Targeting Energy Savings With Retrocommissioning

Analyzing buildings, identifying problems, and defining solutions

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When a building is in the planning phase, the goal of the owner and design team is to select equipment that will closely match the needs of the facility, taking into account the building's occupants, the activities taking place inside of the building, and the operating conditions surrounding the building. The hope is that equipment will perform to expectations and, in the rare cases it does not, the facility staff will detect any problems and take the appropriate action.

As typically happens, buildings plans are modified, construction schedules get compressed, equipment orders change, installation problems arise, and the expertise required to detect and correct problems proves insufficient. As a result, buildings often underperform in terms of efficiency. Although this is not a new problem, it is taking on new meaning, as building owners increasingly focus on sustainability and cost-containment issues. Now more than ever, building performance, particularly as it relates to energy efficiency, is front and center.

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In response, building owners are turning to the commissioning process to verify that a facility and all of its systems, components, and assemblies can be operated and maintained to meet health, productivity, sustainability, and financial goals. In short, commissioning ensures a building and its systems are operating efficiently and as specified by the owner's project requirements.

Commissioning Anytime, Anyplace

A building can undergo commissioning at any time during its life cycle or, in the case of ongoing commissioning, throughout its life. Ongoing commissioning is a continuation of the commissioning process intended to verify whether a building continues to meet current facility requirements (CFR). This process includes a number of procedures that occur at various times during a building's life cycle—some continuously and others as needed. With the advancement of smart building controls, ongoing commissioning can be performed from a remote operations center providing 24/7 monitoring of building equipment and systems. Commissioned systems monitored in this fashion provide the greatest opportunity for persistence in optimized operation and sustained avoidance of increased energy costs.

Recommissioning, which pertains to buildings that were commissioned during original construction or went through a retrocommissioning (RCx) process, can be a valuable tool when building use changes or new performance codes or objectives are identified. The process may be scheduled as part of ongoing commissioning or triggered by operational and/or maintenance problems and comfort complaints.

Owners of existing structures not previously commissioned have two options:

- If faced with significant issues, such as poor indoor-air quality (IAQ), comfort complaints, frequent repairs, and increased energy use, owners may consider enlisting the help of a commissioning authority to conduct existing-building commissioning (EBCx). EBCx involves the systematic investigation, analysis, and optimization of building-system performance through the identification and implementation of low/no-cost and capital-intensive facility-improvement measures. Based on

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CFR and customer goals, parts of systems or all systems, including HVAC, controls, lighting, electrical, plumbing, safety, and envelope, could be involved in the process. The goal is to make building systems perform interactively to meet CFR and provide processes to support the continuous improvement of system performance over time.

• When the focus is limited to energy savings in an existing building, the more narrowly scoped RCx process makes sense. Many utilities across the country offer incentive/rebate programs for energy-focused RCx.

Although the RCx process can be expanded to include other building systems, such as electrical, envelope, and plumbing, the process looks primarily at HVAC and control systems to help resolve the most common issues of energy and comfort. Buildings for which space-utilization or performance requirements have changed also can benefit from the RCx process.

Six Phases of RCx

The National Environmental Balancing Bureau identifies six phases of RCx:

• *Contract.* In this first phase, a walkthrough is conducted to determine the general condition of a facility and the level of complexity of its mechanical systems. Details relative to access and construction, including the age and type of equipment, are observed. With respect to the HVAC system, critical operational components, such as dampers, valves, and actuators; variable-frequency drives; and the position of balancing valves on pumps, are observed. Problems associated with deferred maintenance, poor building pressurization, and the like also are on the radar screen. A cursory review of the building automation system (BAS) is performed to gain a general understanding of basic control parameters and operating schedules. The process also includes general interviews with management and the development of a project proposal.

