Project Name
Project Location

TEMPLATE - Construction Phase Commissioning Plan

Prepared by:

Date

TEMPLATE - Construction Phase Commissioning Plan

Summary

The *Construction Phase Commissioning Plan* is developed in draft form for the specific project during the design phase. During the design phase, the plan provides direction for the development of the site-specific commissioning specifications by the design team. During the construction phase, the plan provides direction for the commissioning tasks during construction. The plan focuses on providing support for the specifications and provides forms for the application of the commissioning process.

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Commissioning Plan—Construction Phase

Project: **Project Name**
Project Location

Date*:* _____

Cx Plan Version

_x_ TEMPLATE Construction Phase
___ **Final Construction Phase**

1. Overview

1.1 Abbreviations and Definitions

The following are common abbreviations used in this document.

A/E	Architect and design engineers	FPT	Function Performance Test
BOD	Basis of Design	HVAC	Heating, Ventilating and Air Conditioning
CxG	Commissioning Specialist for the Government	GC	General contractor
		MC	Mechanical contractor
CC	Controls contractor		
COR	Contracting Officer's Representative	PC	Prefunctional Checklist
Cx	Commissioning	PE	Project Engineer – Gov't
Cx Plan	Commissioning Plan document	PM	Project Manager – Gov't
CxC	Commissioning Specialist for the Contractor	Subs	Subcontractors to General
DA	Design Agent		
DOR	Designer of Record	TAB	Test and Balance Contractor
EC	Electrical contractor	USACE	US Army Corps of Engineers
FPC	Fire Protection Contractor	User	Facility User/Occupant – Gov't

1.2 Purpose of the Commissioning Plan

The purpose of the construction phase commissioning plan is to document a plan for the commissioning process during construction.

This plan does not provide a detailed explanation of required testing procedures. In general, this plan identifies roles and responsibilities, systems to be commissioned, commissioning standards and procedures, and sample forms to indicate the level of detail desired. Additionally, this plan does not provide extensive narrative on all commissioning concepts, as this information can be found in commissioning guide references.

1.3 Commissioning Scope

Commissioning is a systematic process of ensuring that all building systems perform interactively according to the Owner's Project Requirements (OPR) and contract documents. This is achieved by, beginning in the design phase, documenting the design intent and continuing through construction, acceptance and the warranty period with actual verification of performance.

Commissioning during the construction and acceptance phase of this project is intended to achieve the following specific objectives:

- Ensure that applicable equipment and systems are installed properly and receive adequate operational checkout by installing contractors.
- Verify and document proper performance of equipment and systems.
- Ensure that O&M documentation is complete and is in custody of the owner.
- Ensure that the Owner's operating personnel are adequately trained.

1.4 Commissioned System

(NOTE: THIS IS AN EXAMPLE. THIS IS NOT A COMPLETE LIST FOR THIS PROJECT. THIS MUST BE EDITED FOR EACH PROJECT TO REFLECT ALL EQUIPMENT AND SYSTEMS TO BE COMMISSIONED.)

The following systems will be commissioned in this project (shall include, but not limited to):

HVAC System (and all integral equipment controls)
- _x_ Computer Room Air Conditioning Units*
- _x_ Hydronic Hot Water System*
- _x_ Chilled Water System*
- _x_ Pumps*
- _x_ Variable speed drives
- _x_ Piping, cleaning and flushing
- _x_ Ductwork
- _x_ Air handling units (including energy recovery modules, MUAs, coils, etc)*
- _x_ Fan Coil Units
- _x_ VAV Terminal Units
- _x_ Testing, Adjusting and Balancing work
- _x_ Unit heaters
- _x_ Exhaust Fans
- _x_ Building automation system (controlled devices, control loops and system integration)*
- _x_ Renewable Energy Systems/Equipment
- _x_ Other energy transfer or producing equipment

Electrical Systems
- _x_ Automatic Lighting Controls
- _x_ Daylighting/dimming controls
- _x_ Occupancy Controls

Plumbing
- _x_ Domestic hot water system

Other
- _x_ Building Air Tightness
- _x_ Control system
- _x_ Indoor Air Quality
- _x_ Water Measurement Devices*
- _x_ Energy Measurement Devices*
- _x_ Fire Protection Systems*

* Denotes critical equipment

2. General Building Information

Owner: **FEDERAL GOVERNMENT**

Project: **PROJECT NAME**

Location: **PROJECT LOCATION**

Building Type (office, court, etc.): Building Type
Square Footage: ###### GSF Number of stories: ##

3. Cx Team Data (primary parties)

(NOTE: THIS IS NOT A COMPLETE LIST. THIS IS A TEMPLATE AND SHOULD BE EDITED FOR EACH PROJECT TO INCLUDE CX TEAM MEMBERS.)

Team Member	Contact Name	Email Address, Phone
Project Manager		
Design Team Leader		
Project Engineer		
General Contractor		
Commissioning Specialist Government		
Commissioning Specialist Contractor		
Mechanical Designer/Eng.		
Electrical Designer/Eng.		
Tenant Representative		
Mechanical Contractor		
Electrical Contractor		
TAB Contractor		
Controls Contractor		
Mechanical Independent Technical Review		
Architect		

4. Roles and Responsibilities (Note this is a template. This must be edited and coordinated with the specifications for this project. Add roles and responsibilities for Cx team members not specifically addressed below such as the Technical Commissioning Specialists.)

4.1 Team Members

The members of the commissioning team consist of the CxC, CxG, PE/COR, GC, A/E (particularly the mechanical engineer), the mechanical contractor, electrical contractor, TAB representative, controls contractor, any other installing subcontractors or suppliers of equipment and those performing technical design review of the construction documents. If known, the Owner's building or plant operator/ engineer is also a member of the commissioning team. Additional information on roles and responsibilities of the CxC and CxG is provided in APPENDIX D.

4.2 General Management Plan

The CxC will be hired by the General Contractor. The CxG is a Government employee. In general, the CxC coordinates the commissioning activities and reports to the CxG and Contracting Officer's Representative copying the GC on all results in accordance with LEED. The CxC's responsibilities, along with all other contractors' commissioning responsibilities are outlined herein or detailed in the specifications. The Specifications will take precedence over this Cx Plan. All members work together to fulfill their contracted responsibilities and meet the objectives of the Contract Documents. Refer to the management protocols section below.

4.3 Descriptions of Roles and Responsibilities

General descriptions of the commissioning roles are as follows:

Commissioning Specialist for the Contractor (CxC):

a. Directs/Coordinates the Cx process and activities.
b. Coordinates all commissioning schedule and activities with the CxG.
c. Obtain copies of all shop drawings, manufacturer's literature, maintenance information or other information as may be needed for systems to be commissioned.
d. Collect the information needed for development of a complete Commissioning Plan and functional performance tests.
e. Obtain all proposed start-up and Prefunctional Checklists documentation.
f. Obtain updates to all project documentation to reflect all supplemental instructions, addenda or other revisions to the project construction documents.
g. Obtain submittals for all systems to be commissioned including controls system and wiring diagrams and narrative sequences of operation, in time for use in preparing the Functional Test Procedures.
h. Obtain preliminary TAB report, indicating all actual field values recorded, prior to initiation of functional testing.
i. Obtain complete operation and maintenance information and as-built drawings for verification, organization and distribution.
j. Update and finalize the Draft Construction Phase Commissioning Plan.
k. As part of Final Commissioning Plan, develop Prefunctional Checklists and Functional Test Procedures from Contract Documents and final equipment submittals including narrative sequences of operation, control diagrams and software code for execution with the assistance of Contractor staff as required. Sample PC and FPT documents located under Appendix C are examples representing the scope and rigor of the commissioning procedures required, and shall be used as the basis for developing the detailed checklists and functional performance test procedures for all equipment requiring commissioning.

