



RETROCOMMISSIONING FOLLOW-UP GUIDELINES

Commercial & Institutional Buildings

San Diego Electric and Gas Retrocommissioning Program

Table of Contents

OVERVIEW	3
1.0 INCENTIVES	3
2.0 TARGETED DOCUMENTATION	3
2.1 REPORT DEVELOPMENT	3
2.2 ARCHIVE THE REPORT	4
3.0 BUILDING OPERATOR AND OWNER TRAINING	4
3.1 SCHEDULE TRAINING	4
3.2 PREPARE TRAINING MATERIALS	5
3.3 CONDUCT THE TRAINING	5
3.4 RETROCOMMISSIONING TRAINING COMPLETION FORM	5
ATTACHMENT A: RCX FINAL REPORT OUTLINE	6
3.1 MEASURE 3: RESTORE OPERATION OF CHILLED WATER PUMP VFD	8



Overview

Immediately after the retrocommissioning measures are implemented, maximum savings can be realized and the treated systems are operating at their peak performance. Over time, however, the efficiency of the systems may decline, unless explicit strategies are put into place to maintain and monitor the improvements. To ensure that the energy savings – and other benefits from retrocommissioning – are long-lasting, the San Diego Electric and Gas (SDG&E) RCx Program requires the following follow-up activities:

- Targeted Documentation
- Building Operator and Owner Training

Each of these activities is summarized below.

1.0 Incentives

The remaining portion of the follow-up incentive is paid to the RCx Provider by PECI upon submittal and approval of the *RCx Final Report* and *Retrocommissioning Training Completion Form*, based upon the final itemized invoices from the RCx Provider. The follow-up incentive ranges from \$3,000 – \$7,500 and is based upon building size:

- Base incentive \$3,000
- \$0.01125 for each sq ft in excess of 100,000 sq ft
- Total follow-up incentive capped at \$7,500

2.0 Targeted Documentation

After implementation, it is essential that the building owner and operators have the resources they need to maintain and monitor the implemented measures. Therefore, the RCx Provider is responsible for developing final documentation describing the implemented RCx measures. Using the provided template, the RCx Provider will develop the *RCx Final Report* for the implemented measures, including, but not limited to: new or improved sequences of operation, the energy savings impact of the measures, the requirements for ongoing maintenance and monitoring of the measures, and contact information for the RCx Provider, in-house staff, and contractors responsible for implementation. To complete this task the RCx Provider must:

- Develop and submit the *RCx Final Report* for review and approval by PECI (see Section 2.1).
- Provide at least two copies of the Report to the Owner and building staff.
- Add any project related documentation to the building O&M files as indicated in the *RCx Final Report*.

2.1 Report Development

The *RCx Final Report* is intended for use as a record of the activities that were conducted through the SDG&E RCx Program and in the operator training. The Report is critical to long-term persistence of savings because it contains recommendations for O&M practices that will maintain the performance of the improved systems. It is a resource to current and future operators and should be made part of the permanent record of recommended O&M practices at the building.



The purpose of the Report is to provide descriptions and recommended O&M practices for each implemented measure. To assist with the Report development, the Program provides a template.

The *RCx Final Report* must contain the following information for each measure that was implemented:

- Finding (as-found condition, problem, or opportunity)
- Measure (improvement or repair)
- Measure's Maintenance

The RCx Provider is required to use the *RCx Final Report* template provided by the Program, and follow the accompanying outline in **Attachment A**. The template represents the minimum content required for the *RCx Final Report*; the RCx Provider should include any additional information gathered during the RCx process that they feel may assist the Owner in maintaining the operational improvements.

Once complete, the *RCx Final Report* must be submitted to PEGI for review and approval.

2.2 Archive the Report

The RCx Provider should work with the Owner and building operators to decide where copies of the *RCx Final Report* should be placed so that it is readily available to the operating staff. Typically, copies of retrocommissioning documentation are placed with the documents describing the construction, operation, and maintenance of the building, provided directly to the Owner, and made available electronically to the appropriate O&M staff.

3.0 Building Operator and Owner Training

Before handing over the *RCx Final Report*, the RCx Provider conducts a follow-up training on the new documentation and implemented measures. The RCx Provider is responsible for conducting an in-house presentation for the Owner and the appropriate building operations personnel (or subcontractors). The training should cover the investigation process and results, measures that were implemented, and requirements for ongoing maintenance and monitoring. To verify that the training was complete, the RCx Provider submits a *Retrocommissioning Training Completion Form* to PEGI, including when the training was held and who was in attendance. To complete this task, the RCx Provider must:

- Schedule a time to train the O&M staff members and Owner after the improvements to the systems are complete.
- Prepare materials for the training using the outline in Section 3.2 as a guideline.
- Deliver the training session to the O&M staff and Owner.
- Submit a *Retrocommissioning Training Completion Form* to PEGI to indicate that the training was conducted (included in the Program Toolkit).

