. Itron attempted to interview all 12 of the identified commissioning providers. However, despite multiple attempts to contact them, some of these providers were not reached. Itron completed telephone surveys with five of the 12 providers; two on the active list and three on the not-so-active list.

Commissioning providers were selected to participate in the program by responding to a PECI Request for Proposal (RFP). PECI reviewed the credentials of the RFP respondents and invited those who qualified to be part of the list of approved commissioning providers.

The commissioning provider survey asked a series of questions that can be categorized by five topic areas. These five areas include:

- Training and orientation,
- Customer issues,
- Scoping report and master list of findings presentations,
- Program performance, and
- Lessons learned and suggestions.

Training and Orientation

Four of the five respondents participated in the PECI orientation and training session in September, 2004. Three out of four of the orientation participants said that they found the training session very useful in gaining an understanding of the process and framework of the program. They said the work session itself laid out the methods for analysis well. The one participant who had not found it particularly useful thought the session was too simple.

All four orientation participants stated that they found the ‘Program Toolkit” manual only somewhat useful. Comments on the Toolkit included that to them, it seemed to be too basic. It needed to have more “real world” examples and examples that were more detailed. One interviewee stated that he would have liked to see a section that addressed the marketing side of the program. He thought there was a need to outline how best to find potential customers.

Customer Issues

Early in the program, the commissioning providers stated that customers were complaining to them about the program feature that required them to pay up front for the retro-commissioning investigation and then receive reimbursement after the investigation was completed. These complaints did result in a program change, as outlined in the “Program Changes” section of the program administrator’s survey results. Other issues mentioned by the commissioning providers included:

- Final decision makers were too remote from the analysis. This caused delays in decision making and sometimes resulted in decisions not to move forward.
- Many customers were not familiar with their own building systems.
- Building staff turnover was often a problem.
- One potential customer told the commissioning provider that the program did not provide enough incentive for a decent return on investment.

Scoping Report and Master List of Findings Presentations

Only the two active commissioning providers could answer the questions in this area of the survey. Both of these providers said that their completed scoping reports were sent to PECI and that PECI presented the results with them on the phone for support. For the master list of findings, one provider had not as yet delivered it at the time of the interview but said it was his intention to make the presentation in person. The other said he emailed the master list of findings to the customer and then had a follow-up phone discussion.

Program Performance

Again, only the two active commissioning providers answered the questions in this area of the survey. Each said that the program was slow in its early stages but did pick up after awhile. Marketing was one problem for the slow start up. PECI relied too much, at least initially, on the commissioning providers to find customers. They needed to be more involved and utility representatives also needed to be involved. The initial requirement for customers to "pay up front" for the investigation was another factor in the slow start up. A positive element of the program performance was that energy savings were found to be larger than anticipated.

Lessons Learned and Suggestions

A key suggestion is to make the customer contact the "internal champion' for the program. The way to secure this is to insure that this customer contact is given all necessary information as quickly as possible and that all questions from the customer contact are answered in a timely fashion. A customer contact that is fully committed to the concept of retrocommissioning their building will prove invaluable in gaining higher-level approvals in the financial decision-making process. Another way to create an "internal champion' is to provide some service for free that the contact would find useful.

2.3 Participants

Four buildings participated in the RCx program, two of which were owned by the same company. The buildings that participated in the program and the associated building size and energy savings are provided in Table 2-1.

Table 2-1: RCx Participant Buildings

Building	Square Footage (conditioned)	Energy Savings (kWh)	Demand Savings (kW)	Natural Gas Savings (Therms)
Building A	1,359,750	1,470,615	21	88,305
Building B	428,000	267,165	170	0
Building C	559,392	496,783	302	0
Building D	367,340	7,654,273	972	177,558
TOTAL	2,714,482	9,888,836	1,465	265,863

Representatives from each of the three companies were interviewed in April, 2006. However, the project for one of these customers was not near completion at the time of the April, 2006 interview. Therefore, this customer representative was interviewed again in October, 2006 after completion of his projects.

One of the participants learned of the program directly from PECI. Another found out about the program from SDREO. The third could not remember where he had first heard about the program. A number of questions were asked in the participant survey and the responses are organized by the following topics:

- Program expectations and why they participated,
- Awareness of the concept and benefits of retrocommissioning,
- Opinions of and satisfaction with the program, and
- Suggestions for improvement.

Program Expectations and Why They Participated

Each of the three respondents expected to receive detailed technical assistance in evaluating the energy operation of their buildings. They wanted the documentation to support making building improvements and one respondent mentioned that the incentive is useful in helping subsidize the cost. Two respondents stated that participating in a program like the RCx program is the right thing to do for society in general. Other important reasons cited for participating included appreciation that the program covered the costs for the engineering master findings, which is sometimes a difficult item to budget. Another respondent noted that he was drawn into the program because of the good reputation of PECI in doing this type of work.

How well expectations were met varied by respondent. Two respondents stated that expectations were exceeded, especially in terms of energy saved. One respondent felt that his expectations were only partially met. He stated that he expected more thoroughness in the evaluation and recommendations. He thought one of the reasons for this lack of thoroughness was the remoteness of the commissioning provider. He would have preferred a local commissioning provider who could have given more time and interest to the project.

Each of the three respondents was complimentary of the effort provided by PECI. They felt, including the one respondent who was not fully satisfied with the program, that PECI was very helpful and flexible. Suggestions for improvement (by two of the three) were that it would be better if local commissioning providers were used. They felt that the distance involved may have contributed to some of the difficulty in keeping deadlines and not providing as thorough of an evaluation as expected.

Awareness of the Concept and Benefits of Retrocommissioning,

Two of the three respondents indicated that they were very aware of the retrocommissioning concept and its benefits. The third stated he was somewhat aware. Each of the three had participated in utility conservation programs in the past installing lighting and HVAC measures. Two of the three said they considered investment in energy efficiency equipment as capital investments. It usually takes six to eight months from the date a decision is made to install an energy efficiency measure to the date of its actual installment.

Opinions of and Satisfaction with the Program

Survey participants were asked to rate their level of satisfaction with elements of the program using a scale from 1 to 5. The value "1" means very dissatisfied and "5" means very satisfied. Nearly all of the indicators were positive. The lowest average score was for the commissioning providers. The highest scores were for the PECI program administrative personnel and the master list of findings report. The following are the average ratings by program aspect:

- 4.7 – PECI program administrative personnel. They were well-liked.
- 3.3 – Commissioning providers. The primary reason for a lower score was that some were not local. The building owners thought they were too distant and slow to respond.
- 4.0 – Results of the scoping report. Sometimes the commissioning providers were slow in providing these reports, though in most case delivery timing was fine.

- 3.7 – Memorandum of Understanding (MOU). Several building owners thought they were too restrictive.
- 4.7 – Master list of findings report. These reports were well received.
- 3.5 – Incentives. Most participants thought they should be higher.
- 4.5 – Contractor who installed the improvements.
- 4.3 – Overall satisfaction with the program.

Suggestions for Program Improvement

Three suggestions for program improvement were provided by the program participants. The first is that the program should not be so restrictive on building size; smaller buildings should be allowed to participate in the program. The second is to use local commissioning providers, and the third is to increase the incentive level.

2.4 Nonparticipants

PECI provided Itron with a contact list that included nine nonparticipants. One of the nine nonparticipants was no longer with his company. Of the remaining eight, Itron completed telephone surveys with five. Itron attempted to interview the remaining three nonparticipants. However, multiple attempts failed to reach them.

Nonparticipants learned about the RCx from a number of different sources. Among those cited were PECI, SDREO, and the Silicon Valley Leadership Group. A number of questions were asked in the nonparticipant survey. These responses are organized by the following topics:

- Perceived program benefits,
- Why they did not participate,
- What did they like or not like about the program,
- How aware were they of Retrocommissioning and DSM programs as a whole, and
- Suggestions for changes.

Perceived Program Benefits

The fact that there was no cost associated with the initial scoping report was seen as a benefit by several respondents. They also liked having the commissioning providers work with their building technical staff. They felt that even this minimum program contact provided a learning experience for their staff.

Why Did They Not Participate?

One of the nonparticipants was a governmental organization. The organization's respondent stated that MOU requirements would violate the "Anti-Deficiency Act" regulations that prevent federal government agencies from committing to do anything that would have a fiscal impact without the funds actually being budgeted for that purpose. The portion of the MOU stipulating that any identified action with a payback of less than one year must be implemented at the owner's expense is the language they had difficulty with. Were it not for this language, they would have participated in the program.

