



STATE OF UTAH - DEPARTMENT OF ADMINISTRATIVE SERVICES

**Division of Facilities Construction and Management**

**DFCM**

# **COMMISSIONING SERVICES**

**Preamble, Objectives & Responsibilities**

## **PREAMBLE FOR COMMISSIONING**

The commissioning process is accomplished through a team effort of cooperation, coordination and communication. The team is comprised of the General Contractor and subcontractors, design architect and engineers, inspection and testing firms, Commissioning Agent (CxA), the end users and operators and DFCM.

The intention is to assemble the team as early in the design process as possible. The commissioning process starts with the selected CxA providing a draft commission plan for all team members to comment on and coordinate with. Once the plan is accepted, the design team and the CxA work together to provide instructions to the construction team on what will be required by the General Contractor and subcontractors to commission the building. This will be done via the specifications if completed before completion of design or via proposal request if completed after the construction contract is underway.

The commissioning plan is a compilation of processes, milestones and inspections. As a minimum, the commission should address the mechanical and electrical systems including the building controls and fire alarms. Other items can be added to the process as required. These may include audio/video systems, telephone and data systems, elevators or any other system or parts.

The CxA is not to replace the design architect and engineers in verifying that the work is constructed per the plans and specifications. They are to supplement the efforts of the design team. Close communication and coordination between the design team, the CxA and DFCM is required. It is the intent for the design team to continue to do both interim and final inspections noting items that do not comply with code or with the contract documents. As the requirements of the commissioning plan are finalized, contract clarifications and modifications may be required to increase or decrease the activities required by either the CxA or the design team or both.

The testing and inspection firms hired by DFCM also have a part in the commissioning activity. As an item is inspected the results need to be communicated. An example is a piping pressure test. If this is an activity on the commissioning plan a decision is required as to who will witness the test and how the information will be reported to all parties including the CxA.

The State Fire Marshal requirements are a part of the commissioning process. Certain items will be identified that need to be incorporated in to the commissioning plan that fall under the authority of the State Fire Marshal.

The General Contractor is ultimately responsible for the end product to function as designed. As such the General Contractor is required to communicate and coordinate the work so that the end result is both functional and maintainable. The General Contractor may wish to hire an outside firm to help in the process or someone within the firm should be assigned this duty. It is intended that the General Contractor regularly schedule a meeting so that all team members can communicate and coordinate issues, requirements and expectations and that this forum be used to solve issues on the job. Via the General Contractor's coordination efforts, items that require access to maintain should be placed in appropriate locations. As items on the commissioning plan are completed the General Contractor must provide documentation of completion and acceptance to the CxA.

Requirements for training shall be documented in the project specifications. Coordination of the training shall be the responsibility of the General Contractor and the CxA.

The CxA will be expected to apply their best knowledge and expertise to represent the State of Utah in confirmation and documentation fulfilling the functional and performance requirements of the State of Utah and DFCM. To reach this goal, it is necessary for the commissioning process to establish and document the criteria for System functions, performance, and maintainability; as well as to verify and document compliance with these criteria throughout design, construction, start-up, testing, commissioning and the initial period of operation.

The CxA should be involved throughout the project from design through the one year general warranty phase of the project. The primary role of the CxA during the design phase is to develop detailed commissioning specifications and review design to ensure that systems meet DFCM's objectives.

**Systems that should be commissioned include:**

- a. Electrical Systems
- b. Mechanical and Plumbing Systems
- c. Operable Building Control Systems
- d. Audio and Visual Systems
- e. Telephone and Data Systems
- f. Building Security Systems
- g. Elevators and Conveyance Systems
- h. Scheduled or Occupancy Sensor Lighting Controls
- i. Daylight Dimming Controls
- j. Refrigeration Systems
- k. Emergency Power Generators and Automatic Transfer Switching
- l. Uninterruptible Power Supply Systems
- m. Life Safety Systems (fire alarm, egress pressurization, fire protection, smoke evacuation)
- n. Domestic and Process Water Pumping and Mixing Systems
- o. Equipment Sound Control Systems and Testing
- p. Paging Systems
- q. Renewable Energy Generating Systems
- r. Building Envelope Systems

Other Systems as identified during the course of design.

1. **COMMISSIONING OVERVIEW**

- A. The objective of the commissioning contract is to document that the new facility fulfills the functional and performance requirements of the contract documents, DFCM and the end user. To reach this goal, it is necessary for the commissioning process to establish and document compliance with these criteria. This process starts at the design phase and continues through the initial period of operation. In addition, the commissioning consultant will review submittals, the completed operation and maintenance (O&M) manuals, as well as assist the General Contractor in the coordination of systems training that shall be provided to the building operators to ensure the building continues to operate as intended.

