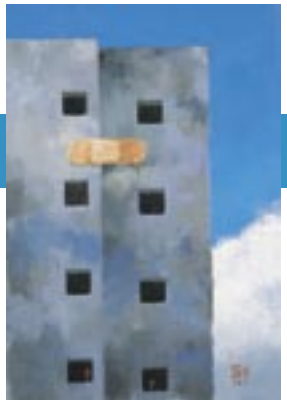

Retrocommissioning

By Stephen R. Wiggins

Many groups in the facilities industry are becoming aware of the greatest potential of the commissioning revolution—retrocommissioning. Retrocommissioning is the systematic process by which owners ensure that their buildings and their systems are optimized to perform interactively to meet the current operational needs as closely as possible. This process may include remedial design and construction to accomplish this goal.

A number of reasons exist for implementing a retrocommissioning project in a facility. Among these reasons, the most popular are:

- The facility is not providing a proper work environment;
- Indoor air quality issues have arisen;
- Mold;
- Energy costs are too high for the facility; and
- Purchasing/selling the facility.

In poorly performing facilities, loss of productivity by employees frequently has been estimated in excess of energy costs by a factor greater than eight. However, energy savings alone, in a facility that has been properly retrocommissioned, will typically pay back the cost of the retrocommissioning in less than three years. Few, if any, properly working facilities exist, and this should be the primary goal of retrocommissioning—making them work. Energy savings simply is a tool used in achieving that goal. You cannot "save" energy; you can only waste it or use it efficiently to achieve your goals.

The 1999 Commercial Buildings Energy Consumption Survey[1] contains energy data for 67.3 billion ft² (6.25 billion m²) of commercial facilities. These facilities, according to the survey, consumed 5,700 MMBtu (6 GJ) of all major fuels.[1] The majority of these facilities were not originally commissioned and are not operating at their expected level of efficiency. Through retrocommissioning, the overall energy use in most of these facilities easily could be reduced by 10%. Our experience indicates that significant energy "savings" has been achieved in the facilities that have gone through this

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process except for one. That particular facility had unique systems, and all of the outside air intakes were blocked off. Once the facility was properly set up, energy use increased. Factoring in the energy "savings," retrocommissioning can be the most economical tool in proper facility management.

As with new building commissioning, the U.S. Green Building Council (USGBC) started a program certifying existing facilities that provide safe and efficient working environments for occupants. This program is called LEED® Green Building Rating System for Existing Buildings (LEED-EB). Having the facility retro-commissioned is a prerequisite. As the USGBC has recognized, a facility must be systematically tested and set up to ensure its efficiency and safe operation. More information regarding this program can be found at www.usgbc.org.

The goals for retrocommissioning vs. those of commissioning vary. The aim of new facility commissioning should be a 100% perfect operating facility that meets the owner's design intents. However, with retrocommissioning the goal is not always a 100% perfect facility. Many times, the existing facility will not meet the current operating goals of the occupants. In these cases, a cost vs. payback analysis is performed to determine the intensity of remedial repairs.

The retrocommissioning process typically will raise a facility's operating efficiency above the 90-percentile mark with little to no extra remedial cost. The final 10% varies drastically from facility to facility.

A recent project in a six-story research/teaching laboratory required a $1.5 million remedial construction project to meet proper operating criteria. Another project in a four-story multiuse facility that contained a special collections library, two floors of research laboratories and other varied uses only required $50,000 of remedial repairs executed during the retrocommissioning project. Approximately 95% of our retrocommissioning projects have required no additional remedial work to meet the owners' current expectations.

The process of retrocommissioning begins with the development of the retrocommissioning plan. This plan should include identification of the team members, their roles and responsibilities. The team members, at a minimum, should include individuals from the facility maintenance staff and the retrocommissioning authority. As the scope of work for each project varies, some projects will include only HVAC and controls. Others will include a variety of systems such as electrical, elevators, exterior walls, waterproofing, plumbing and roofs. The composition of the team will vary. Newcomb & Boyd's experience in retrocommissioning in regard to systems included in project scopes is reflected in *Table 1*.

Some retrocommissioning providers have extensive in-house capabilities while others specialize in one area such as HVAC. Our in-house capabilities, for example, include HVAC; controls; testing, adjusting and balancing (TAB); electrical; fire alarm; life safety; audio-visual; communications; noise; and vibration. On HVAC and controls projects, the team may include the maintenance staff and the retrocommissioning authority alone, or according to the retrocommissioning authority's capabilities may include a controls vendor and TAB firm.

On more complex projects, the team easily may include 10 to 12 members. Each team member's role and responsibilities need to be clearly defined in the retrocommissioning plan. The team should always include at least one member of the maintenance team responsible for operating the facility. If not, all of the benefits gained through the retrocommissioning process can be lost within months after the completion of the project.