Another nonparticipant stated that they did not participate because they had undergone a retrocommissioning three years earlier and they did not feel they needed another. Two others stated that they were already participating in other energy conservation programs that included retrocommissioning activity. The final nonparticipant stated that his upper management simply did not want to budget funds at this time for this activity, though they would like to in the future.

What Did They Like or Not Like About the Program?

Three of the five respondents answered the questions in this portion of the survey. Each of them indicated the same thing. They stated that their firms liked the free scoping report and each thought the recommendations provided by the commissioning provider were very good.

How Aware Were They of Retrocommissioning and DSM Programs as a Whole?

Four of the five respondents answered the questions in this portion of the survey. Three of these four respondents indicated that they were very aware of the benefits of retrocommissioning and the fourth said he was somewhat aware. Three of the four respondents also said that they have in the past and plan in the future to install energy conservation measures in their buildings.

Suggestions for Change

Only one of the respondents had any suggestions for changing the RCx program. The suggestion was that measures that have paybacks of less than one year should be identified early in the program, preferably during the initial scoping study. Alternatively, if this cannot be done, they would like to have the one-year payback limitation removed from the program requirements. It was this one-year requirement that prevented them from participating.

2.5 Summary of Findings

Overall, satisfaction with the program was high among all groups of survey respondents though some specific aspects were lower, such as a desire for larger incentives and for local commissioning providers. PECI was viewed as a good program administrator that maintained good levels of communication and tried to be flexible to the specific needs of different participants. The commissioning providers as a whole were thought to provide good recommendations and services. There were some issues regarding the timeliness of reports and in one case, a customer believed that the master list of findings could have been more detailed. The desire to have commissioning providers that were local was expressed by several survey respondents.

Lessons Learned and Suggestions

Several useful program suggestions and lessons learned were provided by the respondents. However, it must be remembered that participation in this program only included a few buildings and may not reflect the general commercial building population. Among the most important suggestions include:

- A need for a closer relationship with SDG&E,
- A local presence by one of the administrative staff would be useful,
- Have local commissioning providers,
- Develop an “Executive Briefing Package” as part of the marketing materials,
- Extend the length of the program to accommodate typical building owner budget cycles,
- Allow program participation for smaller buildings,
- Provide a means for federal government buildings to participate, and
- Provide a higher incentive level.

2.6 Spillover

Based on the evaluation results, effects from any spillover activities cannot be quantified. However, discussions with all of the program participants made it clear that information received during the building reviews was likely to lead to other energy conservation measures or practices being implemented. The federal facility among the nonparticipants is another facility planning to implement measures as a result of contact with the program. In addition, PECI did not claim any natural gas savings and therm savings did accrue through the program activities. Considering these issues, a follow-up evaluation with these program participants in future years would provide valuable insight into the issue of spillover.

3

Impact Evaluation

The impact evaluation performed by Itron did not include gathering primary data. Rather, it consisted of a review of data and methodologies collected by PECI. Although this method is effective in reviewing methodologies and engineering calculations, Itron recommends that future impact evaluations also include pre and post energy usage data. Only with this form of data can true impacts be evaluated.

The objectives specific to Itron's impact evaluation of the San Diego Retrocommissioning Program were as follows:

- Review measure energy and peak demand savings, and
- Measure the cost-effectiveness of program activities.

The impact evaluation was performed towards the end of the RCx program. By waiting until late in the program, Itron was assured of having the final, approved deliverables and post-implementation data. The post-implementation data collected by the commissioning providers were used by PECI to verify savings and be compared to the commissioning provider estimates of savings from the investigation study. For each of the identified performance improvements, Itron assessed the energy and demand estimates by reviewing the underlying assumptions and the post-implementation measurement data collected. Persistence of savings could not be assessed because of the short term of the evaluation project. Assessment by building and measure follow. The buildings will be referred to as Building A, Building B, Building C, and Building D.

3.1 Building A

The investigation report for Building A was prepared by PECI. In this report, 19 measures were identified and recommended for implementation. Of these 19 measures, nine were implemented. Table 3-1 lists the nine implemented measures and the estimated impacts from each.

Table 3-1: Building A Implemented Measures (Gross Impacts)

Measure #	Measure Description	Annual Electric Savings (kWh)	Annual Gas Savings (Therms)	Peak Demand Savings (kW)
2	Install VFD on one of three evaporator pumps and modify control sequence	54,097	0	0
4	Install VFD on one of three condenser pumps and modify control sequence	129,436	0	0
5	Turn off one of the water fall pumps	78,079	0	11
6	Turn off one of the front water feature pumps	67,131	0	0
7	Turn off one stream pump at night	119,692	0	10
8	Re-enable the demand-controlled ventilation for the South Tower parking garage.	475,931	0	0
12	Eliminate unnecessary simultaneous heating and cooling and reduce AHU fan speeds	426,099	88,305	0
14	Optimize South Tower domestic water booster pump	50,380	0	0
15	Optimize North Tower domestic water booster pump	69,770	0	
Total All Findings		**1,470,615**	**88,305**	**21**

Itron reviewed the detailed implementation spreadsheets to assess the reasonableness of the methodology and the quality of the data utilized.

Measure #2—Install VFD on One of Three Evaporator Pumps

PECI found that one evaporator pump delivered more flow than was necessary when operating to serve one chiller. This operating condition occurred because the chiller evaporator loop contained three parallel pumps (one for each chiller plus a spare) with significant portions of the piping circuit in common.

A VFD was installed to control one of the primary CHW pumps. The controls were set up so that the VFD-controlled pump is always the lead pump when a single chiller is operating. When both chillers are operating, the sequence is changed to operate both of the constant speed pumps to eliminate the efficiency losses inherent in a VFD. When two chillers are operating, the VFD-equipped pump serves as the back-up pump and is arranged to come on-line and operate at full speed if one of the other pumps fails.

The information contained in the spreadsheet "Evaporator Pump Savings Potential.xls" was reviewed. The methodology relied on motor horsepower, pump efficiency levels, high and low flow rates, VFD efficiency, and hours of operation. The basic calculation used is listed in Figure 3-1.

Figure 3-1: Pump HP Formula

$$HP_{New} = HP_{Old} \times \left(\frac{Flow_{New}}{Flow_{Old}} \right)^3$$

Where :

HP_{New} = **New unknown operating horse power**

HP_{Old} = **Current known operating horsepower**

$Flow_{New}$ = **New desired flow rate in gpm**

$Flow_{Old}$ = **Current know flow rate in gpm**

Table 3-2 lists the basic assumptions used by PECI in their calculations. Itron questioned the assumed motor efficiency of 85%, which appeared to be low. PECI responded that the 85% efficiency was based on nameplate information. Itron concluded that the estimated impacts appear reasonable.

Table 3-2: Measure #2 Assumptions (Gross Impacts)

Current pump bhp =	16.25	hp
Assumed motor efficiency =	85%	
Current pump kW =	14.26	kW
Current flow =	1,625	gpm
Desired flow =	1,200	gpm
Pump bhp at lower speed =	6.54	hp
Assumed motor efficiency =	85%	
Drive efficiency =	92%	
Pump kW at new operating point =	6.24	kW
kW savings per hour =	8.02	kW
Annual operating hours =	6,746	hours
Annual savings =	54,097	kWh

Measure #4—Install VFD on One of Three Condenser Pumps

This measure is very similar to Measure #2. PECI found that one condenser pump delivered more flow than was necessary when operating to serve one chiller. This operating condition occurred because the chiller condenser loop contained three parallel pumps (one for each chiller plus a spare) with significant portions of the piping circuit in common.

A VFD was installed to control one of the primary pumps. The controls were set up so that the VFD-controlled pump is always the lead pump when a single chiller is operating. When both chillers are operating, the sequence is changed to operate both of the constant speed pumps to eliminate the efficiency losses inherent in a VFD. When two chillers are operating, the VFD equipped pump serves as the back-up pump and is arranged to come on line and operate at full speed if one of the other pumps fails.

The information contained in the spreadsheet “Condenser Water Pump Test r1.xls” was reviewed. The methodology relied on motor horsepower, pump efficiency levels, high and low flow rates, VFD efficiency, and hours of operation. The basic calculation used is listed in Figure 3-1.

