## Technical vs. Process Commissioning

# Ongoing Commissioning

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The previous eight articles in this series provided a framework to commission new projects starting with helping the owner develop an owner's project requirement (OPR) document, reviewing the design, the construction process through field installation verifications (FIV), operational performance tests (OPT) and the final functional performance tests to prove the building is working. We have a great project. The owners and contractors are both happy. Everyone sees the benefits:

- Increased comfort, fewer occupancy temperature complaints;
- Fewer service/trouble calls from building systems, improved reliability;
- Reduced energy costs;
- Better trained operations and maintenance staff; and
- Enhanced building and system(s) documentation.

At the point where everyone is patting themselves on the back for a job well done, the owner makes the comment. "OK, we have a great building, and it's working as intended. We're all happy campers. What do we do to keep the building in this brand new condition and operating properly?"

This is the last in a series of articles that explain the technical commissioning process for new buildings. Some of these articles' content is derived from *ASHRAE Guideline 0-2005, The Commissioning Process* (published 2005) and the National Environmental Balancing Bureau (NEBB) publication *Procedural Standards for Whole Building Systems Technical Commissioning for New Construction* (revised April 2013).

The answer to that question is the rationale for this article. The industry calls this process ongoing commissioning.

An ongoing commissioning (OCx) program provides the framework to maintain the persistence of building performance over the life of the facility, while providing a method to continually improve building performance. Without an OCx program, building performance degrades over time. Performance degradation inevitably occurs due to slippage in performance at the component, equipment, subsystem and system level. "Most buildings will lose up to 30% of their energy efficiency in the first three years of operation" (based upon a Texas A&M study).

Degradation is due to a multitude of possible faults: manual overrides of reset schedules, leaking control valves, inoperable economizers and deferred maintenance issues. Even when a building is set up and operating efficiently when originally constructed or

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remodeled, without an OCx effort in place to maintain a high level of performance, system performance will degrade over time.

For an OCx program to be successful, it is imperative that first, the building be properly commissioned. Whether the building is new or existing, the systems that serve the building must be operating correctly and efficiently. OCx should be the final phase of either a commissioning event of a new or existing building.

The goal of an OCx program monitors building performance, and identifies degradation as early as possible. The actual method used to identify degradation varies widely, from manual site visits, to real-time automated fault detection and diagnosis (AFDD). Additionally, OCx provides the building operators with a continuous program which allows them to monitor and adjust building operating parameters to fine-tune how equipment and systems operate. The fine-tuning and continuous monitoring of building systems is one of the best-kept secrets of an OCx program.

## Ongoing Commissioning Overview

When a commissioning event is completed for either a new or existing building, the final phase is ongoing commissioning. OCx is a process that occurs after a building has successfully been commissioned. To that point, the OCx process will help identify issues such as the unforeseen need for additional off-season testing, and control sequences that may require fine-tuning over a wider range of varying load conditions that were not seen during the normal commissioning process. Depending upon the project requirements, the OCx program will monitor building performance at the necessary level (component, equipment, subsystem or system).

There are multiple methods to implement an OCx program. At the most basic level, a scheduled onsite visit is made to manually review the performance of building systems. This manual process typically includes reviewing items such as BAS trend data, setpoints and utility data. Interviews with the facility operations team are also performed to understand how the systems have operated, and to help identify potential problem areas that may require further investigation.

ASHRAE's *Performance Measurement Protocols for Commercial Buildings* (PMP) is an excellent resource for customers who are looking for a cost-effective OCx program.

The next level of OCx generally includes some type of remote connection, such as a virtual private network (VPN) of the BAS. This allows the commissioning engineer to remotely access trends, saving travel time to distant sites. BAS data may also be imported into other analysis tools to help identify potential faults and problem areas. Virtually all BAS vendors today offer web-based access to a facility control system, only requiring an internet connection, IP address and the required passwords to access the control system real-time. Historical trend data can be viewed and analyzed.

A cloud-based platform that can provide continuous automated fault detection & diagnostics (AFDD) takes technology even further. Fault detection is the recognition of undesirable abnormalities occurring in equipment, systems, spaces, and/or buildings. Fault diagnostics is the isolation of a root cause of a problem. With AFDD, everything is a question/answer scenario. The detection and diagnostic process features automated software that asks a rules-based question, then runs data control points through algorithms to detect, and then diagnose faults.

ASHRAE defines ongoing commissioning as: "A continuation of the Commissioning Process well into the Occupancy and Operations phase to verify that a facility continues to meet current and evolving Current Facility Requirement (CFR) (OPR for new construction). Ongoing commissioning process activities occur throughout the life of the facility; some of these will be close to continuous in implementation, and others will be either scheduled or unscheduled (as needed)."

