

The Nuts and Bolts of the Commissioning Process

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Synopsis

Wouldn't it be nice to uncover problems as early as possible, correcting small problems before they grow into big ones? Don't we all want to get the most out of our assets? Are you wondering how to validate the design intent of the facility and establish the measurable standards for life cycle facilities management? Assuring your operating staff is properly trained and you are maintaining your equipment to reap the benefits of long-term system performance and reliability is the first step towards preserving your facility operating systems.

This paper gives an overview of the commissioning process, where by the people, equipment, and systems are put through a documentation and validation program to define performance objectives to manage life cycle costs. It will provide the road map for guidance on how to apply commissioning, sharing a list of tasks that should become routine. It will also review the goals and benefits of commissioning for a complete facility and provide insight on how you can apply commissioning to your job and use commissioning as a complete process. Coordinating your systems, conducting testing and validation, training staff, and monitoring operations are key steps in commissioning. Commissioning shows a commitment to safety and quality, and protects capital investments in infrastructure.

This paper will define what commissioning is, list routine tasks that should become a part of the maintenance and operation of your facility, describe the benefits commissioning provides, and state the goal of commissioning for your facility.

- Review the commissioning process
- Identify/list routine tasks that are beneficial in commissioning
- Discuss the benefits of commissioning
- Learn how to apply commissioning to their job role
- Understand goal of commissioning
- Put into practice continuous commissioning

About the Author

George Oberlander, Jr. Director of Gannett Fleming, Inc.'s Facilities Management Group, has 22 years of facilities management experience. Mr. Oberlander is familiar with facilities life cycle from the conceptual design of mechanical, electrical, and plumbing systems to operations and maintenance. Over the years he has developed long-term relationships with a broad range of clients across varied industries including New York-Presbyterian-Hospital (Healthcare), Rockefeller Group Development Corp (Commercial), Long Island Rail Road (Transportation), Brush Wellman (Manufacturing), and the State of New Jersey (Government).

His expertise includes analyzing existing facility work practices and recommending improvements with the overall objectives of streamlining day-to-day operations, reducing downtime, optimizing equipment performance, and improving the efficiency of the maintenance staff. This experience has allowed him to have a unique understanding of the commissioning process.

Mr. Oberlander has a history of exceeding client expectations. His projects have received two “Engineering Excellence Awards” from the New York Association of Consulting Engineers’ “Engineering Excellence Award.” One for New York-Presbyterian Hospital and the other with Long Island Rail Road.

Commissioning Application

If there was a way to reduce your facility life cycle costs, implement a process to benchmark measurable standards of the energy related systems, and validate that the infrastructure of the facility performs according to the owner's requirements; would this be of interest for your facility? The process which can accomplish these facility management requirements is called commissioning. Commissioning can be defined as a process for validation of building equipment, systems and operations personnel. Commissioning can be executed either at the inception of design of a new facility, during construction, or for an existing facility with an augmented process called retro-commissioning. Facilities managers have been plagued with buildings and equipment that perform at lower than optimum levels than designed and perform with higher than budgeted energy costs. Underperforming heating, air conditioning and ventilation systems, electrical power systems failures and faults, unreliable support equipment, and operations staff that do not understand the system operations and basic maintenance and operability deficiencies all result in higher life cycle costs. The overall impact of life cycle costs is not only associated with direct operations costs but also can be attributed to employee productivity associated with indoor environmental conditions.

Facility owners typically feel that they are already paying for these services described under commissioning and wonder why they should expend additional budget to hire a commissioning agent to perform tasks that the construction manager and general contractor should be providing. Facilities are usually designed and constructed with a huge schedule and budgetary pressures that often drives the project management. The reality of this process for the owner is that in the current construction environment the low bidder mentality takes precedence. The contractor is focused on supplying and installing the specified systems with the minimal amount of effort to satisfy their contractual obligation and move on to the next job as expeditiously as possible. The contractor should not be viewed as the source of the problem; however, they should be viewed as a valuable resource, which if managed correctly can provide an invaluable asset to owner to ensure that they are getting full return on investment. The commissioning process incorporates checks and balances to ensure that the documentation, manufactures requirements, and systems, equipment, and operations staff are validated for owner acceptance.

The United States Green Building Council (USGBC) Leadership in Energy and Environmental Design (LEED®) 2.2 Energy and Atmosphere (Prerequisite 1) mandates that fundamental building commissioning be incorporated for LEED certified construction projects. The emphasis for building commissioning has taken a whole new dimension as a result of LEED. Commissioning is recognized as the only way to ensure that the energy design requirements are being met. The commissioning process defines how to perform system and equipment validation. The commissioning process should also be considered for non-LEED projects, since the similar impact can be realized for any facility construction project or in retro-commissioning for an existing facility.