Table 3-3 lists the basic assumptions used by PECI in their calculations. Itron questioned the assumed motor efficiency of 85%, which appeared to be low. PECI responded that the 85% efficiency was based on nameplate information. As with Measure #2, Itron concluded that the estimated impacts appear reasonable.

Table 3-3: Measure #4 Assumptions (Gross Impacts)

Current pump bhp =	30	hp
Assumed motor efficiency =	85%	
Current pump kW =	26.33	kW
Current flow =	1,920	gpm
Desired flow =	1,200	gpm
Pump bhp at lower speed =	7.32	hp
Assumed motor efficiency =	85%	
Drive efficiency =	90%	
Pump kW at new operating point =	7.14	kW
kW savings per hour =	19.19	kW
Annual operating hours =	6,746	hours
Annual savings =	129,436	kWh

Measure #5—Turn Off One of the Waterfall Pumps

In the lobby of the building is a water feature consisting of waterfalls and pools. The water feature works by distributing water to two pools located to the north and south of a central main pool that feeds the main fall. The water cascades through a series of smaller pools on its way to the central pool and feeds smaller, intermediate falls fed by the smaller pools.

PECI believes that the desired water feature aesthetics can be achieved by running one water fall pump instead of two. Functional testing during the investigation revealed that, with some minor adjustment, it is possible to run one waterfall pump and still achieve the desired aesthetics.

The information contained in the spreadsheet "Water fall pump savings calculations.xls" was reviewed by Itron. The methodology for estimating energy savings is a simple calculation of energy use from two pumps before modification and energy use from a two pump during the day and one pump during the night modification. The methods and assumptions appear reasonable. Table 3-4 identifies the basic method and assumptions.

Table 3-4: Waterfall Energy Use Before and After Modification (Gross Impacts)

kW and kWh before modification		
kW = (volts x amps x power factor x 3(1/2))/1000		
=	10.4	kW per pump
=	20.8	Total for two pumps
Nominal start time (manual schedule) =	6	am
Nominal stop time (manual schedule) =	12	midnight
Hours of operation per day (typical of both pumps) =	18	
Daily kWh =	375	kWh
Days per year =	365	days per year
Annual kWh =	136,717	kWh per year
kW and kWh after modification		
kW = (volts x amps x power factor x 3(1/2))/1000		
=	10.0	kW per pump
Nominal start time (auto schedule) =	7	am
Nominal stop time (auto schedule) =	11	midnight
Hours of operation per day (one pump only) =	16	
Daily kWh =	161	kWh
Days per year =	365	days per year
Annual kWh =	58,639	kWh per year
Projected savings =	78,079	kWh per year

Measure #6—Turn Off One of the Front Water Feature Pumps

This is an extension of the work done in Measure #5. The front water feature pumping energy would be reduced by turning off one pump during the evening hours. Additional savings are achieved by throttling of the flow between the higher pool and lower pool that allows one pump to serve both pools.

The information contained in the spreadsheet "Front water fall pumps.xls" was reviewed by Itron. The methodology for estimating energy savings is a simple calculation of energy use change resulting from the scheduling change and the shutting down of one pump. The methods and assumptions appear reasonable. Table 3-5 identifies the basic method and assumptions.

Table 3-5: Measure #6 Assumptions (Gross Impacts)

Scheduled pump saving	
Motor amps saved =	12.50
Motor voltage =	472
Assumed power factor =	0.82
Derating factor for no measured amps =	0.80
kW saved =	6.70
Hours per year =	2,190
kWh per year =	14,681
Shut down pump saving	
kW saved =	6.70
Hours per year =	7,824
kWh per year =	52,450
Total Savings	
kWh per year =	67,131

Measure #7—Turn Off One Stream Pump at Night

Measure #7 is another water feature measure. Initially, the measure was only designed to turn off one (of two) stream pumps at night. However, testing and observation indicated to PECI staff that it would be possible to shut down one water fall pump all of the time and still have the same aesthetic effect (sound and appearance) if the height of the weir between the northernmost waterfalls pool and the central waterfalls pool were increased slightly. This was done along with the original measure goal of shutting down the other pump for nine hours at night.

The information contained in the spreadsheet "Stream pump savings.xls" was reviewed by Itron. The methodology for estimating energy savings is a simple calculation of energy use change resulting from the scheduling change and the shutting down of one pump. The methods and assumptions appear reasonable. Table 3-6 identifies the basic method and assumptions.

Table 3-6: Measure #7 Assumptions (Gross Impacts)

Scheduled pump saving	
Motor amps saved =	14.30
Motor voltage =	472
Assumed power factor =	0.85
kW saved =	9.94
Hours per year =	3,285
kWh per year =	32,643
Shut down pump saving	
Motor amps saved =	14.30
Motor voltage =	472
Assumed power factor =	0.85
kW saved =	9.94
Hours per year =	8,760
kWh per year =	87,049
Total Savings	
kWh per year =	119,692
Demand kW reduction =	9.94

Measure #8—Re-enable Parking Garage Demand-Controlled Ventilation

This measure called for re-enabling the demand-controlled ventilation for the South Tower parking garage. To accomplish this required the servicing and replacement of bad CO_2 sensors and controllers in the garage. The existing system was then modified to prevent loss of air flow through the garage due to reverse circulation through a parallel fan when one fails. A VFD was added to the axial fan to allow fan energy to be optimized. Back-draft dampers were added to the two fans on a common duct to ensure airflow through the garage if one fan fails and to allow one fan to be cycled off during periods of low activity for energy conservation purposes. Monitoring and control points were added to the ECS to provide fan energy optimization, status, and average carbon monoxide level monitoring. The ECS was programmed to operate the axial fan on minimum speed and ramp the speed up as dictated by the carbon monoxide level. If the axial fan reaches full speed and it is not controlling the carbon monoxide level, the ECS would operate one of the DWDI fans. If this still does not control the carbon monoxide level, the second DWDI fan is put into operation. The sequence is reversed as the carbon monoxide level drops.

Data loggers were installed to verify fan shut down. Savings estimates are based on ECS electrical meter data before and after the reactivation. The information contained in the spreadsheet “Garage exhaust fan power before and after fix.xls” was reviewed by Itron. Table 3-7 provides data logger hours per day and assumptions made to estimate energy impacts. The methods and assumptions appear reasonable. However, PECI reports that Building A had made a decision to migrate away from the ECS system to an ALC system. Eventually, the fans will be placed on that system for monitoring purposes. Until that time, periodic data logger deployments will verify that only one pump runs and that it runs on a schedule.

Table 3-7: Measure #8 Assumptions and Data Logger Results (Gross Impacts)

Hours of operation per day based on loggers -	10:00 PM	Off
	5:30 AM	On
	16.50	hours per day
DWDI fan volts -	472	measured
DWDI fan amps -	28	measured
DWDI fan power factor -	82.30%	nameplate
DWDI fan kW -	19	
Axial fan volts -	472	measured
Axial fan amps -	58	measured
Axial fan power factor -	87.20%	estimated
Axial fan kW -	41	
Total kW -	79	
Hours per day saved -	17	
Hours per year saved -	6,023	
kWh per year saved -	475,931	

Measure #12—Eliminate Unnecessary Simultaneous Heating and Cooling and Reduce AHU Fan Speeds

PECI's review of trend data and building operation observations indicated that much of the load on the heating hot water system is the base load on the chilled water system. This indicated that there was a significant amount of simultaneous heating and cooling occurring in the facility. PECI believed that this was attributable to:

- Failure of control valves to seat due to low air pressure and/or wear at the valve seat and/or failure of the valve actuators, particularly at the guest room fan coil units.
- VAV reheat terminal sequences that force the minimum flow rate to 50% of the maximum flow rate if the reheat coil is active.
- Excessive minimum flow settings on the VAV reheat terminals.
- Pneumatically controlled VAV reheat terminals that have failed to full flow/full reheat.
- Programming problems with DDC VAV reheat terminals that cause them to remain in operation even though they are scheduled off and should be forced to 0 cfm.

- VAV fan systems that do not have the discharge static pressure optimized to reflect the requirements at the end of the system.

A number of strategies were implemented in Building A. These included:

- Replace failed VFD on North Tower AH-5.
- North Tower guest room fan coil unit valve failures, pump cycling (curing the symptom).
- South Tower guest room fan coil unit valve failures, fan coil riser shut down valve (curing the symptom).
- South Tower DDC VAV box and fan coil unit verification and program modification—Marina Ballroom Area.
- South Tower pneumatic VAV box repair.
- South Tower blown ducts Level 1—South meeting room corridor.