l. Perform site observations to follow installation progress and to verify system installation and readiness for testing.
m. Reviews and implements the contractor Start-up Procedures and Forms
n. Review submittal of all required prefunctional and start-up documentation provided by Contractor for completeness and reasonableness. This includes installation documentation, start-up documentation, point-to-point checklists and preliminary TAB report, prior to initiation of functional testing.
o. Schedule, direct and witness complete functional testing as defined in the Commissioning Plan and Functional Test Procedures. All testing shall be performed by the Contractors and subcontractors, and documented by the Commissioning Specialist.
p. Conduct commissioning meetings.
q. Provide site observation, functional tests or other project reports in a timely manner.
r. Identify and document inconsistencies or deficiencies in system operations and system compliance. System deficiencies shall be forwarded to the Contractor and Contracting Officer and documented in a Communication Log and the CQC system.
s. Provides limited problem resolution assistance.
t. Coordinate the participation of Government's personnel with equipment, component and systems performance verification and participation in required training.
u. When commissioning has been successfully completed, recommend acceptance to the Government.
v. Once all functional tests have been successfully completed and all outstanding issues resolved, the Commissioning Specialist will provide the Contracting Officer with a Final Commissioning Report of all commissioning activities and test results that occurred during the project.
w. Observe and document training of government personnel on commissioning systems and equipment.
x. Develop Systems Manual and obtain all necessary information/documentation needed for inclusion.
y. Perform Post Occupancy Activities.

Owner/Government Representative (CxG, COR, PE, or PM):
a. Facilitates and supports the Cx process assuring that all commissioning activities are performed in accordance with LEED requirements and contract documents..
b. Approves the Final Commissioning Plan including PCs and FPTs.
c. Approves the Commissioning Report.
d. Performs construction observation.
e. Has final authority in decision making processes

General Contractor:
a. Facilitate the Cx process.
b. Ensure CxC receives copies of all shop drawings, manufacturer's literature, maintenance information or other information as may be needed for systems to be commissioned.
c. Ensure CxC is provided necessary information for updating the Commissioning Plan and development of checklists and functional tests. The Contractor shall review these documents and confirm in writing to the CxC, PE/COR and CxG any known areas of conflict or areas requiring clarifications.
d. Assists in development of Prefunctional Checklists (PC).
e. Ensure all proposed start-up and Prefunctional Checklists documentation is provided to the CxC.
f. Assists in the development of the Functional Performance Testing Procedures and Forms (FPT).
g. Plan for and incorporate all commissioning activities into the construction schedule.

h. Provide a fully operational system per Specifications, started, verified, debugged, calibrated, balanced, tested and under automatic control.
i. Provide qualified personnel to participate in the commissioning tests, including seasonal testing.
j. Provide updates to all project documentation to reflect all supplemental instructions, addenda or other revisions to the project construction documents. Updates and supplemental instructions must be posted to the master set of documentation for review and reference by all Contractors and for the Commissioning Specialist's use.

k. Provide adequate time and resources to support CxC with functional testing of systems to be commissioned.
l. Coordinate participation of the mechanical, electrical, controls and TAB subcontractors, and all Contractor Quality Control personnel in the commissioning process. Ensure that Subs perform their responsibilities.
m. Ensure CxC and CxG receive submittals for all systems to be commissioned including controls system and wiring diagrams and narrative sequences of operation, in time for use in preparing the Functional Test Procedures.
n. Participate in any efforts to finalize sequences of operations with Government and CxC.
o. Verify that coordination, installation, quality control and final testing have been completed such that installed systems and equipment comply with construction documents.
p. Review the Commissioning Plan, interim reports such as issues log and progress reports, and Commissioning Report to include test results and submit comments to the CxC.
q. In a timely manner, address issues identified during construction that may affect the commissioning process or final system performance.
r. Perform start-up and testing of mechanical and electrical equipment and systems and document as required with start-up reports and completion of Prefunctional Checklists. These checklists include installation documentation, start-up documentation, controls point-to-point documentation and calibration documentation, verification that controls sequence of operations meets design intent and TAB final documentation. Reports will be stored in the Contractor's field trailer. Contractor will coordinate efforts to complete the prefunctional documentation.
s. Ensure preliminary TAB report, indicating all actual field values recorded is provided to the CxC and CxG, prior to initiation of functional testing. These reports shall be incorporated in the commissioning field notebook. The final TAB report is distinguished from the preliminary TAB report by the fact that all submittals and corrections shall be approved by the issuance of the final TAB report. All balancing issues and corrections shall have been resolved to the satisfaction of all parties by the final TAB report.
t. Issue a written Certificate of Readiness for each system to CxC, CxG and PE/COR upon completion of all systems work, start-up and Prefunctional Checklists requirements by trade contractors.
u. Responsible for and demonstrate proper system installation and performance (typically through the use of installers, subs and/or manufacturers). Operate equipment and systems as required for functional performance testing. This includes, but is not limited to; manipulating the appropriate controls systems to execute the Functional Test Procedures.
v. Participate in the fine-tuning or troubleshooting of system performance, if either of these measures becomes necessary.
w. Ensure complete operation and maintenance information and as-built drawings is provided to the CxC and CxG for verification, organization and distribution.
x. Provide documentation of training for the systems specified.
y. Provide test equipment required to test all the systems and equipment in this project.
z. Review operating and maintenance data for verification, organization, distribution and conformance to requirement of the Contract Documents.

aa. Provide necessary information/documentation to CxC for inclusion in the Systems Manual.

Subcontractors:
- Demonstrate proper system installation and performance.
- Assists in development of Prefunctional Checklists (PC).
- Assists in the development of the Functional Performance Testing Procedures and Forms (FPT).

Architect/Engineer (A/E or DOR):
- Develops and updates Basis of Design.
- Incorporates Commissioning requirements in construction documents.
- Performs construction observation.
- Assists in resolving problems.

Project Manager:
- Facilitates and supports the Cx process.

5. Construction Phase Commissioning Activities

This section sequentially details the commissioning process by commissioning task or activity.

5.1 Construction Commissioning Coordination Meeting

A commissioning scoping meeting is planned and conducted by the CxC early during the construction phase. Cx Team members such as the GC, CxG, PE/COR, A/E, Technical Commissioning Specialists, and the mechanical, electrical, controls, and TAB subs shall attend. The agenda should include but is not limited to:

- Cx party introductions
- Cx process overview
- Management and lines of reporting and communication are determined
- Draft Cx Plan is reviewed
- Roles and Responsibilities
- Proposed Cx Schedule
- Documentation flow and submittal data the CxG will receive
- Review of building systems to be commissioned including intended operation
- Process questions are addressed

The outcome of the meeting is increased understanding by all parties of the commissioning process and their respective responsibilities. The meeting provides the CxC additional information needed to update the *Cx Plan*, including the commissioning schedule.

Prior to this meeting the CxC is given, by the GC, all drawings and specifications and the construction schedule by trade. The CxC keeps notes from the meeting and distributes them, along with the updated Cx Plan, to each team member.

5.2 Final Commissioning Plan and Schedule - Construction Phase

The CxC develops a final *Construction Phase Cx Plan* using the information gathered from the scoping meeting. The initial commissioning schedule is also developed and integrated into the construction schedule. The Cx schedule will be adjusted as construction progresses. Reference Project Schedule in Total Building Commissioning Specification.

5.3 Site Observation

The CxC will make periodic site visits to observe equipment and system installations. The CxG, selected maintenance personnel and the PE/COR should be notified and may accompany the CxC during these visits. Site visits shall begin regularly by the time 40% of the commissioned systems are installed. The frequency of these visits shall be monthly at a minimum. As construction progresses and mechanical system installation activity increases, CxC representatives will need to increase site observation frequency. The CxC shall provide a site observation report for each visit. Additional CxC visits should include, but not limited to, selective witnessing of DALT, hydrostatic pressure testing, startup, controls startup/point verification, TAB, and spot checking contractor performed Prefunctional Checkout for completeness and accuracy. Observed deficiencies shall be documented and tracked in a construction Cx issues log. The GC will maintain the master issue log.