• *Pre-site investigation.* The RCx team reviews construction drawings and specifications, trend data from the BAS, operation and maintenance manuals, test-and-balance reports, utility bills, maintenance records, and repair and replacement orders. The goal is to gain a better understanding of the original design intent and owner requirements, while differentiating between submitted and installed equipment, analyzing energy use, and establishing operating baselines. Detailed interviews with management, the maintenance staff, and building occupants uncover patterns in building operation. The goal of the interview process is to identify operational issues that need to be investigated during the next (site investigation) phase. A CFR document that will be updated as the project advances through the RCx process is developed. Additionally, a RCx plan to guide the site-investigation phase is developed.

• *Site investigation.* The RCx team uses findings from the previous two phases to develop a field-testing plan. Using the CFR, along with information gleaned from the interview process, as a guide, the team conducts a more detailed investigation of the building, looking for issues resulting from installation defects, deferred maintenance, control problems, and building-pressurization problems. Quick fixes are made, with hands-on training provided to the maintenance staff.

• *Analysis.* Data recorded during the site-investigation phase are used to define problems and identify solutions. After any additional testing is completed, the RCx team presents a

corrective-action report, including estimates of costs of implementing solutions and any energy/operational savings that will result, to the owner. After studying and prioritizing the recommended solutions, the owner determines the corrective actions that will be taken.

• *Corrective action.* Corrective actions can range from control-programming changes to capital projects, such as mechanical-equipment replacement. All corrective actions must be commissioned to verify their effectiveness in achieving desired results. The commissioning performed during this phase is similar to that performed during new construction.

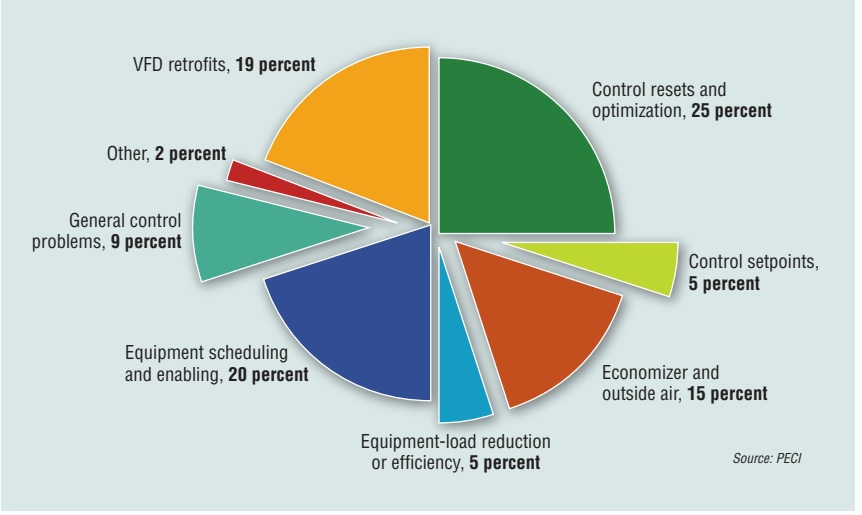
• *Followup.* During this phase, a facility's performance after corrective actions have been taken is verified, and an ongoing commissioning plan is developed. With many building owners expecting RCx projects to pay for themselves through energy savings, the verification of energy-cost reduction is one of the most important issues for RCx teams. Depending on the owner's requirements, a measurement-and-verification (M&V) plan may be required to demonstrate that energy savings were achieved. Final activities include conducting a lessons-learned workshop to improve the delivery of future projects and document any off-season testing that may be required.

Before the RCx process begins, it is important to secure commitment and support from management, along with buy-in from the building staff and, where applicable, cooperation from tenants. Throughout the process, communication is important to ensuring the RCx team has a clear understanding of the building owner's needs and concerns.

Benchmarking

Benchmarking plays a significant role in determining whether a building is a good candidate for energy-focused RCx. Benchmarking requires submetered data that identify a building's energy consumption per square foot. This data can be used in dashboards to show building performance before and after the RCx process. Cloud-based monitoring platforms are making it easier and more economical for building owners to not only create dashboards, but have a M&V process that follows the International Performance Measurement and Verification Protocol (IPMVP).

