

**American University**  
**Master Commissioning Plan**  
Revision 2.0

1/25/2022



# American University Master Commissioning Plan

Revision 2.0

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# 1 Introduction

Commissioning is defined as a systematic process of assuring by verification and documentation, from the design phase to a minimum of one year after construction that all building facility systems perform interactively in accordance with the design documentation and intent, and in accordance with the owner's operational needs, including preparation of operations personnel.

This Commissioning Plan is intended to be a roadmap for the parties involved in the Commissioning process. It lists the systems to be commissioned, the Commissioning process activities, and the roles and responsibilities for each party involved.

The goals of the Commissioning Plan are to identify and define the following:

- Systems to be commissioned.
- Commissioning Team members.
- Commissioning activities.
- Commissioning Team member responsibilities for each Commissioning activity.
- Documentation requirements from each activity and Commissioning Team member.
- Schedule parameters (i.e., how will Commissioning activities integrate into the other project delivery milestones?).
- Acceptance criteria for the completion of commissioning

## 2 Commissioning Team Members

Role	Company	Title	Name	Phone	Email Address
Owner's Project Manager	American University	Project Manager			
Owner's Commissioning Rep.	American University	Cx Manager	Curtis Drew	202-885-2403	scdrew@american.edu
Escorting and Access	American University	FM Support			
Design Team		Architect			
		Mechanical Engineer			
		Electrical Engineer			
Construction Team		Project Manager			
		Mechanical Contractor			
		Electrical Contractor			
		TAB Contractor			
		Controls Contractor			
Commissioning Agent		Lead Cx Agent			
		Lead Mechanical			
		Lead Electrical			

### 3 Systems to be Commissioned

#### **Building Automation**

- Sequence of Control – HVAC, Electrical & Plumbing Systems
- Graphics Integration – HVAC, Electrical & Plumbing Systems
- Intersystem Functional Testing
- Alarm verification

#### **Mechanical Systems**

- HVAC System and Building Campus Loop CHW/HW Connections
- Indoor Air Quality Monitoring System
- Energy Management System
- Domestic Hot Water System

#### **Life Safety Systems**

- Fire Suppression System
- Fire Alarm System
- Smoke Management Systems

#### **Electrical Systems**

- Normal Power Systems
- Emergency Electrical Power
- Critical Power
- Lighting & Occupancy Controls
- Building A/V & Communications Systems

#### **Security Systems**

- Card Access
- Cameras

#### **Specialty Systems**

- Classroom/Conference Room Audio-Visual, Lighting & Communications
- Laboratory Support Systems