5.4 Periodic Meetings

The CxC attends selected planning and job-site meetings while on site in order to remain informed on construction progress and to update parties involved in commissioning. The PE/COR and GC provide the CxC and CxG with information regarding substitutions, change orders and any supplemental instructions that may affect commissioning equipment, systems or the commissioning schedule. The CxC and CxG may review construction meeting minutes, change orders or requests for information for the same purpose. Later during construction, necessary meetings between various commissioning team parties will be scheduled by the CxC, through the GC, as required to meet the project's needs. These periodic meetings shall initially be held monthly (and may coincide with the CxC site visits) and then more frequently as project nears completion or as requested by the COR or CxG. The COR and CxG should be notified of all meetings. The CxC will provide minutes for these meetings.

5.5 Miscellaneous Management Protocols

The following protocols will be used on this project.

Issue	Protocol
Requests for Information (RFI) or formal documentation requests:	The CxC goes first through the GC and CxG.
Minor or verbal information and clarifications:	The CxC communicates directly with subcontractors while keeping the CxG, PE/COR and GC informed.
Deficiencies notification:	The CxC documents deficiencies through the CxG and PE/COR, but may discuss deficiency issues with GC prior to notifying the CxG and PE/COR. Copies of deficiency reports shall be provided to CxG and PE/COR.
Functional Test Scheduling or Training:	The CxC may provide input for (and do some coordination of) testing and training, but does not schedule testing or training.
Scheduling Commissioning meetings:	The CxC coordinates date and schedules through GC, CxG, and PE/COR. The GC notifies attendees directly.
Significant Change requests:	The CxC has no authority to issue change orders.
For making small changes in specified sequences of operations:	The CxC may suggest (to the DOR, for approval by the PE/COR) changes in sequences of operations to improve efficiency or to control or to correct deficiencies.
Disagreements between contractors and CxC's interpretations:	Try and resolve with the CxC first. Then work through CxG and GC who will work with CxC directly.

5.6 Progress Reporting and Logs

At the beginning of construction, the CxC provides the PE/COR with monthly C*ommissioning Progress Reports*. Thirty (30) days prior to the startup of the first piece of major equipment, the frequency of progress reports is increased to twice per month, until startup is completed. Thirty (30) days before functional testing of equipment begins, weekly progress reports are required until functional testing and all non-conformance issues are resolved. The CxC may increase the reporting frequency as needed. The progress reports shall include, but are not limited to, an update of the schedule with list of requested schedule changes and new items added to the schedule, a list of new and outstanding deficiencies, and a description of commissioning progress corresponding to the plan. The CxC keeps a log of all commissioning-related issues that require current or future attention using a *Commissioning Issues Log*. Samples of the *Commissioning Progress Report and Commissioning Issues Log* are included in Appendix A.

The CxC regularly communicates with all members of the commissioning team, keeping them apprised of outstanding issues, commissioning progress, and scheduling through memos, progress reports, etc. The CxC maintains all commissioning related materials in an organized notebook to become part of the final Cx report.

5.7 Cx Related Submittals and Documentation

5.7.1 Standard Submittals

The CxC provides all Subs responsible for commissioned equipment with commissioning documentation requirements for their respective equipment and systems through the GC. Subcontractor documentation submissions typically coincide with the normal submittal process. At a minimum, this documentation includes manufacturer's installation instructions, start-up and check-out procedures, O&M data, performance data and control drawings. The CxC reviews and approves submissions relative to commissioning issues expressed in the contract documents. CxC recommendations are provided to the DOR, CxG, owner and/or PE/COR as directed.

5.7.2 Special Submittals, Notifications and Clarifications

The Subs, GC or DOR shall notify the CxC within one (1) week of approval of any design intent or operating parameter changes, added control strategies and sequences of operation, or other change orders that may affect commissioned systems. Thirty (30) days prior to performing any applicable tests, the Subs must provide the CxC full procedure details. As TAB phases are completed, a draft TAB report is provided to the CxC with full explanations of approach, methods, results, data table legends, etc. The final TAB report is provided to the CxC and CxG upon completion.

These submittals to the CxC do not constitute O&M manual submittal compliance. Documentation requirements for the O&M manuals are discussed in Section 5.11, herein.

The CxC may request additional design narrative from the DOR and/or the contractor depending on completeness of original bid documents. The CxC may submit written RFIs to contractors through the standard process.

5.8 Prefunctional Checklists, Tests and Startup

Prefunctional checklists (PC) are important to ensure that the equipment and systems are installed and operational and that functional performance testing (FPT) may proceed without unnecessary delays. The CxC will assist/develop with commissioning team members detailed prefunctional checklists and start up plans. The CxC shall provide prefunctional checklists and start up plans to CxG for review. Each piece of equipment receives full prefunctional checkout by the GC/Subs. No sampling strategies are used. The

prefunctional checkout for a given system must be successfully completed prior to formal functional performance testing of equipment or subsystems of the given system.

Prefunctional checklists are primarily static inspections and procedures to prepare the equipment or system for initial operation (oil levels OK, fan belt tension, labels affixed, gages in place, sensor calibration, etc.). Some prefunctional checklist items entail simple testing of the function of a component, a piece of equipment or system (such as measuring the voltage imbalance on a three phase pump motor of a chiller system). Prefunctional checklists augment and are combined with the manufacturer's start-up checklist.

Contractors typically already perform some, if not all, of the prefunctional checklist items the commissioning authority will recommend. Few contractors actually document in writing the execution of these checklist items. This project requires that the procedures be documented in writing by the installing technician. To document the prefunctional testing and startup process, site technicians performing line item tasks, initial and date each checklist item. Only individuals having direct knowledge of a line item being completed shall check and initial forms. The CxC may not witness all of the prefunctional checks, but will perform spot checks and will witness prefunctional testing of larger or more critical pieces of equipment. Critical equipment requiring witnessing by the CxC is identified in paragraph 1.4 Commissioned Systems.

Subcontractors will execute and sign the prefunctional checks and start up procedures. The GC ensures that each PC is properly completed and provides them to the CxC.

5.8.1 Start-up Plan

The CxC assists the commissioning team members responsible for startup in developing detailed start-up plans for all equipment. The parties responsible for each part of startup and initial checkout are identified on the prefunctional checklists by the GC.

The following procedures will be used for this project: (the Subs are responsible for the plan development)

1. The CxC adapts and enhances, if necessary, the representative prefunctional checklists (PC) and procedures and develops original lists, as necessary.
2. The CxC transmits them to the GC who designates which trade or contractor is responsible to fill out each line item on the Prefunctional Checklist from the CxC. The GC then transmits the checklist to the responsible Subs.
3. The Sub designated to develop the Start-up Plan obtains manufacturer installation, start-up and checkout data, including actual field checkout sheets used by the field technicians.
4. The Sub copies all pages with important instructional data and procedures (not covered in manufacturer field checkout sheets) from the start-up and checkout manuals and adds a signature line in the column by each procedure.
5. The copied pages, along with the prefunctional checklist provided by the GC (originally from the CxC) and the manufacturer field checkout sheets become the "Start-up and Checkout Plan." For systems that may not have adequate manufacturer start-up and checkout procedures, particularly for components being integrated with other equipment, the Sub should provide the added necessary detail and documenting format to the CxC for approval, prior to execution.
6. The GC/Subs transmit the full Start-up Plan to the CxC and CxG for review and approval.
7. The CxC and CxG review and approve the procedures and the format for documenting them, using a standard form, noting any procedures that need to be added, and conveys to the GC. The GC then transmits the full start-up plan to the Subs for their review and use. (This

usually means that the Prefunctional Checklist, alone, will go to more than one Sub, while the full plan will go to the primary installing contractor.)