ASHRAE Guideline 0.2, *The Commissioning Process of Existing Buildings and Assemblies,* is expected to be published later this year. The last step of GL 0.2 includes an ongoing commissioning phase. The main activities in the OCx Phase of GL 0.2 are:

- Assemble the OCx Team;
- Update the OCx Plan;
- Verify achievement of current facility requirements;
- Investigate unacceptable performance or outcome;
- Implement corrective actions;
- Update systems manual;
- Update facility personnel training;
- Write/deliver OCx report; and
- Obtain owners acceptance.

## Develop the OCx Plan

The OCx plan is developed during the commissioning process for new buildings, and during the existing building commissioning (EBCx) process for existing buildings. The OCx plan should explain what equipment and systems will be included, what measurements and monitoring/trending will be performed to document building performance, how data will be analyzed and how identified problems will be corrected.

The OCx plan should: address how to maintain the OPR that was achieved during commissioning a new building, or how to maintain the CFR that was achieved during commissioning existing buildings; address areas such as the reduction of energy, enhancements in facility operations, maintenance procedures and occupant satisfaction. The OCx plan should evolve with the building and any changes that are made to the CFR. Always answer the question: how do we maintain the CFR while improving building performance over time.



## Assemble the OCx Team

Ownership is a key attribute to a successful OCx program, so it is critical to have a team that is responsible for executing the OCx Plan. The team members will vary depending on each facility, and can consist of any combination of individuals such as the owners, operations and maintenance staff, outside service contractors, outside controls contractors or commissioning professionals. The level of monitoring and analysis required by the OCx Plan, coupled with the available internal resources that each facility has, will drive the overall team makeup.

## Update the OCx Plan

Once a new building is turned over to an owner, the building becomes an existing building. The OCx Plan is a living document that will evolve over the life of a facility. The plan which was developed earlier in the commissioning process (either new or existing building commissioning), should be updated to make sure that all operating parameters to

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be tracked and assessed are still appropriate, and determine what metrics will be used to track performance over time.

## Verify Achievement of Current Facility Requirements

Initially, the OCx process will verify that the acceptable performance defined in the OCx plan is being achieved. That process can range from manual viewing of trend data, to FDD systems, reviewing comfort complaint/trouble calls and internal surveys of building occupants. Based on the results from the verification process, building operators will discover issues and investigate changes to get back on track to achieve the CFR, while often further improving the level of building performance.

When energy monitoring and tracking is part of the OCx plan, then a formal measurement and verification (M&V) plan should be part of the OCx plan.



## Investigate Unacceptable Performance or Outcome

When unacceptable performance is identified, such as temperature or relative humidity setpoints that are not maintained, the cause of the performance degradation must be determined so that a resolution to the problem can be established. It is important to identify the root cause of unacceptable performance so that the true issue is identified and resolved. Symptoms can lead the commissioning professional to the root cause; however, it is critically important not to get sidetracked by treating symptoms, but to focus on identifying the root cause of the problem.

Three examples using trends to investigate unacceptable performance are shown in *Figures 1* through *3*. *Figure 1* shows that a change was made to a control system that disabled a condenser water reset control sequence for a water cooled chiller. Instead of the condenser water supply (leaving the cooling tower) resetting based on the ambient air wet-bulb temperature, a fixed setpoint of 65°F (18°C) was overridden, thus eliminating the potential energy

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savings that could be achieved if the reset strategy was left enabled.

*Figure 2* shows a three-week period of an AHU that has a discharge air temperature of 50°F (10°C), when the original design for the area served only required a 55°F (10°C) discharge air temperature. Further investigation determined that a problem with the integrity of the building envelope created an excess moisture load in the summer months, forcing the O&M staff to reduce the discharge air temperature in order to control the dew-point temperature in the occupied space.

*Figure 3* shows an AHU with simultaneous heating and cooling occurring. Trends such as this do not always indicate what the exact problem is, only that there is a problem that requires further investigation to identify the root cause of the problem.

## Implement Corrective Actions

Once the root cause of the problem has been identified, then the corrective action needs to be implemented. Facilities that have been properly commissioned typically do not require corrective actions of a significant magnitude. Typical corrective actions can range from minor repair items, additional operator training to setpoint adjustments or minor control programming modifications.

## Update Systems Manual

As the OCx plan is managed and the work executed, changes will be made to the original equipment and or building systems. The systems manual should be updated at regular intervals to document the changes to establish a single point of reference material for the operations and maintenance staff. The systems manual is a valuable resource to develop in-house training programs for current and future operations and maintenance staff.

## Update Facility Personnel Training

As a facility evolves over time, O&M staff turnover is inevitable. Keeping the O&M staff trained is critical to the success of the OCx program. Staff training should be updated as required to address the needs of new individuals that are either part of the OCx team, or play a supporting role to the team. If new equipment or systems are added to the facility, than training should be updated to reflect the requirements of the added facility infrastructure.