## 4 Commissioning Process Matrix

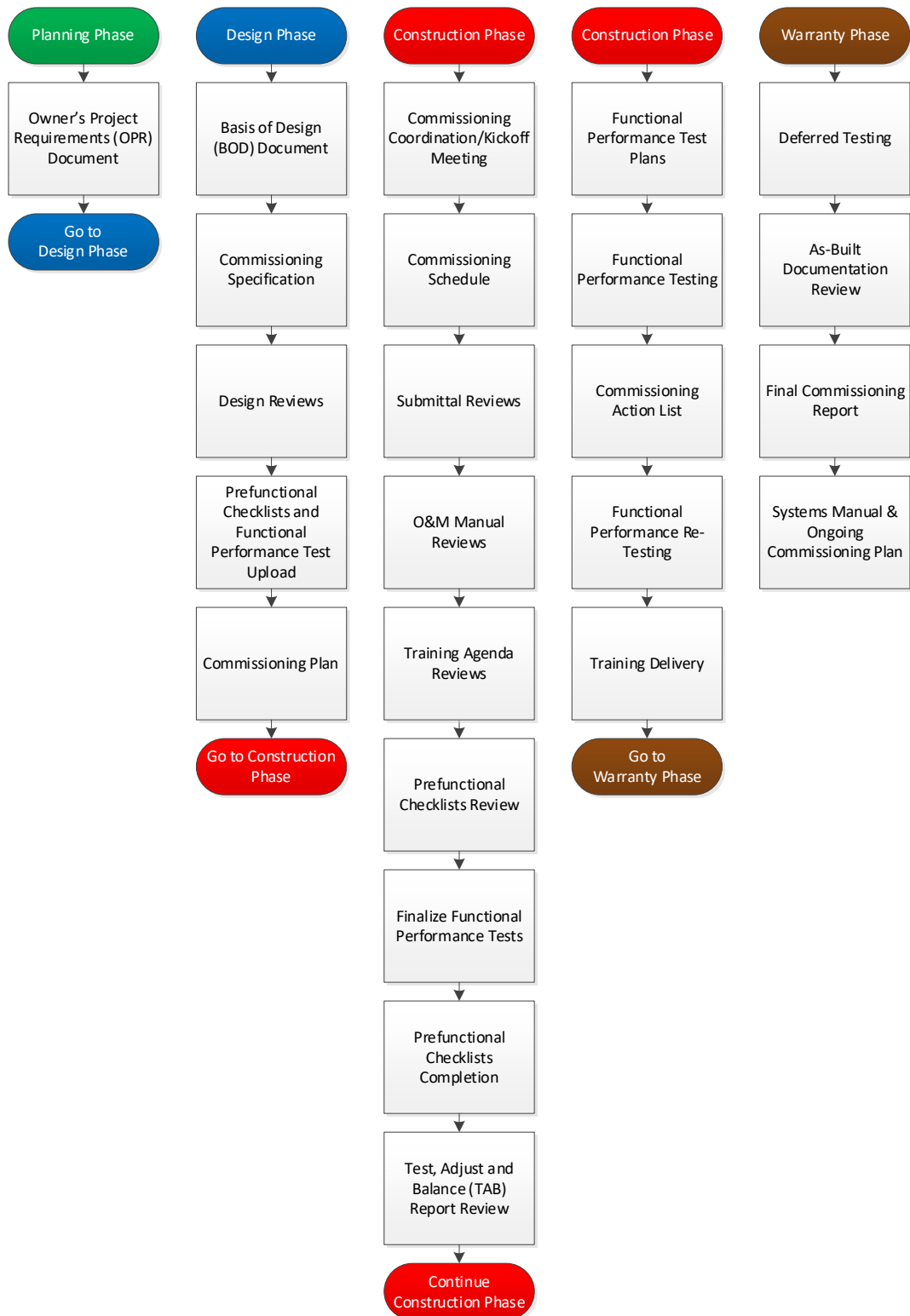
The following matrix tabulates the major commissioning activities; when they occur during the project life cycle; and the commissioning team member roles and responsibilities for each activity. For additional detail, please refer to Section 6: Commissioning Activities Narratives.

In the Commissioning Team Member columns an “R” indicates the responsible team member for each activity, and a “✓” indicates a team member who needs to participate in the activity.

	PROJECT PHASE				COMMISSIONING TEAM MEMBER					
	Planning	Design	Construction	Warranty	AU Project Manager	Cx Manager	Other AU Departments	Design Team	Construction Team	Cx Agent
Owner’s Project Requirements	✓	✓	✓		✓	✓	✓	R		✓
Basis of Design (BOD) Document		✓			✓	✓	✓	R		✓
Commissioning Specification		✓			✓	R		✓		
Design Reviews		✓			✓	R	✓	✓		✓
PFC/FPT Upload		✓	✓			✓			✓	R
Commissioning Plan		✓	✓		✓	✓		✓	✓	R
Construction Phase Cx Kickoff			✓		✓	✓			✓	R
Commissioning Schedule			✓		✓	✓		✓	✓	R
Submittal Reviews			✓		✓	✓	✓	✓	R	✓
O&M Manual Reviews			✓		✓	✓	✓	✓	R	✓
Training Agenda Reviews			✓		✓	✓	✓		R	✓
PFC Review			✓			✓			R	✓

	PROJECT PHASE				COMMISSIONING TEAM MEMBER					
	Planning	Design	Construction	Warranty	AU Project Manager	Cx Manager	Other AU Departments	Design Team	Construction Team	Cx Agent
Functional Checklist Review			✓			✓			R	✓
PFC Completion			✓		✓	✓			R	✓
TAB Report Review			✓		✓	✓	✓	✓	✓	R
FPT Planning			✓		✓	✓		✓	✓	R
Functional Performance Testing			✓		✓	✓		✓	R	✓
Commissioning Issues Log			✓		✓	✓		✓	✓	R
Functional Re-Testing			✓		✓	✓	✓	✓	R	✓
Training Delivery			✓		✓	✓			R	
As-Built Review				✓		R	✓		✓	✓
Deferred Testing				✓	✓	✓	✓			R
Final Commissioning Report				✓		✓				R
Systems Manual				✓		✓				R

## 5 Commissioning Process Flowchart





## 6 Commissioning Activities Narratives

### Planning Phase Activities

#### **Owner's Project Requirements (OPR) Document**

The Owner's Project Requirements (OPR) will quantitatively define the performance and operational requirements for the commissioned systems. These performance requirements will be the acceptance criteria against which the systems will be judged. They will include parameters such as temperatures, flows, pressures, moisture content, light fixture types, light levels, warranty information requirements, central system availability/tie-in capability, electrical spare capacity requirements, building automation system requirements, etc.