The estimates of energy impact for the strategy “Replace failed VFD on North Tower” relied on logged interval data and engineering calculations. Itron reviewed these data in spreadsheet “NT AHU5 Fan.xls”. Table 3-8 identifies the interval data and assumptions for this strategy. The assumptions and engineering calculations appear reasonable.

Table 3-8: Replace Failed VFD on North Tower Data (Gross Impacts)

Assumed voltage for the kW calc -	480
Assumed power factor for the kW calc -	0.86
Peak hp -	46.07
Peak kW -	34.37
Minimum hp -	0.14
Minimum kW -	0.10
Average hp -	20.17
Average kW -	15.05
kWh savings for the logged interval -	4,377
Logged interval, days -	11
kWh savings per day -	399
Days per year -	365
kWh savings per year -	145,576

The estimates of energy impact for the strategy “North Tower guest room fan coil unit valve failures, pump cycling” relied on engineering calculations utilizing boiler natural gas meter readings and normalized weather data. Itron reviewed these data in spreadsheet “09-23-05 North Tower guest room fan coil unit pump test.xls”. Table 3-9 identifies the natural gas consumption and normalized weather data for this strategy. The minimum savings potential, 209,650 kWh, was the amount claimed in the PECI report. The assumptions and engineering calculations appear reasonable.

Table 3-9: North Tower Guest Room Fan Coil Unit Valve Failures, Pump Cycling Data (Gross Impacts)

Total hours above 65°F in San Diego -	4,193	hours	
	Minimum	Maximum	
Observed reduction in boiler gas consumption -	1,750	3,500	cubic feet per hour
	42,000	84,000	cubic feet per day
Assumed gas energy content -	1,000	1,000	btu/cu.ft.
Consumption in therms -	18	35	therms
Annual savings -	73,378	146,755	therms per year
Percentage gas savings -	32%	63%	
Observed reduction in chiller kW consumption -	50	100	kW
Projected kWh savings potential -	209,650	419,300	kWh
Assumed electricity cost -	$0.1116	$0.1116	per kWh
Percentage electricity savings -	14%	27%	

The estimates of energy impact for the strategy "South Tower guest room fan coil unit valve failures, fan coil riser shut down valve" relied on engineering calculations utilizing boiler natural gas meter readings and normalized weather data. Itron reviewed these data in spreadsheet "South Heating Boiler Gas.xls". Table 3-10 identifies the natural gas consumption and normalized weather data for this strategy. The assumptions and engineering calculations appear reasonable. The savings estimate claimed in the PECI report of 55,324 kWh and 13,104 therms is the average between the low end and high end energy savings values presented in Table 3-10. The assumptions and engineering calculations appear reasonable.

Table 3-10: South Tower Guest Room Fan Coil Unit Valve Failures, Fan Coil Riser Shut Down Valve Data (Gross Impacts)

Gas Savings	Low end	High end	
Reduction in consumption with valves closed -	5,000	10,000	cubic feet/day
	208	417	cubic feet/hour
Nominal heat content -	1,000	1,000	Btu/cubic foot
Therms per hour -	2.08	4.17	therms per hour
Hours per year in San Diego above 65°F -	4,193	4,193	per year; assumes that you would not need hot water for these hours
Annual savings potential -	8,735	17,471	per year
Electricity Savings	Low end	High end	
Assumed percentage of boiler load that is parasitic losses -	60%	40%	
Boiler load that ends up as a simultaneous heating and cooling load -	83,333	250,000	btu/hr
	6.94	20.83	tons
Chiller plant kW/ton	0.80	1.00	kW/ton, all inclusive (chillers, pumps, tower fans, distribution pumps)
kW	5.56	20.83	kW
Hours per year in San Diego above 65°F -	4,193	4,193	per year; assumes that cooling would be required and not heat, thus if the valves were leaking, you would be doing simultaneous heating and cooling
Annual savings potential -	23,294	87,354	kWH per year

The estimates of energy impact for the strategy "South Tower DDC VAV box and fan coil unit verification and program modification—Marina Ballroom Area" relied on engineering calculations utilizing metered data. The Bhp was calculated based on flow and static for similar time periods. These data were converted to kW assuming a fan and motor efficiency and then converted to kW savings per operating hour. Itron reviewed these data in spreadsheet "AC-3 fan speed comparison 05 and 06.xls". Table 3-11 provides a summary of the data used in the energy impact calculations. The assumptions and engineering calculations appear reasonable.

Table 3-11: South Tower DDC VAV Box and Fan Coil Unit Verification and Program Modification—Marina Ballroom Area Data (Gross Impacts)

kW/operating hour - 2006 data	3.42
KW/operating hour - 2005 data	4.53
Difference = savings for 2006, KW per operating hour	1.105
Hours of operation in the past 12 months	4,586
Estimated annual savings - kWh	5,067

The estimates of energy impact for the strategy "South Tower pneumatic VAV box repair" relied on engineering calculations utilizing metered data and equipment characteristics. Itron reviewed these data in spreadsheet "South Tower Terminal Units v3.xls". Table 3-12 provides a summary of the data used in the energy impact calculations. The energy impacts claimed are only the achieved savings up through 8/31/2006. This is only about 6.7% of the anticipated long term impacts. The claimed energy impacts are an average of the low and high ends. The assumptions and engineering calculations appear reasonable.

Table 3-12: South Tower Pneumatic VAV Box Repair Data (Gross Impacts)

Natural Gas Savings			
	Low end	High end	
Total estimated reheat load -	908,820	btu/hr	
Assumed boiler efficiency -	80%		
Non-DDC reheat -	701,070		
Therms into the boiler for non DDC reheat -	8.76	per hour	
Tons at the chiller plant -	58.42	tons	
	Low End	High End	
Hours per year	2,080	4,160	
Therms per year	18,228	36,456	
% in Place by 8/31/06	6.7%		
Savings up to 8/31/06	1,216	2,432	
Electricity Savings			
	Low end	High end	
Boiler load that ends up as a simulateous heating and cooling load -	701,070	701,070	btu/hr
	58.42	58.42	tons
Chiller plant kW/ton	0.80	1.00	kW/ton, all inclusive
kW	46.74	58.42	kW
Hours of AC-1 - 4 operation per year -	2,080	4,160	
Hours per year in San Deigo when OA enthalpy is not suitable for cooling	640	640	Based on bin weather data
Total hours per year -	8,760	8,760	
Hours per year when AC1-4 would be in recirc mode -	152	304	
	Low End	High End	
Annual savings potential -	7,102	17,756	kWH per year
% in Place by 8/31/06	6.7%		
Savings up to 8/31/06	474	1,185	

The estimates of energy impact for the strategy "South Tower blown ducts Level 1—South meeting room corridor" relied on engineering calculations utilizing equipment characteristics data. Itron reviewed these data in spreadsheet "AC1 and 2 leak in L1 corridor.xls". Table 3-13 provides a summary of the data used in the energy impact calculations. The claimed energy impacts are an average of the low and high ends. The assumptions and engineering calculations appear reasonable.

Table 3-13: South Tower Blown Ducts Level 1—South Meeting Room Corridor Data (Gross Impacts)

Item	Low end	High end	Comment
Estimate of leakage			
Opening width, feet	6.00	10.00	
Opening height, feet	4.00	5.00	
Area, square feet	24.00	50.00	
Velocity	50	100	
Flow = Velocity x Area	1,200	5,000	Doesn't include the leakage where the elbow has pulled away.
Estimate of a typcial South Tower AC unit static			
Intake louver	0.10	0.10	Estimate based on past experience
Intake duct	0.02	0.02	60 feet at .03 in.w.c./100 ft
OA damper	0.10	0.10	Estimate based on past experience
Filters	0.50	0.50	Structural rating for 30% prefilters
Cooling coil, wet	1.00	1.00	Estimate based on past experience
Casing losses	0.10	0.10	Estimate based on past experience
System effect	0.25	0.25	Estimate based on past experience
Distribution system to remote terminal unit	0.32	0.43	216 lineal feet times 1.5 and 2 at 0.10/100 ft. of duct
Terminal unit	0.39	0.68	Average (low end) and maximium (high end) terminal unit design DPs
Terminal unit distribution system	0.15	0.15	Estimate based on past experience
Diffusser	0.05	0.10	Estimate based on past experience
External static	1.17	1.61	
Total static	2.99	3.43	
Estimated fan efficiency	75%	80%	
Estimated motor efficiency	85%	90%	
Leakage Hp = (Leakage flow x Static)/(6.356 * Fan efficiency * Motor efficiency)			
Leakage Hp =	0.88	3.75	
kW = .746*Hp	0.66	2.80	
Hours of operation per year	5,587	5,587	ECS data for the past 11 months; assumes 500 hours for August
kWh	3,686	15,619	

Measure #14—Optimize South Tower Domestic Water Booster Pump

In its investigative report, PECI found that the South Tower domestic water system utilized a conventional constant speed pump set that regulates flow to match demand via a pressure regulation valve. PECI recognized that the pressure regulating valve represents a pump energy burden that could be avoided if pump capacity could be modulated by some other method. Regulating pump capacity via speed modulation with a variable speed drive offered an opportunity to achieve the desired result while avoiding the pump energy burden represented by the throttling of the pressure reducing valve. To achieve energy reduction, PECI modified the existing pumping package via the addition of variable speed drives and controls as well as the elimination or modification of the pressure regulating.