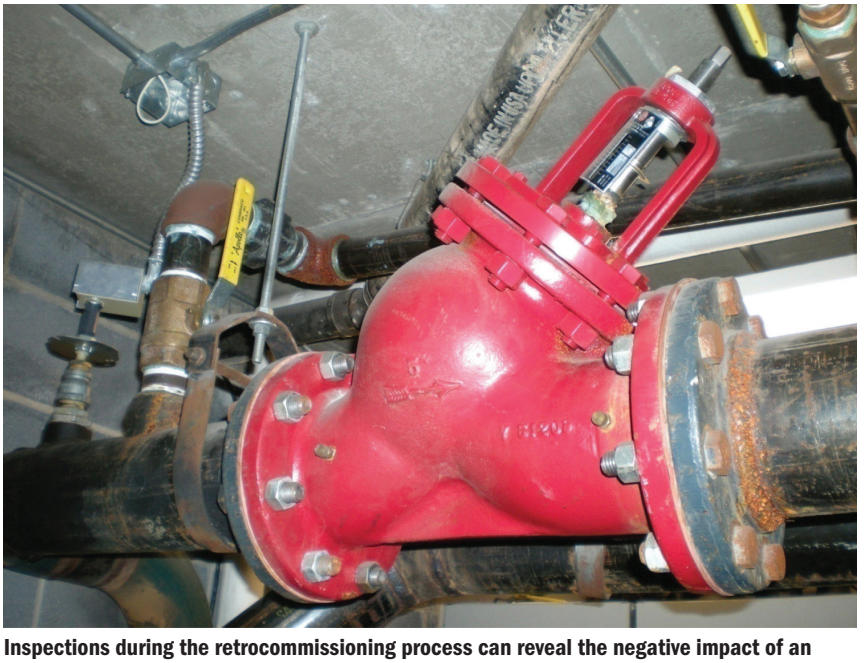
The building owner who opts to engage in RCx can anticipate lower operating costs and reduced energy consumption. The process also minimizes breakdowns, reduces repairs and associated costs, and increases the life expectancy of assets, even as optimization strategies produce improved IAQ and comfort.



Cost savings by finding type. Results show most savings relate to controls.

Getting to the Root of a Problem

RCx directly addresses the root causes, rather than the symptoms, of problems, ensures that a build-



Inspections during the retrocommissioning process can reveal the negative impact of an oversized pump: excessive throttling on the triple-duty valve.

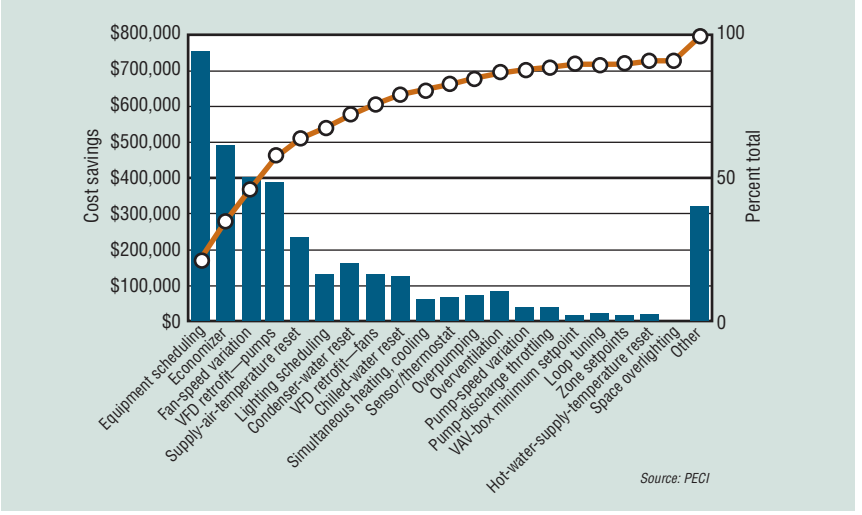
ing meets the CFR as closely as possible, and aligns strategic business goals and objectives with facility operations/infrastructure. At the same time, it assists in achieving Leadership in Energy and Environmental Design for Existing Buildings: Operations & Maintenance certification and can improve a building's ENERGY STAR rating.