The commissioning consultant will develop and coordinate the execution of a commissioning plan which includes observing and documenting all system's performance to ensure that systems are functioning in accordance with DFCM's objectives and contract documents.

2. **DEFINITIONS**

- A. *Commissioning*: Commissioning is a quality-focused process for achieving, validating and documenting that the facility and its systems are planned, designed, installed, tested and capable of being operated and maintained to perform in conformity with the design intent. The process extends through all phases of a project, from conceptualization to occupancy and operation, with checks and documentation at each stage of the process to ensure validation of their performance to meet the User Agency and DFCM contract documents.
- B. *Commissioning Agent*: An entity that plans, schedules, and coordinates the commissioning team to implement the Commissioning Process.
- C. *Commissioning Process*: A quality-focused process for enhancing the delivery of the project. This includes verifying and documenting the project and its systems and assemblies are planned, designed, installed, tested, and operated to meet DFCM's requirements.
- D. *Commissioning Plan*: A document that outlines the organization, checklist, schedule, team members and associated responsibilities, allocation of resources, systems to be commissioned and documentation requirements of the Commissioning Process.
- E. *Test Procedure*: A written protocol that details the expectations, schedule and deliverables of the Commissioning Process activities related to training of project operating and maintenance personnel, users and occupants.
- F. *Verification*: The process by which specific documents, components, equipment, assemblies, systems and interfaces among systems are confirmed to comply with the contract documents.

- G. *Owner's Project Requirements (OPR):* A document that details the functional requirements of a project and the expectations of how it will be used and operated. These include project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information. The focus of the OPR is on the final goals, not specific technologies and should concentrate on concepts rather than criteria. The OPR forms the basis from which all design, construction acceptance and operational decisions are made. The OPR is considered a “living document” and should change and evolve over time.
- H. *Basis of Design (BoD):* A document that records the concepts, calculations, decisions, and product selections used to meet the OPR and to satisfy applicable regulatory requirements, standards, and guidelines. The document includes both narrative descriptions and lists of individual items that support the design process.

3. **COMMISSIONING TEAM MEMBERS**

- A. Members Appointed by the DFCM:
  - (1) Commissioning Agent
  - (2) Representatives and operation and maintenance personnel of the User Agency.
  - (3) Architect and engineering design professionals
  - (4) Energy Modeler
- B. Members Appointed by General Contractor(s): Individuals, each having authority to act on behalf of the entity he or she represents, explicitly organized to implement the commissioning process through coordinated actions. The commissioning team shall consist of, but not be limited to, representatives of General Contractor, including project superintendent and subcontractors, installers, suppliers, and specialists deemed appropriate by the CxA.
- C. For Commissioning Team minimum responsibilities refer to the Commissioning Responsibility Matrix on the following page.

4. **COMMISSIONING RESPONSIBILITY MATRIX**

<b>Task</b>	<b>Arch/ Eng</b>	<b>General Contractor</b>	<b>Agency</b>	<b>Commissioning Agent</b>
Owner's Project Requirements (OPR)	P	C	S	C
Basis of Design (BoD)	P	C	S	S
Commissioning Specifications	S	C	C	P
Coordination of Commissioning Requirements in Construction Documents	P	S	C	S
Commissioning Meetings During Construction	S	P	C	P
Commissioning Coordination with Sub-Contractors During Construction	S	P	C	S
General Contractors Building Punch List	S	P	C	S
General Contractors Building Punch List Verification	S	P	C	S
Commissioning Punch List	S	P	C	S
Commissioning Punch List Verification	S	S	C	P
Record Documents in Writable Format	P	S	C	S
Commissioning Plan/Deliverables Interactive DVD	C	P	C	S
Commissioning DVD Training	C	P	C	S
Building Systems Training	C	P	C	S

P = **Primary Role** – The person or entity that is to be responsible for orchestrating and organizing an activity or task. Documentation responsibilities are assigned to this person or entity.

S = **Secondary Role** – The person or entity that is to act as support and assistance for the assigned activity or task. This person or entity is to act as Primary Role in absence of the assigned party

C = **Coordination and Assistance Only** – The person or entity that has a vested interest in the outcome and findings of the team, however, is not to participate in directing the operations.