Retro-Commissioning

The concepts of commissioning and retro-commissioning (RCx) although very similar have some unique differences that need to be recognized. The RCx process is usually executed as a result of facility deficiencies that are impacting the operations and subjecting the owner to escalated costs for a facility that is currently in service. However, equipment documentation and design criteria may not be available in RCx, and an in-depth functional analysis may be required to determine how the systems should perform prior to execution of functional testing. The other key point is that the analysis will also include equipment assessment from an operations and maintenance (O&M) perspective to determine if the systems require modifications to maintenance procedures, repairs, replacement, and possible design upgrades. The key ingredient will be the interaction of the commissioning agent and operations staff to benchmark the current issues and develop goals on what the owner wants to achieve in the facilities management process.

Commissioning Process

The focus moving forward in this paper will be on the commissioning process since there are more variables associated with RCx that are owner specific and many of the same concepts. For a project team to fully realize the benefits of commissioning, it is important that the commissioning goals be clearly defined in the early stages of the project as with the development of the design intent document and commissioning plan. Experience has shown that the commissioning process can be as much an educational experience as it is functional. The commissioning process not only encompasses defining the requirements, but also establishing a clear road map as to how each task can be completed by ensuring that the information is available by which design intent can be validated according to the schedule requirements of the project.

The commissioning process matches the different phases of construction:

Phase I: Design Phase Commissioning “Commissions the design criteria”

Phase II: Construction Phase Commissioning “Commissions the systems and equipment”

Phase III: Operations and Maintenance (O&M) Phase Commissioning “Commissions the people and processes.”

Phase IV: Post Acceptance Phase “Optimize the commissioned systems management for life cycle cost management”

The commissioning approach not only makes certain that the design intent is complete and the systems and equipment operate as per the design intent, but also to make sure the people and process are in place to keep the systems and equipment operating as per the design intent over the life of the facility.

A. Design

1. Coordination of Commissioning Team

The commissioning agent will conduct a scoping meeting. The representatives of the architect and design engineers and project Manager will be in attendance. The objective is to have a good understanding of the commissioning scope and process, establish communication protocols, and responsibilities of various participants and the general commitment of the project requirements.

2. Design Intent Document Development

The initial Design Intent Document will be developed using the requirements outlined in the owner's (user's) requirements and the design professional's plan in a narrative description of the various building systems and their intended modes and conditions of operation. The emphasis will be to clearly define the bench marks for each integrated system leading to how each system is to be commissioned per design intent.

3. Design Phase Commissioning Plan

The development of the commissioning plan will be facilitated by the commissioning agent during the design phase of the project to provide the road map for the commissioning process throughout the life of the project. The objectives of the plan will be to ensure the sustainability of the facility, enable the maximum utilization of assets, education of O&M personnel, and establish measurable data for operational energy efficiency.

4. Design Document Review

The design document review will encompass the major systems outlined in the commissioning plan. The specification and drawing submittals shall be reviewed at each of the submittal intervals as determined in the contract

5. Coordinate Commissioning Specification Sections for Final Specifications

The project specifications will be updated to reflect commissioning requirements for each of the systems to be commissioned as outlined in the commissioning plan. The specifications shall be detailed to what each benchmark should be for acceptance based on each defined measurable. The requirements for acceptance shall be based on measurable standards so that each system can be commissioned as per the design intent document.

6. Review Final Plans and Specifications for Commissioning

The commissioning objective is to ensure accessibility to systems and equipment and that proper test points are available and established. The final submittals will be evaluated to make certain that the criteria defined in the specifications are commissionable and maintainable.

7. Review Contract Specifications for Installation Contractor Requirements

The requirements shall be consistent with the commissioning plan so required submittals are documented in the contract to ensure adherence to the commissioning requirements. The contract shall contain references to each of the submittal milestones for each of the systems.

B. Construction

1. Construction Phase Commission Plan

The commissioning plan shall be refined to include schedule details for commissioning testing status for the systems identified. Schedules are prepared for each work package and integrated into a total project schedule that reflects the requirements of each task, the project constraints, and required interfaces.

2. Coordinate Construction Phase Coordination Meeting

The construction phase coordination meeting will be focused on establishing the tentative commissioning schedules, prioritization, the complete commissioning scope, pre-functional testing (PFT) and functional testing (FT) activities, and inspection, submittals, testing and balancing (TAB), training, and fundamental acceptance requirements outline in the commissioning plan.

3. Coordinated Drawing Review

The coordinated drawing review will involve the commissioning agent's review of the commissioned equipment and shop drawing submittals to ensure that the manufactures are meeting the requirements established in the design intent.

4. Review O&M Documentation

The timely submittal of O&M documentation is crucial for the successful coordination of testing requirement development and requirements for the commissioning process execution. The review of this documentation is also a key objective of the commissioning agent to make certain of completeness.

5. Evaluate Installations for Maintenance Access and Replacement Criteria

The requirements, as reviewed in the final plans and specifications, shall be incorporated in the PFT to make certain the criteria is evaluated in the specifications for maintainability and are field inspected for completeness.