5.8.2 Execution of Checklists and Startup

Four weeks prior to startup, the GC and Subs shall incorporate the startup and initial checkout activities into the overall construction schedule and notify all applicable parties. The startup and initial checkout plan shall be executed. The CxC, and CxG if available, will observe, at minimum, the procedures for each piece of primary equipment. For components of equipment, (e.g., VAV boxes), the CxC observes a sampling of the prefunctional and start-up procedures.

To document the process of startup and checkout, the site technician performing the line item task initials and dates each paragraph of procedures in the "Startup Plan" and checks off items on the prefunctional and manufacturer field checkout sheets, as they are completed. Only individuals having direct knowledge of a line item being completed shall check or initial the forms.

The Subs and vendors execute the checklists and tests and submit a signed copy of the completed start-up and prefunctional tests and checklists to the CxC. The CxC and CxG may review prefunctional checklists in progress, as necessary.

5.8.3 Sampling Strategy for CxC Observation of Prefunctional Checkout and Startup

(NOTE: THIS IS AN EXAMPLE. THIS IS NOT A COMPLETE LIST FOR THIS PROJECT. THIS MUST BE EDITED FOR EACH PROJECT TO REFLECT ALL EQUIPMENT AND SYSTEMS TO BE OBSERVED.)

Equipment or System	Fraction To Be Observed by CxC
Chillers/Boilers/HRCH	100%
Air Handling Units (including Energy Recovery)	100%
Pumps, VFD's	100%
Pipe flushing	At beginning and end
Computer Room Units	100%
VAV Terminal Units	25%
Building automation system	100% review of PVT Report
TAB work	100% review of TAB Report
Other misc. equipment/systems	25%

5.8.4 Deficiencies and Non-Conformance

The Subs clearly list any outstanding items of the initial start-up and prefunctional procedures that were not completed successfully at the bottom of the procedures form or on an attached sheet. The procedures form and deficiencies are provided to the CxC within 48 hours of test completion. The CxC works with the Subs and vendors to correct and retest deficiencies or uncompleted items, involving the CxG, PE/COR and others as necessary. The GC, through installing Subs or vendors, corrects all areas that are deficient or incomplete according to the checklists and tests in a timely manner, and shall notify the CxC as soon as outstanding items have been corrected and resubmit an updated report. Upon satisfactory completion, the CxC recommends approval of the execution of PCs and startup and initial checkout of each system to the CxG and PE/COR using a standard form.

5.8.5 TAB

The TAB contractor submits the outline of the TAB plan and approach to the CxC and the controls contractor eight weeks prior to starting the TAB. Included in the approach, is an explanation of the intended use of the building control system. The CxC reviews the plan and approach for understanding and coordination issues and may comment, but does not "approve." The controls contractor reviews the feasibility of using the building control system for assistance in the TAB work. The TAB submits weekly written reports of discrepancies, contract interpretation requests and lists of completed tests to the GC, CxC, and CxG. This facilitates quicker resolution of problems and will result in a more complete TAB before functional testing begins. TAB work will not begin until the control system has been prefunctionally tested and approved by the CxC.

5.8.6 Controls Checkout Plan

The controls contractor develops and submits a written step-by-step plan to the CxC, CxG, and PE/COR through the GC which describes the process they intend to follow in checking out the control system for proper operation. This Controls Checkout Plan shall include forms for the documentation of individual component verification which is considered the Performance Verifications Test (PVT) or Point-to-Point test. Components that are tested and verified on an individual basis are part of the Prefunctional Checks and are documented in conjunction with these forms.

The GC shall verify that the controls contractor reviews the TAB plan with the TAB contractor prior to starting TAB work in order to determine the control system capabilities to aid in executing TAB work. The controls contractor will provide the TAB with any necessary unique instruments for setting terminal unit boxes and instruct TAB in their use (handheld control system interface for use around the building during TAB, etc.). The controls contractor shall also provide a technician qualified to operate the controls to assist the TAB contractor in performing TAB and the CxC in performing all PCC checkouts.

All CxC required controls prefunctional checklists, calibrations, start-up and selected functional tests of the system shall be completed and approved by the CxC prior to TAB. The GC through the controls contractor shall execute tests and trend logs and remain on site for assistance for mechanical system functional tests.

5.8.7 Certificate of Readiness

The GC shall issue a Certificate of Readiness certifying that all equipment, systems, and controls are complete and ready for Functional Performance Testing. The Certificate of Readiness shall include all equipment and system start-up reports, Performance Verification Test Reports, Prefunctional Checklists, TAB Report, and the Building Air Tightness Report. The GC and the Mechanical, Electrical, Controls, and Testing, Adjusting, and Balancing Representatives shall sign and date the Certificate of Readiness.

5.9 Development of Functional Performance Test and Verification Procedures

5.9.1 Overview

Functional performance testing (or functional testing) is the dynamic testing of systems (rather than just components) under full automatic operation (e.g., the chiller pump is tested interactively with the chiller functions to see if the pump ramps up and down to maintain the differential pressure setpoint, etc). Systems are tested under various modes, such as during low cooling or heating loads, high loads, component failures, unoccupied, varying outside air temperatures, fire alarm, power failure, etc. The systems are run through all of the control system's sequences of operation and components are verified to be responding as the sequences state. The CxC develops the functional performance test procedures in a

sequential written format and coordinates, oversees and documents the actual testing, which is performed by the installing contractor or vendor.

5.9.2 Development Process

Before test procedures are written, the CxC obtains all requested documentation and a current list of change orders affecting equipment or systems, including an updated points list, control sequences and setpoints. The CxC develops specific test procedures to verify proper operation of each piece of equipment and system listed in the Cx Plan and Specifications. The CxC obtains clarification, as needed, from contractors and the DOR regarding sequences and operation to develop these tests. Prior to execution, the CxC provides a copy of the equipment and systems functional testing to the installing Sub (through the GC) who reviews the tests for feasibility, safety, warranty and equipment protection. Blank copies of the procedures are input into the O&M manuals for later use by operations staff. The test procedure forms shall include the following, at a minimum:

a. System and equipment or component name(s) and configuration(s).
b. Equipment location and ID number.
c. Unique test ID number, and reference to unique PC and startup documentation ID numbers.
d. Date.
e. Project name.
f. Participating parties.
g. A copy of the specific sequence of operations or other specified parameters being verified.
h. Formulas used in any calculations.
i. Required pre-test field measurements.
j. Instructions for setting up the test, including special cautions, alarm limits, or other equipment-specific information.
k. Specific step-by-step procedures to execute the test in a clear, sequential, and repeatable format.
l. Acceptance criteria of proper performance with a Yes / No check box to allow for clear marking of whether or not proper performance of each part of the test was achieved.
m. A section for comments.
n. Signature and date blocks for the CxC, CxG, Contractor, PE and DOR.

Functional testing and verification shall be achieved by manual testing (persons manipulate the equipment and observe performance) and by monitoring the performance and analyzing the results using the control system's trend log capabilities.

5.9.3 Functional Testing Plan Overview

The CxC develops a testing plan overview to provide the Cx Team with a better idea of where functional testing lies in the schedule, what issues prevent the start of testing, which contractors are needed for each test and how much time might be expected from them. This is developed after most equipment has been started up and when functional testing dates are not too far off. The testing plan overview is provided to the contractors to assist in moving more efficiently to functional testing.

5.10 Execution of Functional Testing Procedures

5.10.1 Overview and Process

Functional Performance Testing shall be performed after PCs, startup, calibration, control checkout and TAB are complete and Certificate of Readiness has been submitted for a given system. The CxC schedules functional tests through the GC, CxG, and PE/COR. The CxC directs, witnesses, and documents the functional testing of all equipment and systems according to the Specifications and the Cx Plan. The CxG will oversee/witness the functional testing. The Subs execute the tests, unless otherwise specified. The control system shall be successfully tested before it can be used to verify dependent system and/or component performance. Air and water system balancing shall be complete and reconciled prior to functional testing of related equipment and /or systems. Testing proceeds from components to subsystems to systems and finally to interlocks and connections between systems. The CxC documents the results of the test.