The information contained in the spreadsheet “07-26-06 ST DWBooster Amps.xls” was reviewed by Itron. The methodology identified in the spreadsheet relied on data logging new and old pump skid amps over a similar time frame. Table 3-14 lists the results from the data logging along with other methodological assumptions. The methods and assumptions appear reasonable.

Table 3-14: South Tower Domestic Water Booster Pump Optimization Data (Gross Impacts)

Assumed voltage for the kW calc -	480
Assumed power factor for the kW calc -	0.86
Peak hp -	22.91
Peak kW -	17.09
Minimum hp -	4.22
Minimum kW -	3.15
Average hp -	9.81
Average kW -	7.32
kWh savings for the logged interval -	295.61
Logged interval, days -	2.14
kWh savings per day -	138.03
Days per year -	365.00
kWh savings per year -	50,380

Measure #15—Optimize North Tower Domestic Water Booster Pump

This measure is essentially identical to Measure #14, except this one addresses the North Tower domestic water booster pump. Itron reviewed the information contained in the spreadsheet "North Tower DCW Booster Pumps.xls". As with Measure #14, the methodology identified in the spreadsheet relied on data logging new and old pump skid amps over a similar time frame. Table 3-15 lists the results from the data logging along with other methodological assumptions. The methods and assumptions appear reasonable.

Table 3-15: North Tower Domestic Water Booster Pump Optimization Data (Gross Impacts)

Assumed voltage for the kW calc -	480
Assumed power factor for the kW calc -	0.86
Peak hp -	17.00
Peak kW -	17.00
Minimum hp -	2.81
Minimum kW -	2.81
Average hp -	6.79
Average kW -	6.79
kWh savings for the logged interval -	746.68
Logged interval, days -	3.91
kWh savings per day -	191.15
Days per year -	365.00
kWh savings per year -	69,770

3.2 Building B

The investigation report for Building B was prepared by EMC Engineers, Inc. (EMC). In this report, six measures were identified and recommended for implementation. Of these six measures, three were implemented. Table 3-16 lists the three implemented measures and the estimated impacts from each.

Table 3-16: Building B Implemented Measures (Gross Impacts)

Measure #	Measure Description	Annual Electric Savings (kWh)	Annual Gas Savings (Therms)	Peak Demand Savings (kW)
1	Provide Small HVAC Unit for Security and Modify the start/stop schedule on the Lobby cold deck AHU fan.	41,956	0	0
2	Reduce AHU cold deck fan energy on floors 2-20 and optimize flat plate free cooling operation.	170,851	0	139
3	Optimize chiller plant efficiency by reducing condenser water supply temperature	54,358	0	31
Total All Findings		**267,165**	**0**	**170**

Itron reviewed the detailed implementation spreadsheets to assess the reasonableness of the methodology and the quality of the data utilized.

Measure #1—Provide Small HVAC Unit for Security

EMC found that the cold deck fan (40 hp) for the air handling unit serving Building B's lobby operated 24 hours per day, seven days per week. The fan operated continuously even though cooling from the chilled water system was not available. It was EMC's recommendation that the cold fan be placed on a stop-start schedule similar to the hot deck fan. It was also EMC's recommendation that a small HVAC unit be provided to the area utilized by security staff, but this portion of the measure was not implemented.

Itron reviewed the information contained in the spreadsheet "M1 - Lobby AHU.xls", which included the data used for the energy impact estimate calculation. The methodology employed was to collect trend data for the cold deck fan on-off operation for pre- and post-implementation. The initial estimate of energy impact was based on the pre-implementation trend data and the on-off energy reduction achieved with the new schedule. This methodology appears reasonable and the estimates of energy impacts also appear reasonable. However, although the cold deck fan operation schedule has been implemented as recommended, EMC could not log into the system to verify correct programming. Although Itron believes that the energy impact methodology is sound, the program would benefit from observing the post-installation trend data.

Measure #2—Reduce AHU Cold Deck Fan Energy on Floors 2–20

EMC recommended changing the cold deck temperature setpoint to 50°F for the digitally controlled floors and 55°F for the pneumatically controlled floors. The cold deck static pressure setpoint would also be lowered to 0.6" WC for each AHU. Additionally, changeover controls should be modified for free cooling.

Itron reviewed the information contained in the spreadsheet “M2 - Reduce Fan Energy.xls”, which included the data used for the energy impact estimate calculation. The methodology employed was to collect trend data on cold deck temperature, fan speed, and cold deck static pressure. These data were collected for each of the floors from Floor 2 through 20 and represented the baseline condition. To represent the post-installation period, changes were made to the cold deck temperature, cooling setpoint, and duct static point. Engineering calculations were used employing the baseline trend data and the recommended post-installation changes. No savings were predicted for optimizing the switchover between free and mechanical cooling because this work has been contracted to the Hartman Company and Optimum Energy under a separate effort.

This methodology and the estimates of energy impacts appear reasonable. However, as with Measure #1, EMC is not able to log into the energy systems at Building B remotely to verify post-installation performance. Although Itron believes that the energy impact methodology is sound, the program would benefit from observing the post-installation data.

Measure #3—Optimize Chiller Plant Efficiency

EMC observed that Building B’s chiller plant operated with a constant 75°F condenser water supply temperature. EMC suggested that the chiller plant could operate more efficiently at lower condenser water supply temperatures, with a lower limit at 60°F.

Itron reviewed the information contained in the spreadsheet “M3 - Chiller Plant CW Reset.xls”. The methodology used to estimate measure impact was based on gathering trend data on chiller power, chiller VFD speed, and CHWS, CHWR, CWS, and CWR temperatures. The measure impact is based on chiller performance curves before and after the condenser water supply temperatures are reset to 60°F.

This methodology and the estimates of energy impacts appear reasonable. However, as with the other two measures, EMC is not able to log into the energy systems at Building B remotely to verify post-installation performance of the chiller speed and power, CWS temperature, and cooling tower fan power. Although Itron believes that the energy impact methodology is sound, the program would benefit from observing the post-installation data.

3.3 Building C

The investigation report for Building C was prepared by EMC Engineers, Inc. In this report, eight measures were identified and recommended for implementation. Seven of these eight measures were implemented. Table 3-17 lists the seven implemented measures and the estimated impacts from each.

Table 3-17: Building C Implemented Measures (Gross Impacts)

Measure #	Measure Description	Annual Electric Savings (kWh)	Annual Gas Savings (Therms)	Peak Demand Savings (kW)
1	Correct Uneven Flow Through Cooling	93,984	0	40
2	Improve Chiller Sequencing	60,556	0	0
3	Raise the Chilled Water Supply	29,205	0	12
4	Reduce Cooling System Night Operation During the Summer	168,010	0	0
5	Optimize AH-1 control	25,410	0	1
6	Optimize AH-2 & 3 control	115,731	0	208
7	Optimize AH-4 control	3,888	0	41
Total All Findings		**496,783**	**0**	**302**

Itron reviewed the detailed implementation spreadsheets to assess the reasonableness of the methodology and the quality of the data utilized.