6. Witness Predetermined Testing Activities and Review Testing Documents

Witnessing can include participation of factory testing for pre-assembled systems for HVAC, laboratory testing equipment, electrical switch gear and control components, building automation control, and security systems. The testing evaluation will include review of the PFT and functional testing so the tests are in compliance with meeting the requirements for commissionable systems.

7. Review TAB Documentation and Coordination

The TAB process shall be evaluated for completeness to fulfill the requirements outlined in the design intent and to meet the measured criteria as determined to achieve optimum operation and energy efficiency. The TAB documents shall be reviewed to indicate they contain the measured test points and operating conditions for complete analysis and to establish bench marks for final acceptance inspection and operational tests.

8. TAB Verification Review and Deficiency Report

The final TAB verification report shall then be submitted to the commissioning team addressing the deficiencies and addressing review for corrective action. The final report will document the corrective action taken. It will be up to the commissioning team to determine acceptance based on the final verification results.

9. Supervision of FT

The commissioning agent's role will be to make certain the systems are tested to fulfill that systems have been commissioned as per design intent and that the deficiencies are reported as well as corrective action. The final commissioning report will include the information based on testing results and actions taken.

C. O&M Transition Phase

1. Coordinate Preliminary Training Sessions

The commissioning agent's role is to coordinate the execution of the commissioning process for O&M personnel. The commissioning agent will also establish the schedule for preliminary training sessions for O&M personnel, design professionals, factory personnel as required, contractors and sub's. The listed parties shall be in attendance to demonstrate a complete system overview by design intent for the facilities systems and components.

2. Coordinate System Orientation and Inspection

The commissioning agent will coordinate the system orientation and inspection of the commissionable systems outlined in the commissioning plan. The orientation meeting proceedings will be documented by the commissioning agent preparing minutes of the meeting and submitting a separate summary of any system deficiencies logged during testing.

3. Coordinate Final Record Drawing Submittals

The commissioning agent will receive final record drawings for review and acceptance. The drawing set will be assembled as provided by the architect and design engineers based on the record drawing information from general contractor.

4. Coordinate the O&M Training Sessions

The commissioning agent will develop the attendance list as required for the facility staff, design professionals, factory representatives, and the construction manager and record personnel in attendance. The commissioning agent will also review training agendas to make certain content and details are conducive to fully encompass commissioned system O&M. The complete and final O&M documents should be available for training to reference system specific content.

5. Develop Final O&M Documentation

The commissioning agent will compile, organize, and index the commissioning data into labeled binders to be included with the O&M Manuals. The content of the final documentation manuals will comprise of approved final submittals reflecting any modifications

D. Post Acceptance

1. Commissioning Report

Upon completion of commissioning activities, the commissioning agent will produce a written report documenting commissioning activities and their results. Any deficiencies found will be identified with suggested remedies, and any corrective action taken will be reported.

2. Functional Performance Tests for Seasonal Condition

The follow-up of functional testing shall be defined in the commissioning plan to make sure HVAC, facility control, building management systems, and seasonal dependent electrical and mechanical systems are retested to make certain optimum performance is achieved during the complete environmental and operational cycle. The functional results will be detailed in the deficiency log and submitted as an addendum to the Commissioning Report.

3. Deficiency and Open Issue Review

The summation the testing activities with open deficiency items will be presented to the commissioning team and will be part of the final commissioning report. The commissioning agent will document any corrective action plans by the commissioning team and establish follow-up review protocol to track and manage corrective action activities.

4. Warranty Management and Develop Follow-Up Schedules

The commissioning agent will develop a follow-up schedule based on the corrective action plan and review. The commissioning agent will include in the schedule that there will be an operational review at approximately 10 months into the 12-month warranty period.

5. Re-commissioning Manual

The commissioning agent will assemble a re-commissioning manual to outline the design criteria and measurable standards and tests that are required to re-certify and validate that the commissioned systems are meeting functional performance standards for future use.

Benefits of Commissioning

The commissioning process ultimately benefits the owner by uncovering problems as early in the project cycle as possible. The intent is to shift the focus of facilities management from the end of the project to the design phase by addressing the issues which impact system performance, operability, and maintainability. The ability of the commissioning agent to be effectively the owner's representative during each validation step assists in reduction of change orders, contractor callbacks, and enables the identification and resolution of issues prior to facility turnover.

The operational cost savings to the owner will be the active validation process for energy operational performance to ensure that the systems are coordinated to operate at optimum design conditions. The commissioning process ensures that these systems have been checked and certified. The ability to bench mark these operational parameters will provide the owner with the system metrics to maintain each of these systems to this standard for the life of the facility.

The coordination of training and documentation will also provide the owner with complete O&M data and knowledge to transition the operations personnel from facility acceptance and beyond for the life of the facility.

The commissioning process is an effective tool for facilities and construction management to implement a process which will not only benefit the immediate needs during construction but provide long term benefits for the complete life cycle.