1. **COMMISSIONING AGENT'S MINIMUM RESPONSIBILITIES**

- A. Design Phase:** The CxA is responsible during the design phase for preparing the commissioning plan and inserting into the contract documents the requirement that the General Contractor will follow to insure a properly functioning building. The CxA shall:
- (1) Organize and lead the commissioning team.
  - (2) Assist the design team, DFCM and end users in establishing/updating the Owner's Project Requirements (OPR) and creating the Basis of Design (BoD) for the project.
  - (3) Prepare a project commissioning plan. The commissioning plan is continually updated as a project progresses through the various phases from design through DFCM acceptance and one year post-occupancy. The plan must contain the following elements at the design phase:
    - (a) Identification of all of the systems to be commissioned.
    - (b) Definition of the commissioning process scope. Scope to include pre-installation and installation checklists, functional testing requirements, final documentation checklists and DFCM training verification.
    - (c) Definition of the commissioning roles and lines of communications for each member of the project team.
    - (d) A comprehensive commissioning schedule which includes both sequencing and time requirements for each task.
  - (4) Prepare project-specific test and inspection procedures and checklists. Develop full commissioning specifications for all commissioned equipment and systems to allow the commissioning plan to be completed.
  - (5) Prepare specifications for training modules to be provided and recorded by the General Contractor on DVD.
  - (6) Perform focused reviews of the OPR, BoD, design, drawings and specifications at Schematic, Design Development, and Construction Documents phase. Review the design for compliance with design intent and that the design allows for the validation of the commissioning requirements. Back-check review comments in subsequent design submission.
  - (7) Coordinate a controls integration meeting and act as technical liaison between the mechanical engineer and building controls contractor/designer.

**B. Bid Phase**

- (1) Provide answers to commissioning related questions and any supplemental documentation that may be required.

- C. Construction Phase:** The CxA is responsible for the functional testing program which objectively verifies that the building systems perform interactively in accordance with the Contract documents. Written, repeatable test procedures, prepared specifically for each project, are to be used to functionally test components and systems in all modes of operating conditions specified for testing. These tests are documented to clearly describe the individual systematic test procedures, the expected systems response or acceptance criteria for each procedure, the actual response or findings, and any pertinent discussion. All response, findings and pertinent discussions regarding each test are to be included in the final commissioning report.

On new building commissioning projects, the CxA reviews systems installation for commissioning related issues throughout the construction period.

All commissioning activities and findings are to be documented as they occur.

- (1) CxA responsibilities:
  - (a) Coordinate and direct the commissioning activities. Plan and conduct commissioning meetings as needed and distribute minutes.
  - (b) Perform site visits, as necessary, to observe component and system installations. Attend selected planning and job-site meetings.
  - (c) At the beginning of the construction phase, conduct an initial construction-phase coordination meeting for the purpose of reviewing the commissioning activities and establishing tentative schedules for operation and maintenance submittals; operation and maintenance training sessions; testing, adjusting and balancing work; and project completion.
  - (d) Include design changes and scheduled commissioning activities coordinated with overall project schedule. Identify commissioning team member responsibilities, by name, firm, and trade specialty, for performance of each commissioning task.
  - (e) Review and comment on addendums and submittals from General Contractor for compliance with DFCM's Contract documents, OPR, BoD, Contract Documents, and construction-phase commissioning plan.

- (f) Review requests for information and change orders for impact on commissioning and DFCM's objectives.
- (g) Review construction meeting minutes for revisions/ substitutions relating to the commissioning process. Assist in resolving any discrepancies. Request and review additional information required to perform commissioning tasks, including O&M materials, General Contractor start-up and checkout procedures. Review normal General Contractor submittals applicable to systems being commissioned. Review requests for information and change orders.
- (h) Review General Contractor coordination drawings.
- (i) Review and comment on performance expectations of systems and equipment and interfaces between systems relating to DFCM's contract documents and Basis of Design. Recommend specific measures, which when implemented cause the building's energy systems and controls to function as intended. Provide troubleshooting and performance verification.
- (j) Review installation procedures with subcontractors to ensure complete compatibility with Commissioning Requirements and Design Intent. Work with contractors and equipment suppliers in the development of construction checklists for commissioned equipment.
- (k) Coordinate, witness and document manual functional performance tests performed by installing contractors. Coordinate retesting as necessary until satisfactory performance is achieved. Analyze functional performance trend logs and monitoring data to verify performance.
  - Tests on respective HVAC equipment shall be executed during both the heating and cooling season. Functional testing shall be done using conventional manual methods, control system trend logs, and read-outs or stand-alone data-loggers.
- (l) Witness any ductwork testing and cleaning sufficient to determine that proper procedures were followed. Include documentation in the Commissioning Record.
- (m) Confirm air and water systems balancing by spot testing and by reviewing completed reports and by selected site observation.
- (n) With necessary assistance and review from installing contractors, write the functional performance test procedures for equipment and systems. This will include manual functional testing, energy management control

system trending and may include stand-alone data-logger monitoring. Submit to PM for review and confirmation if required.