The development and distribution of the retrocommissioning plan is followed by a detailed examination of the original construction documents and the documents from any renovations that may have occurred during the life of the facility. These documents should be reviewed to determine the original basis of design, flexibility of the design, type of systems, capabilities of systems, and any unique usage areas.

For many of these existing facilities, original construction documents do not exist. In these cases, part of the discovery phase of the process is composed of determining systems capability and flexibility. As-built documents should also be produced as part of the retrocommissioning process. The utility use history of the facility should also be reviewed; if the project is to be submitted for LEED-EB, one year of energy use records will be required. This may, in some cases, require the installation of meters or data recorders months prior to the site investigation phase.

Following the review of existing documents, the facility maintenance staff should be interviewed. In preparing for these interviews, the maintenance records for the facility during the past year should be reviewed. This provides the interviewer with specific questions regarding the operation of the building systems.

These interviews will be useful in determining the condition of the existing systems, uncovering persistent problems that occur, and showing any possible "corrections" that may have been implemented since initial occupancy. An additional benefit of the interviewing process is that, many times, "areas of training" needs for the staff will be discovered and addressed during the retrocommissioning process. No classroom training can compare to the benefits found during the retrocommissioning process.

Similar interviews should be conducted with the occupants of the facility. These interviews are best conducted by areas of use. For example, if a facility has administration, laboratory and scientific library areas, then interviews with management representatives from each area is critical. Each area interview should be conducted separately. If held together, valuable information will be missed due to cross talk. The retrocommissioning authority should document all comments made during the interviews, and each comment will need to be addressed in the final report.

While both the maintenance and occupant interviews are always valuable in terms of information, the information gathered should not affect the retrocommissioning plan. The retrocommissioning process is systematic. To be successful, all steps must be followed sequentially.

The steps that need to be executed during the site visit are as follows:

- Trends of the facility variables such as temperature and humidity should be set up and launched for further analysis. If the facility controls system is used for this, it must be calibrated first. Trends of utility use, such as electrical, gas, steam and domestic water should be launched;
- Trends of equipment states such as on/off, cycle time and total runtime for direct expansion compressors should be set up and launched;
- Survey the facility for current occupancy levels and space utilization;
- Survey the physical condition of the equipment and systems included in the scope of the project;
- Survey the facility for air and water flow rates;
- Survey the facility for control system device calibration;
- Survey the temperature, humidity, lighting levels and CO_2 levels; and
- Perform a point-to-point test of the controls systems.

System	Percentage of Projects
HVAC	100%
Controls	100%
Testing, Adjusting and Balancing (TAB)	100%
Electrical (Normal and Emergency Systems)	10%
Plumbing	5%
Elevators	5%
Fire Alarm/Life Safety	5%
Security	2%
Structural	2%
Exterior Walls	5%
Roofs	5%

Table 1: System frequency.

At the completion of the site visit, the discovery phase report will be produced into one step. This report details the findings of the site visit. It provides recommendations on how to correct the identified deficiencies and presents a cost estimate for each recommendation. Many retrocommissioning providers combine the site visit and discovery phase into one product. Any "quick fixes" such as TAB work, controls system calibration, writing corrected sequences of operation, reprogramming control devices, and minor systems upgrades are executed as part of the site visit. It is our experience that, during the majority of retrocommissioning projects, the facility can be brought up to acceptable standards by the retrocommissioning team. This results in immediate occupant satisfaction and reduced payback times.

If serious items are found or if the facility use has drastically changed, a remedial design may be necessary. A design professional that works directly for the retrocommissioning authority should execute the remedial design.

The designer may develop design approaches that differ from the recommendation of the retrocommissioning authority, and these differences will need to be evaluated. If any of these approaches are deemed beneficial by the retrocommissioning team, they should be incorporated into the new design. As with any new design, the retrocommissioning authority should review the design for commissionability, maintainability, and best application.

Oftentimes during the procurement of the construction, the owner will contract for the services of the retrocommissioning authority. The retrocommissioning authority may be tasked with reviewing the proposals for completeness to determine if the contractors have a thorough understanding of the project, as well as to verify that the contractor has made allowances for any special conditions such as ensuring the facility continues to operate during the construction process.

After the construction contract has been awarded, the retrocommissioning authority may be contracted to perform commissioning on the new project with the goal of verifying that the new project brings the facility into compliance with the owner's operating intent.

If these steps are properly implemented and the recommended corrective actions taken, the facility will operate to a level of satisfaction for the owner and occupants.

Author's Note

This article is intended to be introductory in nature. A more detailed explanation of the process for owners and providers will be presented at the 13th National Conference on Building Commissioning. Information can be found at www.PECI.org or e-mail ncbc@peci.org. The National Environmental Balancing Bureau presents a two-and-a-half-day seminar on retrocommissioning biannually. Information can be found at www.NEBB.org.

References

1. Energy Information Administration. 1999. Commercial Buildings Energy Consumption Survey.