Functional Performance Tests shall be demonstrated to the satisfaction of the CxC. FPTs shall be witnessed and endorsed by the CxC upon satisfactory completion. The CxG recommends acceptance of each test to the PE/COR. The PE/COR gives final approval on each test. The actual testing program shall be conducted in accordance with the approved FPT procedures and shall be documented as required. The GC shall notify the CxG and PE/COR at least 14 calendar days prior to date of each functional performance tests.

5.10.2 Deficiencies and Retesting

Every effort shall be made to expedite the testing process and minimize unnecessary delays, while not compromising the integrity of the procedures. Nonconformance and deficiencies observed in materials, installation, or operation shall be addressed immediately, in terms of notification to responsible parties, and providing recommended actions to correct deficiencies. The GC shall have responsibility for resolving construction deficiencies. Corrections of minor deficiencies identified are made during the tests at the discretion of the CxC and CxG. The CxC shall maintain a master deficiency and resolution log, and shall provide the PE and CxG with written progress reports and test results with recommended actions. The CxC shall also document the deficiency and resolution on the test procedure form. Subs correct deficiencies and notify the CxC of corrective action. The CxC schedules retesting through the GC, CxG and PE/COR. Decisions regarding deficiencies and corrections are made at as low a level as possible, preferably between CxC, CxG or PE/COR and the Sub. For areas in dispute, final authority resides with the PM.

5.10.3 Facility Staff Participation

The Owner's facilities operating staff are encouraged to attend and participate in the testing process. The CxC will notify the PE/COR, who will then notify the facility staff when the commissioning events will occur.

5.10.4 Sampling

Multiple identical pieces of non-life-safety or otherwise non-critical equipment may be functionally tested using a sampling strategy. Critical Equipment, requiring 100% of systems/components to be functionally tested, is identified in 1.4 Commissioned Systems. The following table provides additional information on the sampling strategy to be used on this project: **(NOTE: THIS IS AN EXAMPLE. THIS IS NOT A COMPLETE LIST FOR THIS PROJECT. THIS MUST BE EDITED FOR EACH PROJECT TO REFLECT ALL EQUIPMENT AND SYSTEMS TO BE SAMPLED.)**

Equipment or System	**Fraction To Be Observed by CxC**
Chillers/Boilers/HRCH	100%
Air Handling Units (including Energy Recovery)	100%
Pumps, VFD's	100%
Computer Room Units	100%
Electrical Systems	20%
Domestic Hot Water	20%
Building Air Tightness	100%
Indoor Air Quality	100%
Other misc. equipment/systems	20%

5.11 Deferred Testing

5.11.1 Unforeseen Deferred Tests

If any check or test cannot be completed due to the building structure, required occupancy condition, or other deficiency, a request for delay execution of checklists and FPT may be delayed contingent on approval of the PM. These tests shall be conducted as soon as possible in the same manner as seasonal testing.

5.11.2 Seasonal Testing

The CxC shall schedule, coordinate, and observe additional testing for seasonal variation in operations and control strategies during the opposite season to verify performance of the HVAC system and controls. The GC shall execute and document tests and correct deficiencies with facilities staff and the CxC, CxG, and/or PE witnessing. Testing shall be completed during the warranty period to fully test all sequences of operation. The GC shall make necessary revisions to O&M manuals and records due to the testing.

a. Seasonal commissioning pertains to testing under full-load conditions during peak heating and peak cooling seasons, as well as part-load conditions in the spring and fall. Initial commissioning will be done as soon as contract work is completed, regardless of season. For the major heating and cooling generation and distribution systems, means of artificial loading shall be developed by the CxC as a means of demonstration, to a reasonable level of confidence, the ability to handle larger peak seasonal loads. Subsequent commissioning shall be undertaken at the appropriate time thereafter to ascertain adequate performance during the different seasons.

b. All equipment and systems shall be tested and commissioned in a peak season to observe full-load performance. Heating equipment shall be tested during winter design extremes. Cooling equipment shall be tested during summer design extremes, with a fully occupied building. Each Contractor and supplier will be responsible to participate in the initial and the alternate peak season test of the systems required to demonstrate performance.

c. All equipment and systems affected by occupancy variations will be tested and commissioned at the minimum and peak loads to observe system performance. Each Contactor and supplier will be responsible to participate in the occupancy sensitive testing of systems to provide verification of adequate performance.

d. Based on the scheduling of seasonal testing, the Contractor and COR shall discuss/coordinate Beneficial Occupancy and start of warranty period for affected systems.

5.11.3 Short-Term Diagnostic Testing

After initial occupancy, the GC shall perform short-term diagnostic testing, using data acquisition equipment or the building automation system to record system operation over a two- to three-week period. The dynamic interactions between components in the building system shall be investigated. The scheduling, interaction between heating and cooling, and effectiveness of the HVAC system in meeting the comfort requirements and design conditions shall be evaluated. The GC shall document tests and findings, and correct deficiencies according to the original testing requirements.
.

6. Occupancy and Operation Phase Commissioning Activities

6.1 O&M Manuals and Warranties

6.1.1 Standard O&M Manuals

The CxC, CxG, and DOR review the O&M manuals, documentation and redline as-builts for systems that were commissioned to verify compliance with the Specifications. They recommend approval and acceptance of these sections of the O&M manuals to the PE/COR. The PE/COR gives final approval on these documents. The CxC, CxG, DOR and PE/COR review each equipment warranty and verify that all requirements to keep the warranty valid are clearly stated.

6.1.2 Systems Manual

The CxC will compile, organize and index the following commissioning data by equipment into labeled, indexed and tabbed, three-ring binders and deliver it to the GC, to be included with the O&M manuals.

The Systems Manual shall include the following (ASHRAE Guideline 0, Annex O shall be used for format and content):

a. Index of Systems Manual with notation as to content storage location if not in actual manual.
b. Executive Summary.
c. Owner's Project Requirements.
d. Construction Record Documents, specifications, and approved submittals.
e. A list of recommended operational record-keeping procedures, including sample forms, logs, or other means, and a rationale for each.
f. Ongoing optimization guidance.

g. Operations and maintenance manuals (includes operating procedures for all normal, abnormal, and emergency modes of operation; maintenance procedures; parts and recommended spare parts list; troubleshooting guide; and systems schematics (one-line diagrams).
h. Training materials.
i. Commissioning Report.

6.2 Training and Orientation of Owner Personnel

The GC shall provide Owner/Maintenance personnel training and orientation for all commissioned equipment and systems as required by the contract documents. Training will be coordinated by the GC.

6.3 Warranty Period

During the warranty period, seasonal testing and other deferred testing required is completed according to the Specifications. The CxC coordinates this activity. Tests are executed and deficiencies corrected by the appropriate Subs, witnessed by CxC, facilities staff, the PE/COR and the CxG. Any final adjustments to the O&M manuals and as-builts due to the testing are made. In addition the CxC will return to the project approximately 10 months into the 12 month warranty period. During this visit(s) the CxC will review with facility staff the current building operation and the condition of outstanding issues related to the original and seasonal commissioning and review and analyze trend data for compliance to the construction documents. The CxC will also interview facility staff and identify problems or concerns they have operating the building as originally intended. The CxC will make suggestions for improvements and for recording these changes in the O&M manuals. The CxC will identify areas that may come under warranty or under the original construction contract. The CxC will also assist facility staff in developing reports and documents and requests for services to remedy outstanding problems. Results of this inspection shall be documented in the final summary Commissioning Report.