Measure #1—Correct Uneven Flow Through Cooling Tower

EMC found that uneven flow caused by poor flow balancing in the distribution header on top of the cooling tower was causing about 25% of the tower media to run dry. Excess water was observed flowing out of the face on one side of the cooling tower, while one quadrant appeared to have no flow. Better flow would reduce tower fan energy by utilizing a greater heat transfer area of the media. Existing balancing valves could be used to balance the flow. The chiller plant operates with a condenser water supply temperature setpoint of 70°F. The chiller plant could operate more efficiently at lower condenser water supply temperatures, with a lower limit at 60°F. This measure was found to have a strong synergistic relationship with Measure #3 and that Measure #3 must also be implemented to achieve the savings expected for this measure. Measure #3 was implemented.

Itron reviewed the information contained in the spreadsheet “RCxM #1 - Hartman Loop Eval.xls”. The methodology used to estimate measure impact was based on gathering trend data on CT fan current, condensing water temperatures, and ambient weather conditions including humidity over a 48-day period to establish operating characteristics. Additionally, trend data on chiller power, chiller VFD speed, and CHWS, CHWR, CWS, and CWR temperatures were gathered.

The valves were rebalanced by the maintenance staff. Balancing the flow through the cooling tower caused the Hartman Loop to operate more efficiently, as anticipated. The post-implementation analysis indicated that the Hartman Loop was more efficient. Itron believes that the energy impact methodology is sound and should be accepted.

Measure #2—Improve Chiller Sequencing

EMC found during the planning phase that the chillers were sequenced according to the Hartman Loop programming. This sequence operated chillers in parallel down to where both chillers were 20% loaded (60 kW each) before turning off one chiller. When chillers were ramped up, one chiller was operated up to 100 kW, before the second one was turned on. Operation of a chiller down to 20% load and its associated pumps is not efficient.   This inefficiency was detected with BAS trend data. Power and temperature data were collected for all cooling plant equipment including chillers, chilled water pumps, chilled water temperatures, and condenser water temperatures. The goal of this measure is to operate the chillers on the most efficient part of the performance curve. The goal is met when the chillers are sequenced for serial operation, fully loading one chiller before bringing on the second chiller.

Itron reviewed the information contained in the spreadsheet “RCxM #2 - Optimize Chiller Seq.xls”. This spreadsheet includes all of the collected trend data and the engineering calculations used to estimate the energy impacts. Implementation of this measure was confirmed and Itron believes that the energy impact methodology is sound and should be accepted.

Measure #3—Improve Chiller Sequencing

Implementation of this measure is closely tied to the implementation of Measure #1. EMC found that the chiller plant was operating with a chilled water supply temperature in the range of 37°F to 45°F, with an average temperature of about 40°F. Chilled water coils require temperatures closer to 45°F to maintain a minimum supply air temperature of 55°F. The chiller plant operates more efficiently at a higher chilled water supply temperature. The chilled water temperatures and setpoints were detected with the BAS trend data. Chilled water temperatures were reset based on the chilled water demand by monitoring the positions of the chilled water control valves.

The spreadsheet “RCxM # 1 and 3 -Chiller Plant Improvements.xls” includes the recorded trend data and the engineering calculations used to estimate the energy impacts. Post-implementation trend data indicated that the chilled water coil temperature was being maintained at an average value of 45°F, which was the goal of the measure. Itron believes that the energy impact methodology is sound and backed up by the post-implementation trend data, and should be accepted.

Measure #4—Reduce Cooling System Night Operation During the Summer

EMC found in its observations that during selected summer days, the HVAC system, including fan systems and the chilled water system, operated 24 hours per day to maintain building temperatures. Electrical interval data (in 15-minute intervals) indicated a total of 54 days of continuous operation in 2004. During the winter, the evening electric load was around 140 kWh and in the summer the load was around 280 kWh. The additional load in the summer was caused by night-time cooling system operation. There are minimal loads at night when the building is unoccupied and there are no solar gains. In addition, outside air temperatures are low. Most of the summer night loads appear to be heat gain from AHU fans.

The HVAC systems are normally operated between 6:00 A.M. and 8:00 P.M. A concern was raised by the Building C engineers with respect to this measure because it was believed that the building would not recover from night setback conditions and be capable of maintaining space temperatures during the following day. ECM gave good explanations as to why these concerns were unwarranted, and the measure was implemented.

The effects of this measure were detected by analyzing equipment operating schedules in the BAS, reviewing BAS trend data for HVAC equipment, and by reviewing electrical interval data. The spreadsheet "RCxM #4 - Reduce Summer HVAC Hours.xls" includes these trend data and the engineering calculations used to estimate energy impact from the measure. Post-implementation trend data indicate that the schedule was implemented as detailed in the measure description. This post-installation trend data information supports the savings estimates developed by ECM. Itron believes that the energy impact methodology is sound and backed up by the post-implementation tend data, and should be accepted.

Measure #5—Optimize AH-1 Control

EMC found in its observations that the chilled water valves were cycling frequently, causing the supply air temperature to fluctuate between 53°F and 63°F when AH-1 was in operation. The goal of this measure was to eliminate chilled water valve cycling and gain control of the supply air temperature, which will reduce fan energy. The controls parameters for the chilled water valve were adjusted to eliminate cycling and a supply air temperature reset strategy based on fan speed was programmed.

The proposed strategy was implemented and changes to existing programming are documented in AHU Programming Changes (BUILDING C - AHU Programming Changes.doc). The savings calculations are anticipated to stay the same but trend data will not be available for analysis until the weather pattern in the San Diego area stabilizes. The spreadsheet "AHU Summer Schedule Trend Data 7-12-06.xls" includes data from a sample day of trend data for AH-1 along with the engineering calculations used to estimate energy impacts. Itron believes that the energy impact methodology is sound and should be accepted.

Measure #6—Optimize AH-2 and AH-3 Control

EMC found in its observations that the AH-2 and AH-3 units serve common supply air duct loops on Floors 10 through 26. AH-3 was operating with a constant fan speed of about 95%, forcing supply air backwards through the AH-2 supply air duct to AH-2, which was operating with a fan speed in the 30 to 50% range. Both AHUs maintain a static pressure setpoint at 1.5 inches of static. AH-2 operated with a constant 55°F supply air temperature, but AH-3 was experiencing cycling at the chilled water valve that resulted in supply air temperatures cycling between 55°F and 65°F throughout the day. The ineffectiveness of AH-3 at delivering supply air to the load was likely a cause of the difficulty in cooling down the building in the summer. The goal of this measure was to eliminate chilled water valve cycling, recalibrate static pressure sensors, and gain control of the supply air temperature, which will reduce fan energy.

As with Measure #5, the proposed strategy was implemented and changes to existing programming are documented in AHU Programming Changes (BUILDING C - AHU Programming Changes.doc). The savings calculations are anticipated to stay the same but trend data will not be available for analysis until the weather pattern in the San Diego area stabilizes. The spreadsheet "AHU Summer Schedule Trend Data 7-12-06.xls" includes data from a sample day of trend data for AH-2 and AH-3 along with the engineering calculations used to estimate energy impacts. Itron believes that the energy impact methodology is sound and should be accepted.

Measure #7—Optimize AH-4 Control

EMC found in its observations that AH-4 was operating at about 70% to 80% fan speed with supply air temperatures in the 53°F to 60°F range. The mixed air temperature sensor was reading incorrectly and it was not possible to determine whether the economizers were operating correctly. The goal of this measure was to gain control of the supply air temperature, which would reduce fan energy. A supply air temperature reset strategy based on fan speed was followed using the same strategy used on AHU-1 through AHU-3.

As with Measures #5 and #6, the proposed strategy was implemented and changes to existing programming are documented in AHU Programming Changes (BUILDING C - AHU

Programming Changes.doc). The savings calculations are anticipated to stay the same but trend data will not be available for analysis until the weather pattern in the San Diego area stabilizes. The spreadsheet "AHU Summer Schedule Trend Data 7-12-06.xls" includes data from a sample day of trend data for AH-4 along with the engineering calculations used to estimate energy impacts. Itron believes that the energy impact methodology is sound and should be accepted.

3.4 Building D

The investigation report for Building D was performed by Ove Arup & Partners, Ltd. (Arup). Building D consists of ten buildings. Building #9 is a future building with construction yet to be completed and building #10 is undergoing renovation. The remaining eight buildings are all two-story, ranging in size from 48,000 square feet to 140,600 square feet. Buildings #4, #5, #6, and #7 were identified as suitable for the RCx program. In the investigation report, a total of 40 measures were identified and six measures were implemented. Table 3-18 lists the six implemented measures and the estimated impacts from each. It should be noted that the impact values listed in Table 3-18 do not have an interaction value applied. Averaged across all of the savings, this interaction value is about 91%.