Training is key to the success of RCx. Throughout the process, a building staff needs to be engaged and trained—not only in the proper operation of building equipment and systems, but in any corrective action that is implemented. The process may reveal that employees were not trained adequately in building operations when the facility was turned over to them. As a result, the potential for energy savings may exist, but operators are unaware of how to achieve and maintain performance. In such a case, the RCx process will identify the level of training required.

It is important to provide training with respect to any changes made as a result of RCx. Owners and operators need to understand why control sequences are modified and fixed setpoints they are used to seeing are now resetting automatically as building load changes. A solid ongoing commissioning and training plan will help building operators adhere to corrective actions and maintain performance.

What Makes a Good RCx Authority

In looking for a RCx authority, building owners should consider experience, certification, and the ability to understand not only the engineering side of the process, but the operational side—someone with the expertise to go into the field, identify problems, and recommend and take appropriate corrective measures; someone who can create an actionable report with measures that can be accomplished within a realistic budget; someone whose skills match the goals and scope of the project; and, in some cases, someone who will guarantee savings calculated as part of the RCx process.



Cost savings by measure.

Every building has needs specific to it, its occupants, and the work that goes on inside. By listening and asking the right questions, a provider can discern those needs. The goal of a RCx provider is to help his or her customer achieve whatever is important to the customer's core business objectives and goals. RCx is not a cookie-cutter process. It is tailored to a building, and when properly conducted by a reputable and experienced provider, it can optimize how systems and equipment operate and function together for improved building performance and energy savings.

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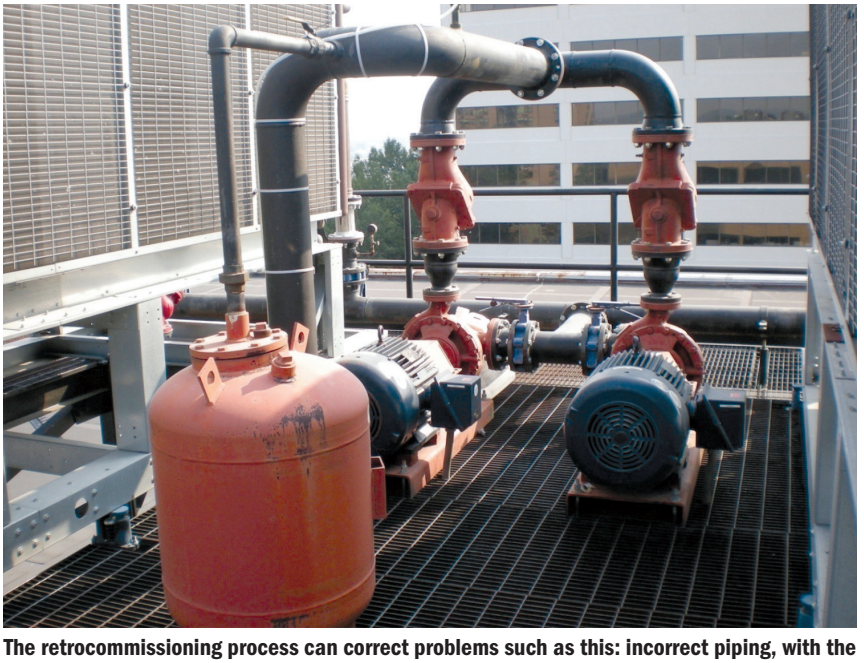

The retrocommissioning process can correct problems such as this: incorrect piping, with the expansion tank on the discharge side of pumps.