6.4 System Performance Verification

The CxC shall review the operation of the building with the operation and maintenance staff and occupants within ten months of facility acceptance by the Government. The CxC shall resolve all outstanding commissioning related issues during the warranty period.

The CxC shall implement a thermal comfort survey of building occupants within a period of six to ten months of facility acceptance by the Government. This survey shall collect anonymous responses about thermal comfort in the buildings, including an assessment of overall satisfaction with thermal performance and identification of thermal comfort-related problems. The CxC shall develop a plan for corrective action if the survey results indicate that more than 20% of occupants are dissatisfied with thermal comfort in the building. This plan shall include measurement of relevant environmental variables in problem areas in accordance with ASHRAE Standard 55.

The main parameter to be measured in the thermal comfort survey shall be satisfaction with thermal environment. The answer shall be posed in a seven-point scale format running from very satisfied (+3) to very dissatisfied (-3) with the center (0) signifying the neutral point. The percent dissatisfied shall be the percentage of respondents who answer "dissatisfied" (any of the lower three points of the seven point scale). The survey shall identify each thermal zones by room number(s) and ask the respondent to identify his/her thermal zone. Survey shall include follow-up questions that are asked if the respondent indicates dissatisfaction to identify the nature and cause of the problem. The survey shall be administered in person, over the phone, over networked computers, or on paper. The CxC shall be responsible for collecting each completed survey. The survey shall be consistently applied and available for participation by all regular occupants.

The CxC shall develop a corrective action plan. This plan shall identify each question and the number of responses for each answer of each question. The corrective action plan shall identify the percent dissatisfied for each question. The corrective action plan shall identify the nature and location of any thermal environmental problems. The plan shall suggest directions for corrective actions based on the follow-up questions that identify the nature and cause of the problem.

7. Written Work Products

The written work products are described in Appendix B, Formal Written Work Products. The table describes each product, responsible party, due date, recipients, and approving authority.

7.1 Final Commissioning Report

A final summary report by the CxG will be provided to the PE/COR within thirty (30) days of substantial completion. The report shall include an executive summary, list of participants and roles, brief building description, overview of commissioning and testing scope and a general description of testing and verification methods. For all commissioned equipment, the report should contain the disposition of the commissioning specialist regarding the adequacy of the equipment, documentation and training meeting the contract documents in the following areas: 1) Equipment meeting the equipment specifications, 2) Equipment installation, 3) Functional performance and efficiency, 4) Equipment documentation and design intent, and 5) Operator training. All outstanding non-compliance items shall be specifically listed. Recommendations for improvement to equipment or operations, future actions, commissioning process changes, etc. shall also be listed. Each non-compliance issue shall be referenced to the specific functional test, inspection, trend log, etc. where the deficiency is documented. The functional performance and efficiency section for each piece of equipment shall include a brief description of the verification method used (manual testing, BAS trend logs, data loggers, etc.) and include observations and conclusions from the testing.

Appendices shall contain control sequences, meeting minutes, progress reports, issues logs, site visit reports, findings, unresolved issues, communications, etc. The commissioning plan, prefunctional checklists and functional tests (along with blanks for the operators) and monitoring data and analysis will be provided.

A copy of the Commissioning Report will be included in the project's LEED documentation.

8. Commissioning Schedule

8.1 General Issues

The following sequential priorities are followed:

1. Equipment shall not be used for heating/cooling during construction until pre-start checklist items and all manufacturers' pre-start procedures have been completed. Moisture, dust and other environmental and building integrity issues must also have been addressed.
2. Equipment/system functional testing shall begin only after prefunctional, startup, and TAB work has been completed.
3. Functional testing of controls system and its controlled equipment shall begin only after all points have been calibrated and prefunctional testing has been completed.
4. TAB shall begin only after the controls system has been approved by the CxC for use for TAB work.
5. TAB work shall begin only after envelope work and ceiling installation have been completed.

APPENDIX A

Example Construction Phase Forms

COMMISSIONING ISSUES LOG

Project:_____

Location:_____

Prepared by:_____ **Page _____ of _____**

Attach additional pages as necessary for issues requiring more explanation and tracking.

#	Issue	Date Found	Effects	Possible Cause	Recommendations	Actions Taken	O&M Doc. Issue?	Open/ Closed (Date)

COMMISSIONING PROGRESS REPORT

Project: _____ Date: _____ Prepared by: _____

Reporting Period: _____ Report #:_____

Commissioning tasks worked on since last report and general progress:

_____
_____
_____
_____
_____
_____
_____
_____

Areas where schedule is not being met: _____

_____
_____
_____

Recommended actions: _____

_____
_____
_____
_____

Requested schedule adjustments: _____

_____
_____

Next steps: _____

_____

Other comments (include general comments and field notes): _____

_____
_____

Non-Compliance Report attached. (Y/N) _____ *Issues Log Attached. (Y/N)* _____
Misc. comment sheets attached. (Y/N) _____

_____
Commissioning Agent

APPENDIX B

Commissioning-Related Formal Written Work Products and Submittals

Product	Created By	Product Description and Form	Approved By	Product Assigned In
Final Cx Plan	CxC	Final Cx plan for const. phase	CxG recommends approval to PE/COR	Cx Plan 5.2
Cx Schedule	GC/CxC/Subs	Schedule of Cx Activities	PE/COR	Cx Plan 7.2
Cx related submittals	GC/Subs	Detailed data on all commissioned equipment	CxC/CxG recommends approval to PE/COR	Cx Plan 5.7
Prefunctional Tests and Checklists	CxC, GC and Subs	List by equipment of prefunctional checklists and prefunctional tests	CxG recommends approval to PE/COR	Cx Plan 5.8
Start-up and initial checkout plans	GC and Subs	Specific listing of procedures for combining CxG prefunctional checklists with Sub's startup and checkout.	CxC/CxG	Cx Plan 5.8.1
Start-up and initial checkout reports	GC and Subs	Filled out prefunctional checklists, tests, startup and initial checkout	CxC/CxG recommends approval to PE/COR	Cx Plan 5.8.2
Controls Contractor Initial Check-out Plan	Controls Contr.	Complete step-by-step plan on checkout and calibration procedures, including forms for documentation	CxC/CxG recommends approval to PE/COR	Cx Plan 5.8.6
TAB plan and approach	TAB	Outline of TAB plan, approach and schedule	CxC; PE/COR	Cx Plan 5.8.5, Specifications
TAB progress reports	TAB	List of discrepancies, interpretations needed, tests completed	none	Cx Plan 5.8.5
Draft TAB report	TAB	Draft TAB report with method and results	CxC/CxG (Required for Cx)	Cx Plan 5.7.2
Final TAB report	TAB	Final TAB report with method and results	CxC/CxG (Required for Cx)	Cx Plan 5.7.2
Change orders	GC; PE/COR	Change orders that affect Commissioned equipment	N/A	Cx Plan 5.7.2
Issues Log	CxC	Record / track of all issues and deficiencies	N/A	Cx Plan 5.6
Systems Manual	CxC	Record / track of all submittals, checklists, tests, etc.	N/A	Cx Plan 6.1.2

Cx progress reports	CxC	Gives scheduling needs and update, deficiency report, Cx progress	N/A	Cx Plan 5.6
Functional Performance Test forms	CxC	Full description of test procedures in “form” format	CxG recommends approval to PE/COR	Cx Plan 5.9
Completed Functional Performance Test forms	CxC	Recorded documentation of the test on the form	CxG recommends approval to PE/COR	Cx Plan 5.9
Final Cx report	CxC	Summary report with status of each system and important findings, etc. Compilation of all important Cx data (checks, tests, issues, reviews, etc.)	CxG recommends approval to PC/COR	Cx Plan 7.1
O&M manuals	GC and Subs	Documentation of design, equipment, operations and maintenance, as-builts, etc.	CxC/CxG recommends approval to PE/COR (required for Cx)	Cx Plan 6.1 and Specifications
Thermal Comfort Survey	CxC	Survey used to collect data from building occupants regarding thermal comfort and satisfaction	N/A	Cx Plan 6.3
Corrective Action Plan	CxC	Plan recommending correction action for issues identified during occupancy phase commissioning and thermal comfort survey	N/A	Cx Plan 6.3

APPENDIX C

Example Prefunctional Checklists, Functional Performance Tests, Integrated System Tests, and Building Envelope Inspection Checklists

Download example Building Envelope Inspection Checklists, Pre-Functional Checklists, Functional Performance Test Checklists, and Integrated Systems Test Checklists for specification section 01 91 00.15 TOTAL BUILDING COMMISSIONING at the following location: **http://www.wbdg.org/FFC/NAVGRAPH/graphtoc.pdf**. The checklists submitted in the Interim and Final Construction Phase Commissioning Plans must contain the same level of detail shown in the examples. The submitted checklists are not required to match the format of the examples.