Table 3-18: Building D Implemented Measures (Gross Impacts)

Measure #	Measure Description	Annual Electric Savings (kWh)	Annual Gas Savings (Therms)	Peak Demand Savings (kW)
1	Supply Air Static Pressure Reduction	569,402	0	70
2	Exhaust Fan Static Pressure Reduction	192,127	0	22
3	Reduce Space Airflow	1,744,673	44,694	705
4	Thermostat Deadband Increase	409,608	568	174
5	Nighttime Setback of Airflow	4,281,882	82,250	0
14	Nighttime Setback of AHU Temperatures	456,581	50,047	0
Total All Findings		**7,654,273**	**177,558**	**972**

Measure #1—Supply Air Static Pressure Reduction

The first measure implemented at Building D was to reduce the supply air static pressure from 1.7" toward 1.0" wg, while maintaining VAV box operations in buildings #4, #5, #6, and #7. The benefit of the measure is the reduction in excessive pressure being produced by set-points and currently being taken out by VAV boxes. The reduction of this pressure leads to a corresponding reduction in fan energy use.

Itron reviewed Arup's assumptions and engineering calculations for this measure, which appear in the spreadsheet "EEP Cost Savings Summary 3-7-06 Update.xls". The assumptions and methodology appear reasonable and the calculations accurate. Itron believes that the impact estimates provided by Arup should be accepted.

Measure #2—Exhaust Fan Static Pressure Reduction

The second measure implemented at Building D is similar to the first measure, but involves the reduction in exhaust fan static pressure rather than a reduction in supply air static pressure. As with Measure #1, excessive pressure is being produced by the current set-points. The reduction of this pressure leads to a corresponding reduction in fan energy use.

Itron reviewed Arup's assumptions and engineering calculations for this measure, which appear in the spreadsheet "EEP Cost Savings Summary 3-7-06 Update.xls". The assumptions and methodology appear reasonable and the calculations accurate. Itron believes that the impact estimates provided by Arup should be accepted.

Measure #3—Reduce Space Airflow

For the third measure, Arup modified the CFM in the offices by reducing the air change rates from 12 to 8, giving an estimated CFM reduction of 27%. This reduction reduced heating and cooling demands resulting in a reduction in cooling tower, chiller, boiler, and pumping energy requirements.

Itron reviewed Arup's assumptions and engineering calculations for this measure, which appear in the spreadsheet "EEP Cost Savings Summary 3-7-06 Update.xls". The assumptions and methodology appear reasonable and the calculations accurate. Itron believes that the impact estimates provided by Arup should be accepted.

Measure #4—Thermostat Deadband Increase

For the fourth measure, Arup increased the thermostat deadband from a setting of +/- 0°F, to +/- 2.5°F. Increasing the deadband minimizes equipment operation changes resulting in reduction in loads and maintenance on fans, pumps, chillers, cooling towers and boilers.

Itron reviewed Arup's assumptions and engineering calculations for this measure, which appear in the spreadsheet "EEP Cost Savings Summary 3-7-06 Update.xls". The assumptions and methodology appear reasonable and the calculations accurate. Itron believes that the impact estimates provided by Arup should be accepted.

Measure #5—Nighttime Setback of Airflow

Arup modified the night/weekend airflow setbacks from 7:00 P.M. to 6:00 A.M. (daily) and 7:00 P.M. Friday to 6:00 A.M. Monday (weekend). This modification reduced air supplied at night and during weekends when it is not required. This results in savings on fan, pump, chiller boiler, and cooling tower loads.

Itron reviewed Arup's assumptions and engineering calculations for this measure, which appear in the spreadsheet "EEP Cost Savings Summary 3-7-06 Update.xls". The assumptions and methodology appear reasonable and the calculations accurate. Itron believes that the impact estimates provided by Arup should be accepted.

Measure #14—Nighttime Setback of AHU Temperatures

For this measure, Arup modified the night/weekend setbacks of AHU temperatures, increasing the unoccupied range from 50°F (heating) to 60°F (cooling) in offices and 65°F (heating) to 78°F (cooling) in labs. Increasing the setpoint during unoccupied times results in savings on fan, pump, chiller, boiler, and cooling tower loads.

Itron reviewed Arup's assumptions and engineering calculations for this measure, which appear in the spreadsheet "EEP Cost Savings Summary 3-7-06 Update.xls". The assumptions and methodology appear reasonable and the calculations accurate. Itron believes that the impact estimates provided by Arup should be accepted.

3.5 Freeridership Estimation, Impact on Program TRC, and Net Savings

Initially, Itron planned to develop a rough estimate of freeridership based on participant response to the question "About what percentage of the measures would you have installed without participating in the program?" The responses were "0%", "could be up to 20%", and "very little". However, after consideration of the generally vague answers and lack of specificity of the question, Itron recontacted the participants and asked more detailed questions regarding potential freeridership. The three questions were:

1. Would you have initiated and paid for the retrocommissioning investigation if you had not participated in the program?
2. If the answer to #1 is no, would you have implemented any of the measures without the energy and cost savings calculations provided by the program? If so, what percentage and on what approximate timeline?
3. If the answer to #1 is yes, please explain what the impetus for pursuing RCx would have been and if it was budgeted or scheduled prior to learning about the RCx program. What percentage of the measures would you have implemented on your own and on what approximate timeline?

All but one participant said they only implemented the RCx measures because of the program. The remaining participant indicated that they may have possibly thought of some of the measures on their own, but after consideration, they concluded that the only reason they did implement the measures was because of the investigation report and the incentive.

Based on this follow-up analysis, Itron concluded that there were no free riders in the PECI San Diego RCx Program. This should not be interpreted to mean that RCx programs in general have no free ridership. This finding only reflects that for this very small program, free ridership is estimated to be zero.

Using a net-to-gross ratio (NTG) of 1.0, Table 3-19 identifies the ex ante gross program projected savings and the ex post net evaluation savings. Note that no values are provided for therms as PECI did not claim any natural gas savings. Ex post energy savings are about 60% greater than the originally estimated ex ante projected energy savings. The ex post peak MW savings are about double the originally estimated ex ante projected peak MW savings.

The estimated TRC value for this program is calculated to be 3.933 when using the NTG value of 1.0. This 3.933 TRC value is much higher than the initial projected TRC value of 2.196. Based on this TRC, the RCx program appears to be very cost-effective.

Table 3-19: Evaluated SDG&E RCx Savings Over 20 Years

Program ID*: 1381-04

Program Name: Retrocommissioning Program

Year	Calendar Year	Ex-ante Gross Program Projected Program MWh Savings (1)	Ex-Post Net Evaluation Confirmed Program MWh Savings (2)	Ex-Ante Gross Program-Projected Peak Program MW Savings (1**)	Ex-Post Evaluation Projected Peak MW Savings (2**)	Ex-Ante Gross Program-Projected Program Therm Savings (1)	Ex-Post Net Evaluation Confirmed Program Therm Savings (2)
1	2004	-	-	-	-	-	-
2	2005	6,224	-	0.78	-	-	-
3	2006	6,224	9,873	0.78	1.56	-	-
4	2007	6,224	9,873	0.78	1.56	-	-
5	2008	6,224	9,873	0.78	1.56	-	-
6	2009	6,224	9,873	0.78	1.56	-	-
7	2010	6,224	9,873	0.78	1.56	-	-
8	2011	6,224	9,873	0.78	1.56	-	-
9	2012	6,224	9,873	0.78	1.56	-	-
10	2013	-	9,873	-	1.56	-	-
11	2014	-	-	-	-	-	-
12	2015	-	-	-	-	-	-
13	2016	-	-	-	-	-	-
14	2017	-	-	-	-	-	-
15	2018	-	-	-	-	-	-
16	2019	-	-	-	-	-	-
17	2020	-	-	-	-	-	-
18	2021	-	-	-	-	-	-
19	2022	-	-	-	-	-	-
20	2023	-	-	-	-	-	-
TOTAL	**2004-2023**	49,795	78,985			-	-

**Please include the definition of Peak MW used in the evaluation.
Definition of Peak MW as used in this evaluation: Average kW reduction during the period Monday-Friday 12 p.m. - 7 p.m., during the months of June through September
1. Gross Program-Projected savings are those savings projected by the program before NTG adjustments.
2. Net Evaluation Confirmed savings are those documented via the evaluation and include the evaluation contractor's NTG adjustments.

