A Case for Industrial Retrocommissioning

Nathaniel Altfeather, Focus on Energy

ABSTRACT

The concept of retrocommissioning (RCx) commercial buildings has become increasingly visible in the energy efficiency field. Energy programs have capitalized on this opportunity by creating incentives that promote the practice, require implementation of uncovered opportunities, and capture the resulting savings.

Due to the HVAC-focused approach to traditional Building RCx, the industrial sector, where the majority of energy is consumed by process utilities, is generally unserved by these incentives.

This paper explores the application of the retrocommissioning process to industrial systems and shares a cost-effective model for a potential Industrial Compressed Air RCx process and incentive.

Exploring the Definitions of Retrocommissioning

It is very important to have a working understanding of the definitions of the different commissioning terms. The Building Commissioning Association (BCA) is one of the most commonly referred to administrators of an RCx process. The definitions from the BCA website as they apply to building commissioning are as follows.

- **Commissioning**: A quality-oriented process for achieving, verifying, and documenting that the performance of facilities, systems, and assemblies meet defined objectives and criteria.
- **Re-Commissioning**: A (re)application of the commissioning process requirements to a project that has (previously) been delivered using the commissioning process.
- **Retrocommissioning**: The commissioning process applied to an existing facility that was not previously commissioned.

How Is Retrocommissioning Different from an Audit?

The word "audit" has become a generalized term and can refer to a wide range of services or assessments. There are three main differences that separate a typical audit from RCx. These differences include; the goal of the assessment, the intended output from each assessment, and the up front cost to complete each type of assessment.

The goal of RCx is to validate that a system meets specified design criteria while the goal of an audit is to verify that a process is utilizing best practices. It is possible and quite common for a system or process to utilize best practices and at the same time those best practices are not delivering the performance required by the owner. For this reason a key component to any RCx

is the establishment of intended design criteria for the system in question. This is accomplished by either uncovering original design documentation if it is still relevant or developing new criteria based on the owners current needs.

The second difference between a general audit and RCx is the intended output. While a general audit often results in suggestions for more efficient equipment, new controls, or other large investments, the output from a retrocomissioning assessment is intended to be low/no-cost repairs to existing equipment or changes to controls programs that returns the system to intended operating performance.

This example may help illustrate the difference between an audit and RCx.

> *A company that has already installed the latest state of art system with the best controls for energy efficiency may not receive many recommendations from a general audit. However, a commissioning of the same system may uncover that controls were programmed wrong, a sensor is not calibrated, or a piece of equipment installed incorrectly and by addressing these simple items the customer may save significant energy savings by avoiding an improperly operating system.*

The level of effort required to accomplish a RCx assessment is greater than a general audit and requires a greater up front investment. Where an audit maybe performed with a simple walk through and possible spot measurements or gathering of nameplate data, RCx requires data logging and dynamic system function testing. An audit is often provided at little or no cost by equipment providers and usually results in recommendations that require large investments. A RCx has a high up front cost, but usually results in recommendations requiring little or no additional investment.

The Need to Establish Industrial-Specific Retrocomissioning Procedures

In Wisconsin the Focus on Energy program has developed a commercial building RCx program and incentive. To date there have been no applications of this incentive awarded to industrial end users. Industrial end-users that have inquired about the offering are often turned off when they learn that the assessment only focuses on the building HVAC and lighting. These manufacturers are interested in a RCx assessment but they want it to include their major process utilities which are their areas of largest concern.

Upon reading the BCA definitions for commissioning one might naturally conclude that the BCA offers procedures for commissioning any “system” or “assembly” that resides inside of any “facility”. In practice however, the BCA’s procedures are strictly focused on what the BCA refers to as “Building Systems”.

Although the BCA does not explicitly define building systems, a quick review of its Commissioning Process Templates shows that the phrase “building systems” pertains to comfort HVAC, lighting, plumbing, and safety systems. Similarly the 2007 version of Energy Star’s Retrocommissioning guide provides direction only for “lighting”, “supplemental loads”, “distribution system”, and “heating and cooling loads”. As a result, the incentives energy programs have been developed to promote RCx tend to focus on comfort HVAC and lighting exclusively.