APPENDIX D

CxC and CxG Roles and Responsibilities

DESIGN PHASE	CxG	CxC
Ensure that design team has OPR	X	
Develop Cx plan (DESIGN PHASE include draft CONSTRUCTION PHASE)	X	
Review concept level design submission against OPR	X	
Start developing Cx specification	X	
Ensure that design concept is in compliance with OPR	X	
Develop format for the systems manual	X	
Review midpoint design submission against OPR	X	
Update and incorporate comments into Cx specification	X	
Review completed design documents prior to release for construction against OPR	X	
Finalize Cx specification	X	
Ensure the completed design documents are in compliance with the OPR prior to release for construction	X	
Review Basis of Design (BOD) and concur that it is compliance with the requirements in the OPR	X	
Develops format for Construction Phase Cx issues log	X	
Develop draft Sample Prefunctional Checklists (PC)	X	
Develop draft Sample Functional Performance Tests (FPT)	X	
Compile Design Phase Cx report	X	
CONSTRUCTION PHASE	**CxG**	**CxC**
Review construction submittals and shop drawings against contract documents and maintain Cx Submittal Log		X
Assure construction submittals and shop drawings have been reviewed by CxC in accordance with Cx Spec, conducting random audits of Cx Submittal log and construction submittals	X	
Reviews and recommend approval of Cx schedule	X	X
Finalize commissioning plan in accordance with Cx spec		X
Review and recommend approval of Final Commissioning Plan	X	
Perform routine inspections	X	X
Chairs Cx construction progress meetings		X
Maintains Cx issue log		X
Review Cx issue log	X	
Finalize PFC for installed equipment using draft PFC as template		X

Review and recommend approval of finalized PFC	X	
Executes PFC as required (CxC must witness in accordance with Cx Plan)		X
Review and recommend approval of completed PFC	X	
Develops FPT for installed equipment using draft FPT as starting point		X
Review and recommend approval of finalized FPT	X	
Executes FPT as required by Cx Plan		X
Witness representative sample of FPT during execution	X	
Review and recommend approval of completed FPT	X	
Compile Construction Phase Cx report		X
Review and approve Construction Phase Cx Report	X	
Compile Systems Manual		X
Review and approve Systems Manual	X	
Ensure turnover of Systems O&M Manual (by Contractor) to Facility Staff	X	X
Submits all Cx documentation required per LEED	X	X
Ensure proper Systems O&M training has been provided (by Contractor) to Facility Staff	X	X
OCCUPANCY AND OPERATIONS PHASE	**CxG**	**CxC**
Verify any seasonal testing of the facility.	X	X
Review the facility and its performance within 10 months of substantial completion.	X	X
Within 10 months of substantial completion, review building operation with operations staff and occupants in order to identify any problems in operating the building as originally intended.	X	X
Verify training effectiveness of O&M staff within 10 months after substantial completion	X	X
Document results of post occupancy review		X
Review post occupancy review documentation	X	

ROLES AND RESPONSIBILITIES MATRIX

(excerpt from ER 1110-345-723, Total Building Commissioning Procedures)

Pre-Design Phase(D-B-B)/RFP Development(D-B)		CxG = Gov't Comm Specialist COR = Contracting Officer Rep DOR = Designer of Record CxD = Design Comm Specialist CxC = Construction Comm Specialist O&M = Gov't Facility O&M					L = Lead P =Participate A = Approve R = Review O = Optional N/A = Not Applicable	
Commissioning Roles & Responsibilities								
Category	**Task Description**	**CxG**	**COR**	**CxD**	**DOR**	**CxC**	**O&M**	**Notes**
Meetings	Pre-Design Kick-Off Meeting	P	P	P	L	N/A	P	
	Owner's Project Requirements Meeting	P	P	P	L	N/A	P	
	Commissioning Planning Meetings	P	P	L	P	N/A	O	
Coordination	Coordinate with [COR, DOR, etc.] to ensure that Cx is incorporated into project planning and documents.	L	P	P	P	N/A	O	
Cx Plan & Spec	Draft Commissioning Plan	R	A	L	R	N/A	R	
Schedules	Preliminary Commissioning Schedule	R	A	L	R	N/A	O	
OPR	Prepare Owner's Project Requirements	R	A	P	L	N/A	P	
Commissioning Documents	Identify systems to be commissioned	P	P	L	P	N/A	R	
	Preliminary acceptance criteria	R	P	L	P	N/A	R	
	Commissioning Documents preliminary templates	R	R	L	R	N/A	R	

Note: *(Appendix C) is just a sample to depict how such a matrix would be developed. There are many more commissioning tasks to be identified beyond what the sample identifies. The type of involvement shown is for instruction purposes only and would need to be developed on a project by project basis for the scope, size, and complexity of the project, the degree of rigor required, and with consideration of available District resources and expertise.*

Design Phase (D-B-B)		CxG = Gov't Comm Specialist COR = Contracting Officer Rep DOR = Designer of Record CxD = Design Comm Specialist CxC = Construction Comm Specialist O&M = Gov't Facility O&M					L = Lead P =Participate A = Approve R = Review O = Optional N/A = Not Applicable	
Category	**Task Description**	**CxG**	**COR**	**CxD**	**DOR**	**CxC**	**O&M**	**Notes**
Coordination Cx Plan & Spec Schedules	Coordinate with [COR, AHJ, Vendors, etc.] to ensure that Cx interacts properly with other systems as needed to support OPR and BoD	P	P	P	L	N/A	P	
	Preliminary Commissioning Plan	R	A	L	R	N/A	R	
	Preliminary Cx Specifications	R	A	L	R	N/A	R	
	Design Phase Commissioning Schedule	R	A	P	L	N/A	O	
OPR and BoD	Maintain OPR on behalf of Owner	P	P	P	L	N/A	P	
	Review Basis of Design Document vs. OPR	R	P	L	P	N/A	P	
	Maintain BoD on behalf of Owner	P	P	P	L	N/A	P	
Reviews	Focused Concept Design Review	R	L	P	P	N/A	P	
	Focused Design Development (35-50%) Review	R	L	P	P	N/A	P	
	Focused Construction Document Review	R	L	P	P	N/A	P	
	Focused Pre-Final Construction Document	R	L	P	P	N/A	P	
	Focused Final Construction Document	R	L	P	P	N/A	P	
	Final Construction Document Comment Backcheck	R	L	P	P	N/A	P	
Functional	Draft Pre-Functional Checklists (PFC)	R	A	L	R	N/A	R	
Test Protocols	Draft System Functional Performance Tests (FPT)	R	A	L	R	N/A	R	

Note: *(Appendix C) is just a sample to depict how such a matrix would be developed. There are many more commissioning tasks to be identified beyond what the sample identifies. The type of involvement shown is for instruction purposes only and would need to be developed on a project by project basis for the scope, size, and complexity of the project, the degree of rigor required, and with consideration of available District resources and expertise.*