Appendix A

Program Administrator Questionnaire

PECI San Diego Retrocommissioning Program

Program Administrator Questionnaire

1. Please briefly describe your primary role in the San Diego Retrocommissioning program.

2. What are the primary goals of the program?

3. In your opinion, how well has the program performed to meet these goals?

4. What do you think are the primary reasons for this level of performance?

5. What are the key lessons you've learned as a result of administering this program?

6. What have been the primary changes in the program since it started?
   a. changes in program staff
   b. changes in staff responsibilities
   c. changes in marketing or outreach activities
   d. changes in tracking program data
   e. changes in reporting procedures
   f. changes in services offered or incentives
   g. other

7. What is the one thing you would change about the program design or implementation if you could?

7(a). Are there other changes you would like to see?

8. Please give a brief description of each of the following program elements. Please also comment on the effectiveness of each. Do you have any suggestions on how they can be improved?
    a) marketing and outreach activities
    b) program promotional materials
    c) program Toolkit and training session
    d) project screening
    e) program tracking
    f) program incentives
    g) scoping report
    h) MOU
    i) persistence strategies
    j) investigation phase report (master list of findings)
    k) customer follow-up efforts
    l) other

9. What are some common problems that you face in dealing with customers?

10. In your opinion, what are the major reasons for participants not going ahead with implementation?

11. What have been the greatest accomplishments of the program to date?

12. What are your primary concerns you have for the program now?

Appendix B

Commissioning Provider Questionnaire

PECI San Diego Retrocommissioning Program

Commissioning Provider Questionnaire

1. Please briefly describe your primary role in the San Diego Retrocommissioning program.

   ____

   ____

   ____

2. How did you become involved in the program?

   ____

   ____

   ____

3. How active of an involvement do you have in the program?
   - very involved
   - somewhat involved
   - involved in a minor way

4. Did you participate in the Orientation and Training Session in September of 2004? (Yes or No)

   5. (If yes to #4) Did you find this training session useful?
      - yes very
      - yes somewhat
      - no, not particularly useful
   6. (If yes to #4) Did you find the Program Toolkit helpful?
      - yes very
      - yes somewhat
      - no, not particularly useful
   7. (If yes to #4) Do you have any suggestions for improving the training session or Program Toolkit?

      ____

      ____

      ____

8. What are some common problems that you face in dealing with customers?

   ____

   ____

   ____

9. In your opinion, what are the major reasons for participants not going ahead with implementation?

____
____
____

10. Please describe how the two primary program deliverables (scoping report and investigation report, or Master List of Findings) are presented to the customer.

____
____
____

11. What procedures do you follow after you deliver each of these reports to the customer?

____
____
____

12. In your opinion, how has the program performed to date?

____
____
____

13. What do you think are the primary reasons for this performance?

____
____
____

14. What are the key lessons you've learned as a result of being a commissioning provider for this program?

____
____
____

15. What suggestions, if any, would you have to improve this program?

____
____
____

Appendix C

Participant Questionnaire

PECI San Diego Retrocommissioning Program

Participant Questionnaire

FIRM NAME:______________________ CONTACT: ________________________
PHONE #: ________________________ TITLE: ____________________________
DATE:___________________________

Hello, this is ___________. I am with Itron, an independent research firm, and we are conducting an evaluation of the PECI San Diego Retrocommissioning Program. I understand that you have participated in that program and I'd like to ask you a few questions about your experience. This should take about 15 minutes and your answers will be kept confidential and will not affect your participation in the program or the incentive you may receive. Would this be a good time?

1. How did you first hear about the retrocommissioning program?

   ____
   ____
   ____

2. How would you describe your current status in the program?
   a) waiting for information from the program (describe what information)
   b) in the process of deciding about recommended improvements
   c) have decided to go ahead with recommended improvements
   d) have decided to not go ahead with recommended improvements
   e) completed recommended improvements but have not received incentive
   f) completed recommended improvements and received incentive

   If yes to 2e or 2f then:

   g) About what percent of these measures would you have installed without participating in the program? _____________%

3. Based on the program's initial description and materials, what services did you expect from the program?

   ____
   ____
   ____

4. What was the single most important reason you decided to participate in the program?
____

5. Were there other important reasons?

6. How well did the program meet your expectations compared to the program's description?

7. Please describe what was different than expected?

8. What were the major things about the program that you liked?

9. What were the major things about the program that you did not like?

10. Is there any aspect of the Retrocommissioning program that you think should be changed? (describe)

11. Before you were approached by the Retrocommissioning program, to what extent were you aware of the benefits of retrocommissioning?
    - Very aware
    - Somewhat aware
    - Not at all aware

12. Using a scale of 1 to 5 where "1" means "very dissatisfied" and "5" means "very satisfied," how would you rate your satisfaction with the following aspects of the program? (*only ask about those areas the respondent is familiar with depending on his progress in the program*)
    a) Program administrative personnel _____
    b) Commissioning provider _____
    c) Results of scoping report (initial walk-through and assessment) _____
    d) MOU _____
    e) Investigative report (ie, Master List of Findings) received through the program _____
    f) Incentives available _____
    g) Contractor who installed improvements (if different than your commissioning provider) _____
    h) Your overall satisfaction with the program _____

13. *(See Q2(c): If respondent has received Investigation Phase Report but has not completed recommended improvements)*
    13(a) What are your plans for implementing the program's recommendations?
    ____
    ____
    ____

    13(b) When do you expect to begin installing the recommended measures?
    ____
    ____
    ____

    13(c) Do you have the funds available in your budget this year to implement the recommended improvements?
    (if no)
    13(e) What is the timing and decision-making process for including these improvements in a future year's budget?

    13(f) Are you planning on installing other efficiency measures not recommended by the program? (describe what and when)

____
____
____

14. *(See Q2(d): If respondent has received Investigation Phase Report but has decided to not continue)*
    14(a) What are your reasons for not implementing the recommended measures?

    ____
    ____
    ____

    14(b) Are you planning on installing other efficiency measures not recommended by the program? (describe what and when)

    ____
    ____
    ____

15. Please describe how investments in electricity or gas efficiency equipment and controls are handled in your budgeting process.
    - Are they considered capital investments? (Yes or No)
    - How much time is needed from the decision to implement improvements until a contractor is hired to complete the work? ___________

16. Have you installed other energy conservation measures before participating in the Retrocommissioning program? (describe)

    ____
    ____
    ____

17. Do you have any suggestions for improving the program? (describe)

    ____
    ____
    ____

I also have a few questions about your business.

18. How long have you operated from this location? ___________

19. Do you own or lease this building? ___________

20. How many employees work in this building? ___________

Appendix D

Nonparticipant Questionnaire

PECI San Diego Retrocommissioning Program

Nonparticipant Questionnaire

FIRM NAME:______________________ CONTACT: ________________________
PHONE #: ________________________ TITLE: ____________________________
DATE:___________________________

1. How did you first hear about the San Diego Retrocommissioning Program?
____
____
____

2. Based on the program's initial description and materials, did you think there were any benefits to participating in the program? (describe)
____
____
____

3. What is the primary reason you decided to not participate in the Retrocommissioning Program?
____
____
____

4. Were there other reasons why you decided to not participate in the program? (describe)
____
____
____

5. What things about the program did you like?
____
____
____

6. What things about the program did you not like?

____
____
____

7. In your opinion, what are some of the reasons customers might decline to participate in the program?

____
____
____

8. What changes would need to be made in the program in order for you to participate?

____
____
____

9. Before you were approached by the San Diego Retrocommissioning Program, to what extent were you aware of the benefits of retrocommissioning?
   - Very aware
   - Somewhat aware
   - Not at all aware

10. Are you currently planning on installing any energy efficiency measures in your building? (describe)

____
____
____

11. Please describe how investments in electricity or gas efficiency equipment are handled in your capital and operations budgeting process.
   - Are they considered capital investments? (Yes or No)
   - How much time is needed from the decision to implement improvements until a contractor is hired to complete the work? ________________

12. Have you installed any energy conservation measures in your building in the past year? (describe)

____
____
____

13. Have you participated in other energy conservation programs? (describe)
____
____
____

I also have a few questions about your business.

14. How long have you operated from this location? ___________

15. Do you own or lease this building? ___________

16. How many employees work in this building? ___________

Thank you very much for your time and feedback.