From an energy program perspective applying the RCx process to these types of systems is very appropriate in the commercial and institutional sector where the vast majority of energy consumption can be attributed to multi-zone comfort HVAC systems that are all controlled through a building automation system. However this model is less appropriate in manufacturing spaces where comfort HVAC and lighting systems are often less complex, not controlled by a central automation system, and usually account for only a fraction of the overall facilities energy consumption.

Although industrial facilities often have great opportunities for ventilation improvement, most industrial facilities do not have the level of comfort HVAC control or complexity required to find sufficient low/no-cost opportunities to justify a comfort HVAC-only RCx investigation. Also the lack of comfort cooling in many industrial spaces removes a large area of opportunity associated with HVAC commissioning that is enjoyed by most commercial spaces.

The largest opportunity for industrial customers comes from their major process-related utilities that are not covered in the processes defined by organizations like the BCA. Although some energy efficiency programs offer incentives to offset the cost of basic system audits for these utilities, the incentives have historically been too small to sufficiently incent a major investigation like that required in retrocommissioning.

Developing RCx Procedures for the Industrial Sector

There are two requirements in developing Industrial RCx programs for the industrial sector. The first requirement is to decide how to address the more complex industrial facility. The second requirement is to develop the specific RCx investigation activities.

As was explained in an earlier section of this paper, an industrial facility potentially has many large separately-controlled systems within a single facility, making a single Industrial Facility RCx, covering all these system at once, impractical.

It is proposed that the best way to address the RCx needs of the industrial sector would be to follow the commercial building example and focus on systems with multiple components that are centrally controlled, like commercial RCx does with building automation systems. Each of the following systems is often controlled with system specific controller and each system has many interacting components making them good candidates for RCx.

- Steam Systems
- Compressed Air Systems
- Chilled Water Systems
- Pump and Fan systems
- Process Ventilation Systems

The incentives and associated commissioning protocol should be titled in such a way as to distinguish them from commercial building RCx. A proposed nomenclature might be Industrial Compressed Air RCx, or Industrial Steam System RCx and so on.

A Proposed Compressed Air RCx Model

The macro-level procedure for RCx is well defined and can be transferred to industrial utilities without much adjustment. The following is a brief overview of that process following closely with what Wisconsin's Focus on Energy already uses for commercial building RCx.

Pre-Investigation Meeting

This initial meeting is used to discuss the owner's needs from the particular system and develop the performance criteria against which the system will be tested. Following the meeting it is important to verify that any assumptions the owner uses in establishing the criteria be verified. For example the owner might believe a process requires a certain air quality level, but this specification may be an artifact of past operations.

Develop System Schematic

Once the performance criteria are established and verified, the investigation continues by developing a complete understanding of the system. It is required as part of the proposed model that the investigator develop a basic schematic with all important control points identified.

Recording of all OEM Performance Data

Each individual piece of equipment in the system needs to be documented along with corresponding nameplate performance data. During the investigation, field tests will be performed to ensure that this equipment is performing

Sensor Testing

It is necessary to verify that sensors used by control system are functioning as the controls system itself will be used to verify that the system operates correctly.

System Investigation

At this stage of the RCx process the investigator will perform tests to verify that each individual piece of equipment in the compressed air system is performing as indicated on the equipment name plate and that the system as a whole is delivering the owner-specified performance as documented in the first step of the process.

Focus on Energy's Proposed Industrial Compressed Air RCx Incentive

The majority of existing RCx incentives is designed to cover some portion of the planning and investigation phases of the process. A requirement for the incentive is for a promise from the system owner to implement some amount of identified measures agreed upon in advance. A summary of existing commercial RCx strategies can be found in Thorne and Nadel's 2003 ACEEE paper *Retrocomissioning: Program Strategies to Capture Energy Savings in Existing Buildings*.

By making a promise from the system's owner to implement uncovered measures a condition of eligibility for the incentive, programs can take into account claimable energy

savings when developing incentives. Focus on Energy previously offered a $4/hp Compressed Air System Audit incentive, but because the audit itself did not result in any savings, the program was only able to justify a small incentive that did not move the market sufficiently. But with the RCx incentive model, savings are generated which allows Focus on Energy to propose a significantly large incentive.