- (o) Coordinate, witness and document manual functional performance tests performed by installing contractors. Coordinate retesting as necessary until satisfactory performance is achieved. The functional testing shall include operating the system and components through each of the written sequences of operation, and other significant modes and sequences, including startup, shutdown, unoccupied mode, manual mode, staging, miscellaneous alarms, power failure, security alarm when impacted and interlocks with other systems or equipment.
- (p) Sensors and actuators shall be calibrated during construction check listing by the installing contractors, and spot-checked by the commissioning consultant during functional testing.
- (q) Coordinate and witness tests on respective HVAC equipment during both the heating and cooling season. However, some overwriting of control values to simulate conditions shall be allowed. Functional testing shall be done using conventional manual methods, control system trend logs, and read-outs or stand-alone data-loggers, to provide a high level of confidence in proper system function, as deemed appropriate by the commissioning consultant and DFCM.
- (r) Observe construction and report progress and deficiencies. In addition to compliance with the Contract Documents, inspect systems and equipment installation for adequate accessibility for maintenance and component replacement or repair.
- (s) Compile test data, inspection reports, and certificates and include them in a systems manual for use during final code inspections.
- (t) Review Project Record Documents for accuracy. Promptly request revisions from General Contractor to achieve accuracy.

#### **D. Start Up & Testing**

- (1) Before startup & testing, gather and review the current control sequences and interlocks and work with contractors and design engineers until sufficient clarity has been obtained, in writing, to be able to write detailed testing procedures.
- (2) Develop an enhanced start-up and initial systems checkout plan with contractors for selected equipment.

- (3) Document systems startup by reviewing start-up reports and by selected site observation.
- (4) Prepare test plans for, assist with execution of, and document tests of commissioned equipment overseen by regulatory authorities.

**E. One Year Post Occupancy Warranty Period**

- (1) Prior to expiration of the construction contract one year warranty, assist DFCM in assessing systems' performance and addressing operational or warranty related issues. Review equipment warranties to ensure that end user's responsibilities are clearly defined.
- (2) Coordinate and supervise required opposite season or deferred testing and deficiency corrections and provide the final testing documentation for the Commissioning Record and Operations & Maintenance manuals.
- (3) Make suggestions for improvements and for recording these changes in the Operations & Maintenance manuals. Identify areas that may come under warranty or under the original construction contract.
- (4) Assist facility staff in developing reports and documents and requests for services to remedy outstanding problems.

**F. Operations & Maintenance Manuals**

- (1) Review and comment on operation and maintenance documentation and systems manual outline for compliance with the Contract Documents. Compile a systems manual that consists of the following: control drawings; sequences of control; and a table of all set points and implications when changing them, schedules, instructions for operation of each piece of equipment for emergencies, seasonal adjustment, startup and shutdown, instructions for energy savings operations and descriptions of the energy savings strategies in the facility.

## 2. **OPERATION AND MAINTENANCE TRAINING REQUIREMENTS**

- A. **Training Preparation Conference:** Prior to Substantial Completion, the CxA shall convene a training preparation conference to include end user's operation and maintenance personnel, contractor, and subcontractors to perform the following:
- (1) Review the Basis of Design and Contract Documents
  - (2) Review installed Systems, subsystems, and equipment
  - (3) Review instructor qualifications
  - (4) Review instructional methods and procedures
  - (5) Review training module outlines and contents
  - (6) Review course materials (including operation and maintenance manuals)
  - (7) Review and finalize training schedule and verify availability of educational materials, instructors, audiovisual equipment, and facilities needed to avoid delays.
  - (8) For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

## 3. **MINIMUM COMMISSIONING DELIVERABLES**

- A. Within sixty (60) days after Substantial completion, a *Final Commissioning Report* shall be delivered to DFCM that includes a compilation of procedures, milestones, testing and inspections for the identified systems and components. Also included in the Commissioning Report shall be the issues log, commissioning plan, progress reports, submittal and O&M manual reviews, training record, test schedules, construction checklists, start-up reports, functional tests, and trend log analysis.

The *Final Commissioning Report* shall include the following:

- (1) Commissioning Plan and Commissioning Specifications
- (2) Owner's Project Requirements (OPR)
- (3) Basis of Design (BoD)
- (4) Design Review Log
- (5) Submittal Review Log
- (6) Test Procedures
- (7) Issues Log (ensure that all deficiencies and their successful correction are clearly documented)

- (8) Construction Checklists
- (9) CxA Site Visit & Cx Team Mtg. Minutes
- (10) O&M Review and Warranty Review
- (11) Training Documentation
- (12) Test Data Reports
  - Rocky Mountain Power (RMP) Commissioning Report (as applicable)
  - occupancy and schedule assumptions
  - heating and cooling load calculations
  - summaries of intended operation sequences
  - as-built and equipment shop drawings
  - schematic drawings of all mechanical, electrical and control systems
  - equipment manuals
  - equipment operating procedures (normal and emergency)
  - balancing reports
  - air and water design conditions
  - maintenance procedures and schedules
  - control program software documents
  - 24-hour telephone contacts for emergency service companies
- (13) Re-commissioning Management Manual
- (14) Seasonal Testing addendum