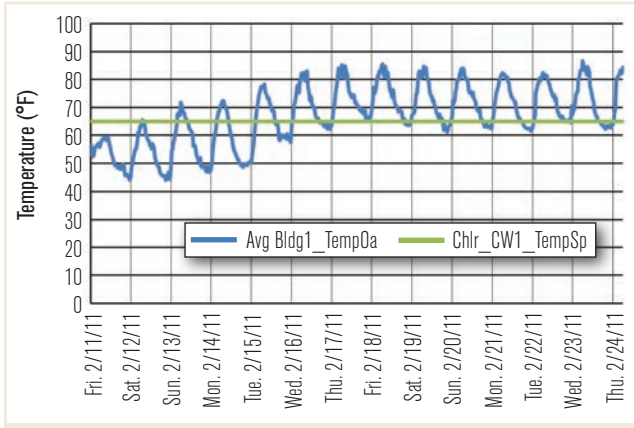


FIGURE 1 Trend indicating an opportunity to reset the entering condenser water temperature.

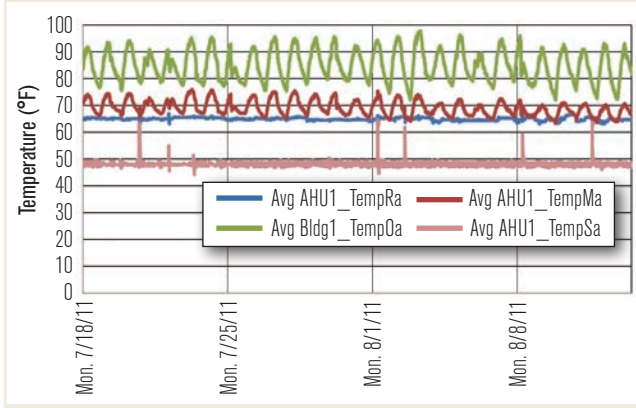


FIGURE 2 Trend indicating a 50°F discharge air temperature on an AHU, when the original design was 50°F.

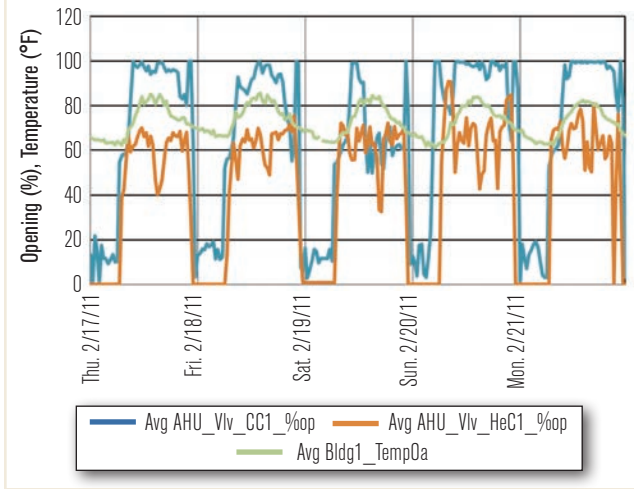


FIGURE 3 Trend showing an AHU with simultaneous heating and cooling occurring.

## Write/Deliver OCx Report

The OCx report is used to document at regular intervals the performance of the facility and success of the OCx program.The report also provides documentation

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of how well the building O&M staff performs their jobs. To a large degree, success of any OCx program rests with the O&M staff. As stated earlier in this article, ownership by the O&M staff is critical.

When an M&V Plan is part of the OCx plan, then results from the M&V plan should be included in the OCx report. The M&V plan should have a description of the M&V Report structure.

The OCx report should be submitted at specified interval (e.g., monthly, quarterly, semi-annually or annually). Either monthly or quarterly reporting is typical. When energy is a metric that is monitored in the OCx plan, it makes sense to follow the monthly reporting cycle with the utility bills.



## Obtain Owner's Acceptance

Since the owner is the one that ultimately pays for the OCx plan, it is important to obtain their acceptance that the OCx program is delivering value to them. The owner should review the OCx report at regular intervals, and the OCx program should be revised to reflect any changes to the CFR.

## Conclusion

Implementing an OCx program protects the owner's initial investment in commissioning, while establishing a framework which allows building operators to continuously improve equipment operation and occupant comfort over time. OCx can also be a driver from reactive to predictive maintenance for customers, while increasing energy savings and extending the useful life of building systems.

We recommend that you consider implementing an OCx program after you have performed the work involved in a demanding technical commissioning process. Keeping occupant comfort levels high and seeing fewer occupancy temperature complaints, reducing service/trouble calls from building systems, improved reliability and keeping energy costs at design levels are all goals that will make the building more efficient and will reduce the overall costs of the building operation. ■