Focus on Energy's proposed RCx incentive offers $15 per non-back up hp to cover the cost of the RCx investigation in return for a commitment from the system owner to implement all identified measures that have less than a 1 year payback or spend at least $15/hp towards implementing those measures. The following requirements are also included to limit applicants to those whose systems will have the greatest opportunity for cost effect RCx benefits.

Incentive Eligibility Requirements

- Systems must have at least 200 hp (not including back up)
- System must be at least 5 years old
- System cannot have had a leak audit performed in the past year
- Systems must operate at least 2 shifts 5 days per week (approx. 4000 hrs/yr)

The incentive is designed to cover a significant portion, if not all, of the cost of the RCx investigation for larger compressed air systems. This is intended to help move those larger systems that have a greater likelihood of significant savings from the type of issues that can be uncovered in a RCx investigation.

Developing the Investigation Requirements

When developing the investigation requirements for an RCx assessment it is best to start with a recognized standard for a comprehensive optimization-type assessment and add the appropriate components for RCx.

Focus on Energy used information from both the Compressed Air Challenge and the ASME EA-4-2008 Draft guidelines for Assessment of Compressed Air Systems to develop the requirements for qualifying RCx investigations.

Potential Savings Estimates

Determining the savings resulting from a RCx investigation is a challenge due to the relative scarcity of average energy-related data on low/no-cost repairs for compressed air systems. Rather than spend too much time theorizing it seems most cost-effective from a program point of view to offer a pilot program with a limited number of awards and utilize the resulting data to confirm a more solid savings estimate to design future offerings around. For the initial pilot design one can, at a minimum, estimate savings from some common problems that RCx should address on most systems.

The DOE says leakage accounting for up to 20% of a system's horsepower is not uncommon. Other common problems with compressed air systems such as broken humidity sensors in cycling dryers and failed compressors controls could account for another 5% savings

on average. If one assumes a system load factor is 65% the above savings represent approximately 15% of nameplate compressor power as a possible average savings if each of these identified items is addressed.

Because the concept of retroactively commissioning compressed air systems is so new it is important to develop incentives based on conservative saving estimates. For that reason the remainder of the paper will assume a typical RCx investigation can reasonably be expected to produce 5% of nameplate horsepower savings.

The program value, using custom incentive rates, of the savings resulting from 5% nameplate horsepower reduction over 4000 hrs of annual runtime is just over $16 making the $15/hp incentive cost effective to the Focus on Energy program if the 5% savings assumption proves accurate.

Moving the Incentive to Market

The incentive is designed to be service provider-driven because many compressed air service providers know which customer's systems suffer from continual problems and would make good candidates for the comprehensive investigation provided by a RCx investigation.

Focus on Energy shared the proposed Industrial Compressed Air RCx incentive with Wisconsin's larger compressed air service providers. Overall feedback was positive with many service providers sharing excitement at an opportunity to simulate activity in an otherwise very tight economic time.

The main concern shared by vendors is the potential reluctance of customers to enter into an agreement to implement measures that the investigation identifies.

Service providers must first fill out a pre-qualification questionnaire to seek pre-approval to proceed with an RCx investigation of a customer's system. This questionnaire gives the program the ability to screen for systems that are good RCx candidates and prevent awarding incentives to customers whose systems are unlikely to provide much savings.

Good candidate systems are those with:

- High levels of air treatment
- Very large systems
- Very old systems
- Systems that have changed uses significantly since they were first designed.

Summary

The RCx model could provide a much needed dose of cost-effective innovation in the industrial energy efficiency sector. Many industrial process utility systems provide the same characteristics as commercial BAS that make good candidates for achieving energy savings through an RCx process. If savings estimates in this paper prove accurate, industrial RCx could provide a large untapped resource for programs looking for cost effective savings from industrial customers.

References

[BCA] Building Commissioning Association, Process Templates. www.bcxa.org/resources/templates/index.htm

[DPE] Department of Energy. Compressed Air Tip Sheet #3 2004. www1.eere.energy.gov/industry/bestpractices/pdfs/compressed_air3.pdf

Wisconsin Focus on Energy. Retrocommissioning Service Provider Manual. www.focusonenergy.com/Business/Commercial-Business/Retro/RCx.aspx