3.1 Schedule Training

The training should be scheduled after the improvements have been made and far enough in advance for the O&M staff and Owner to make arrangements to attend. The training should take place on-site in the retrocommissioned building and, depending on the complexity of the building, last 2-4 hours. PEGI should be notified of the date and time of the training in advance.



3.2 Prepare Training Materials

The RCx Provider is responsible for customizing the outline for the training and developing the training materials. Before preparing the training outline and materials, the RCx Provider should assess the related level of knowledge of the building operators, to set up the training accordingly. For reference, the Program provides the following sample outline for the training:

- Background on the energy use of this particular building
 - Present Energy Utilization Index
 - Compare present ENERGY STAR benchmarking score to other similar types of buildings
 - Describe Operating Schedules and Owner’s operating requirements
- RCx investigation process used in this building
 - Describe the methods used to identify problems and deficiencies
 - Review the *Master List of Findings Summary*
- Implementation process in this building
 - Describe the measures that were implemented and by whom
 - Walk around the building to look at any physical changes or step through the new control sequences at the operator workstation
 - Provide as many details about implementation as necessary to describe what was done
 - Describe improved performance that these measures will create (show trends if available)
- O&M Requirements
 - Describe the O&M requirements needed to keep these improvements working
 - Describe how the staff can be aware of energy efficiency opportunities and begin looking for additional savings potential

The RCx Provider should follow the outline to prepare materials, as necessary, to hand out at the training session.

3.3 Conduct the Training

The RCx Provider conducts the training for the operators and Owner. To the extent possible, the training should incorporate hands-on activities and the attendees should have the opportunity to inspect the treated equipment and systems, discuss what was done and how to maintain the improvements.

3.4 Retrocommissioning Training Completion Form

At the conclusion of the training the RCx Provider submits the *Retrocommissioning Training Completion Form* electronically to PEGI. The RCx Provider should also submit any materials that were handed out to the training attendees.



Attachment A: RCx Final Report Outline

The Program provides a template for the *RCx Final Report* and includes the following elements:

1. Program Cover (provided), customize for the facility
2. Table of Contents (provided, update as necessary)
3. Report Contents (see Outline below)

The RCx Provider should consider the following outline as the minimum content required and include any additional information gathered during the RCx process that they feel may assist the Owner in maintaining the operational improvements. Within the template, the highlighted **[text in brackets]** are meant to be replaced with the requested information and red *italics* are instructions that need to be deleted prior to delivery to PECCI. All “XXXX” items within the report need to be replaced with the correct, corresponding number.

Introduction

Provides an overview of the intent of the report and information regarding the firm who provided the retrocommissioning services.

1.0 Project Overview

This section provides an overview of the facility including building characteristics, energy usage patterns, and description of the installed mechanical systems and building automation system. This is generated from the *Findings Workbook* by copying and pasting rows 3 – 63 from the General tab.

2.0 Retrocommissioning Results

Description of the RCx investigation, including the process overview (provided in template), a summary list of all improvements that were investigated and presented to the Owner for consideration, and a summary list of those measures that were selected by the Owner for implementation. Narrative and lists can be pulled from the *Master List of Findings* and *RCx Investigation Report*.

3.0 Implemented Measures

Detailed descriptions of each implemented measure, organized by equipment or system type. The following information should be provided for each measure:

Overview

- Description of the finding and how it was detected.

Measure

- Brief description of the implemented improvement or repair;
- Where applicable, before/after system performance plots;
- Where applicable, photographs showing the deficiency and improvement;
- Completion date;
- Implementer/Contractor contact information; and
- Cost, energy, and non-energy benefits.



Measure Maintenance

- Recommended O&M practices for each measure

Two examples of this section are provided in the following pages.

4.0 Updated Building Documentation

List of the existing building documentation in which updates were made based upon the RCx activities. To the extent possible, relevant, existing building documentation (“as-builts”) should be updated with the RCx improvements and refer to this Report for detailed changes.



An Example of Section 3.0 in the RCx Final Report:

3.1 Measure 3: Restore Operation of Chilled Water Pump VFD

Overview

All of the air handlers and fan coils in Building A are supplied chilled water from the central chilled water plant. CHWP-11 operates 24/7 to supply this flow. This pump is equipped with a VFD, but the VFD is operating in bypass mode. It appears that no control sequence was implemented when the VFD was originally installed.

Although the majority of the air handlers in Building A run on a 9-5 weekday schedule, some fan coils operate 24/7. The control valves for the air handlers and fan coils are three-way valves. The air handlers are controlled by the EMCS, while the fan coils are controlled by local thermostats with no interface to the EMCS.

Due to the motor operating at 100% speed and the three-way control valves on the cooling coils, the difference between the chilled water supply and return temperatures was quite low (average 1.7°F), well below the design 10°F delta T for the chilled water cooling coils.