Design Phase (D-B)		CxG = Gov't Comm Specialist COR = Contracting Officer Rep DOR = Designer of Record CxD = Design Comm Specialist CxC = Construction Comm Specialist O&M = Gov't Facility O&M					L = Lead P =Participate A = Approve R = Review O = Optional N/A = Not Applicable	
Category	**Task Description**	**CxG**	**COR**	**CxD**	**DOR**	**CxC**	**O&M**	**Notes**
Coordination Cx Plan & Spec Schedules	Coordinate with [COR, AHJ, Vendors, etc.] to ensure that Cx interacts properly with other systems as needed to support OPR and BoD	P	P	N/A	L	P	P	
	Preliminary Commissioning Plan	R	A	N/A	R	L	R	
	Preliminary Cx Specifications	R	A	N/A	R	L	R	
	Design Phase Commissioning Schedule	R	A	N/A	L	P	O	
OPR and BoD	Maintain OPR on behalf of Owner	P	P	N/A	L	P	P	
	Review Basis of Design Document vs. OPR	R	P	N/A	P	L	P	
	Maintain BoD on behalf of Owner	P	P	N/A	L	P	P	
Reviews	Focused Concept Design Review	R	L	N/A	P	R	P	
	Focused Design Development (35-50%) Review	R	L	N/A	P	R	P	
	Focused Construction Document Review	R	L	N/A	P	R	P	
	Focused Pre-Final Construction Document	R	L	N/A	P	R	P	
	Focused Final Construction Document	R	L	N/A	P	R	P	
	Final Construction Document Comment Backcheck	R	L	N/A	P	R	P	
Functional	Draft Pre-Functional Checklists (PFC)	R	A	N/A	R	L	R	
Test Protocols	Draft System Functional Performance Tests (FPT)	R	A	N/A	R	L	R	

Note: *(Appendix C) is just a sample to depict how such a matrix would be developed. There are many more commissioning tasks to be identified beyond what the sample identifies. The type of involvement shown is for instruction purposes only and would need to be developed on a project by project basis for the scope, size, and complexity of the project, the degree of rigor required, and with consideration of available District resources and expertise.*

Construction Phase (D-B-B & D-B) Commissioning Roles & Responsibilities		CxG= Gov't Comm Specialist COR = Contracting Officer Rep CxD = Design Comm Specialist DOR = Designer of Record CxC=Construction Comm Specialist O&M = Gov't Facility O&M					L=Lead P = Participate A = Approve R=Review O=Optional N/A=Not Applicable	
Category	**Task Description**	**CxG**	**COR**	**CxD**	**DOR**	**CxC**	**O&M**	**Notes**
Meetings*	Construction Commissioning Kick Off meeting	P	P	N/A	O	L	P	
	Commissioning/Issues Resolution Meetings	P	P	N/A	O	L	O	
	Project Commissioning Progress Meetings	P	P	N/A	O	L	O	
	Controls Meeting	P	P	N/A	P	L	P	
Coordination	Coordinate with [COR, AHJ, Vendors, etc.] to ensure that Cx interacts properly with other systems as needed to support OPR and BoD	P	P	N/A	P	L	P	
Cx Plan	Final Commissioning Plan w/ final PFCs and FPTs	R	A	N/A	R	L	R	
Schedules*	Duration Schedule for Commissioning Activities	R	A	N/A	O	L	R	
Doc Reviews*	TAB Plan Review	P	A	N/A	R	P	O	
	Submittal and Shop Drawing Review	P	A	N/A	R	P	O	
	Review Contractor Equipment Startup Checklists	P	A	N/A	O	P	O	
	Review Change Orders, ASI, and RFI	P	A	N/A	R	P	O	
Site Observation*	Witness Factory Testing	P	P	N/A	O	P	O	
	Construction Observation Site Visits	P	P	N/A	O	P	O	

Note: *(Appendix C) is just a sample to depict how such a matrix would be developed. There are many more commissioning tasks to be identified beyond what the sample identifies. The type of involvement shown is for instruction purposes only and would need to be developed on a project by project basis for the scope, size, and complexity of the project, the degree of rigor required, and with consideration of available District resources and expertise.*

**For D-B-B acquisition, DOR participation or review for tasks indicated as optional for the DOR should be determined on a case-by-case basis with consideration of scope and complexity of the project/system, availability of resources, and potential benefit of DOR participation/review; these additional services require funding consideration.*

Acceptance Phase (D-B-B & D-B) Commissioning Roles & Responsibilities		CxA = Commissioning Authority COR = Contracting Officer Rep CxG= Gov't Comm Consultant A/E = Designer of Record CxC = Construction Comm Specialist O&M = Gov't Facility O&M				L = Lead P = Participate A = Approve R = Review O = Optional N/A = Not Applicable		
Category	**Task Description**	**CxG**	**COR**	**CxD**	**DOR**	**CxC**	**O&M**	**Notes**
Meetings*	Pre-Test Coordination Meeting	P	P	N/A	O	L	P	
	Issues Resolution and Commissioning Report Review Meetings	P	P	N/A	O	L	P	
Document Reviews*	Review Completed Pre-Functional Checklists	R	A	N/A	R	L	P	
	Pre-Functional Checklist Verification	R	A	N/A	O	L	P	
	Review Operations & Maintenance Manuals	R	A	N/A	O	L	P	
	Training Plan Review	R	A	N/A	O	L	P	
	Warranty Review	R	P	N/A	O	L	P	
	Review TAB Report	R	A	N/A	R	P	P	
	Systems Manual	R	A	N/A	O	L	R	
Site Observations*	Construction Observation Site Visits	P	P	N/A	O	L	P	
	Witness Selected Equipment Startup	P	P	N/A	O	P	P	
Functional Test Protocols*	TAB Verification	P	A	N/A	O	P	P	
	Systems Functional Performance Testing	P	A	N/A	O	L	P	
Reports & Logs*	Final Commissioning Report	R	A	N/A	R	L	R	
	Submit Final Systems Manuals	R	A	N/A	O	L	R	

Note: *(Appendix C) is just a sample to depict how such a matrix would be developed. There are many more commissioning tasks to be identified beyond what the sample identifies. The type of involvement shown is for instruction purposes only and would need to be developed on a project by project basis for the scope, size, and complexity of the project, the degree of rigor required, and with consideration of available District resources and expertise.*

**For D-B-B acquisition, DOR participation or review for tasks indicated as optional for the DOR should be determined on a case-by-case basis with consideration of scope and complexity of the project/system, availability of resources, and potential benefit of DOR participation/review; these additional services require funding consideration.*

Post Occupancy Phase (D-B-B & D-B)	CxG= Gov't Comm Specialist COR = Contracting Officer Rep CxD = Design Comm Specialist DOR = Designer of Record CxC = Construction Comm Specialist O&M = Gov't Facility O&M	L = Lead P = Participate A = Approve R = Review O = Optional N/A = Not Applicable
Commissioning Roles & Responsibilities		

Category	Task Description	CxG	COR	CxD	DOR	CxC	O&M	Notes
Document Reviews*	Systems Monitoring Trended Data	R	R	N/A	R	L	P	
	Systems Manuals Update	R	A	N/A	O	L	R	
Site Observations*	Periodic Warranty (4 & 9 Month) Site Visits	P	P	N/A	O	P	P	
Functional Test Protocols*	Deferred and/or seasonal Testing	P	A	N/A	O	L	P	
Technical Activities*	Commissioning/Issues Resolution/Lessons Learned Meetings	P	P	N/A	O	L	P	
	Post-Occupancy Warranty Checkup and review of Significant Outstanding Issues	P	P	N/A	O	L	P	
Reports and Logs*	Final Commissioning Report Amendment	R	A	N/A	R	L	R	
	Issues Logs Closure Report	R	R	N/A	O	L	R	

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