Measure

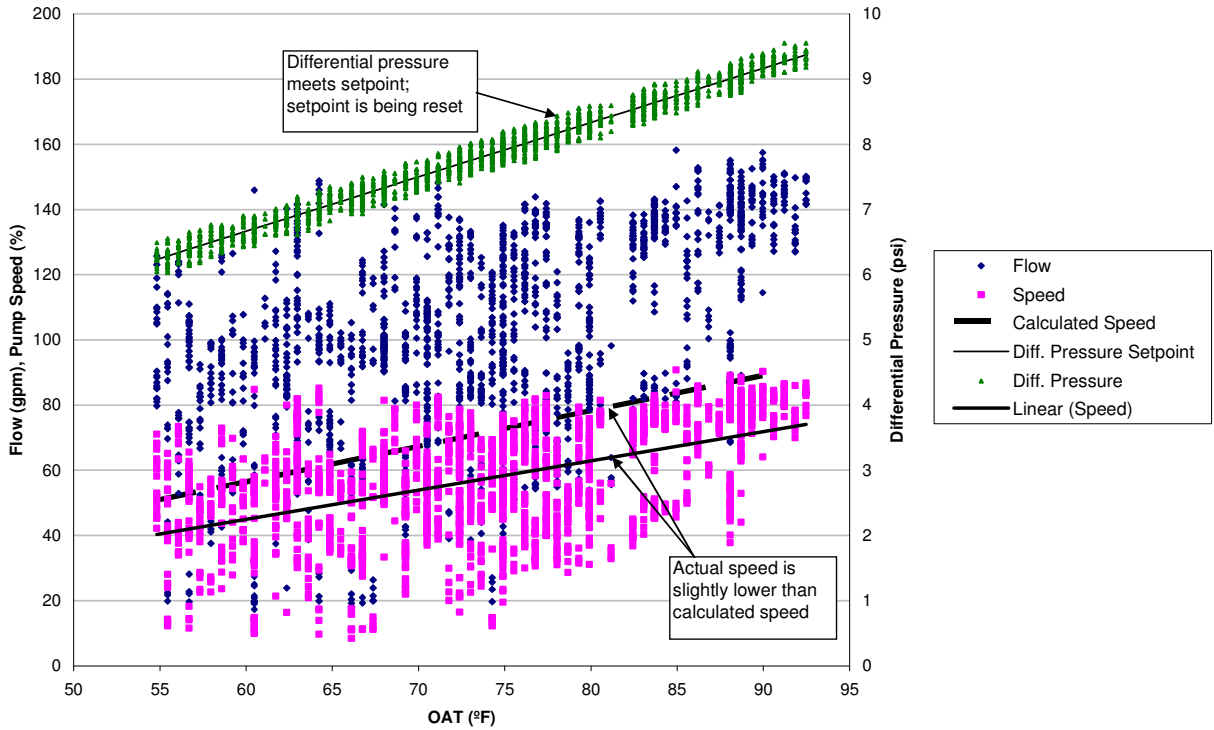
The following work was performed:

1. Pressure sensors were installed in the chilled water piping near the cooling coil for air handler AHU-7, which is near the end of one of the piping loops (i.e., far from the pump).
2. The shutoff valve in the bypass leg of each cooling coil was closed, to convert the system to variable flow (except for the coil at the end of each piping run).
3. The following pump control sequence was implemented: the pump speed modulates to maintain the differential pressure setpoint across the pressure sensors. This setpoint is reset based on outside air temperature (5 psi at 40°F OAT, 10 psi at 100°F OAT).

The following chart shows that the system is operating as expected. The pump speed is modulating to maintain the differential pressure setpoint, the setpoint is being met, and the setpoint is being reset based on OAT.



Follow-Up Trend Data (Post-Implementation)



The implementation information for this measure is summarized in the table below:

Completion Date	February 2007
Implementation Cost	\$4,000
Estimated energy and cost savings	101,610 kWh, or \$5,826
Non-energy impacts	Improved temperature control.
Contact Information for Implementer/ Contractor	XYZ Controls Contracting, Inc. 1234 Oak Street Bonsall, CA Mobile: 691-234-5678 Office: 619-456-7890 contractor@xyz.com

Maintenance and Monitoring

To verify that this measure and its associated energy savings continue to persist, trend data can be collected and analyzed periodically through the EMCS for the points indicated in the previous chart



(pump speed, chilled water flow, differential pressure). The measure is persisting if the pump speeds and differential pressures match those indicated in the above chart. This method of analysis would clearly show if either the VFD or control sequences are bypassed.

The values in the implemented differential pressure setpoint reset strategy (5 psi at 40°F OAT, 10 psi at 100°F OAT) were based on estimates of system performance. These values could be modified for a more aggressive strategy if cooling loads are being met and the cooling coils are always less than 100% open. A more aggressive strategy would lower pump speeds even further.