For LEED certification purposes, the OPR must include the following sections:

- Owner and User Requirements
- Environmental and Sustainability Goals
- Energy Efficiency Goals
- Indoor Environmental Quality Requirements
- Equipment and System Expectations
- Building Occupant and Operations and Maintenance Requirements

The Facilities Management Commissioning Authority will oversee the development of the OPR, but critical input will be needed from the Project Manager, Occupant/User Groups, and the Design Team

The Commissioning Manager will manage the OPR throughout the duration of the project, editing as necessary to reflect American University performance expectation changes and serve as a target for functional testing expectation.

### Design Phase Activities

#### **Basis of Design (BOD) Document**

The Basis of Design (BOD) documents the Design Team's approach to achieving the requirements of the OPR. It describes the types of equipment to be used, system configurations, systems interactions, and general operating strategies. It also documents any general rules, philosophies, and assumptions made by the Design Team. This document will be created and managed by the Design Team and reviewed by AUFM, the CxA and Project Management team.

Throughout the life of the project, the Commissioning Manager will monitor the design evolution and bring any deviations from the BOD to the attention to the Design Team.

#### **Commissioning Specification**

The Cx Manager will prepare a Commissioning Specification to be included in the design documents. The Cx Specification will detail the Design Team's and Contractor's responsibilities during the Design, Construction and Warranty Phases of the project. The

Design Team will incorporate the Commissioning Specification into the Division 1 section of the Design Specifications.

The Cx Specification will include, but not be limited to: Cx-related scheduling; submittal management; prefunctional checklists; functional performance testing; O&M and systems manuals; O&M and systems training; as-built drawings; and warranty management. Furthermore, the Cx Specification will define Contractor readiness and participation during functional performance testing. Cx Alloy, the AUFM provided commissioning software, will be required for documentation requirements for pre-testing/testing activities.

### **Design Review**

The Cx Agent, Cx Manager, AUFM and the Project Manager will review the design documents at predetermined design phase milestones (e.g., DD, 50% CD, 100% CD/Permit documents). AUFM will be represented by designated members of the Design Review team, responsible for reviewing the design documents concurrently with the CxA, CxM and Project Manager prior to the design review meetings.

Comment spreadsheets for each group shall be sent prior and consolidated for review by the Project Manager and Cx Manager before being distributed to the Design Team at the conclusion of the Design Review meeting(s). Design Review comments will be entered, tracked and answered on Cx Alloy.

The Design Review team will review the design drawings and specifications for the following commissioning-related items:

- Compliance with the Owner's Project Requirements.
- Clarity of the design.
- Clear integration requirements between equipment and systems
- Ability to test and validate system operation.

### **Prefunctional Checklists & Functional Performance Test Upload**

The Cx Agent will prepare prefunctional checklists (PFCs) and functional performance test procedures (FPTs) for the systems and equipment to be commissioned based on the Cx Plan. There shall be one prefunctional checklist and one functional performance test procedure for each commissioned system or piece of equipment uploaded to Cx Alloy.

### **Commissioning Plan**

The Cx Agent will prepare the Commissioning Plan. The systems to be commissioned section will be refined to represent the quantity and types of systems in the final construction documents. Sampling strategies pertaining to the functional performance testing will be detailed in the Commissioning Plan, initially outlined in the bid documents and design. The Cx Plan will be incorporated into the construction bid documents by reference and uploaded to Cx Alloy.

## **Construction Phase Activities**

### **Commissioning Coordination/Kickoff Meeting**

The Commissioning Manager will plan, facilitate and document Construction Phase Commissioning Coordination Meetings. The coordination meetings are intended to help every team member understand and execute their roles and responsibilities within the commissioning process, to coordinate the details of current and upcoming commissioning activities, and to review outstanding action items.

The first meeting will be a Construction Phase Commissioning Kickoff Meeting to review the specifics of the Commissioning process, identify new representatives to the Commissioning Team, and establish communication and documentation protocols for implementing the Commissioning process as efficiently and effectively as possible. This meeting provides an overview so that the team understands the big picture and the benefits they will accrue by participating in the process.

Subsequent Commissioning Coordination Meetings will be held as frequently as deemed necessary by the Commissioning Manager to remain integrated into the Construction Phase process. Frequency will vary throughout the construction as the Commissioning process requirements vary depending on what is happening on the construction site.

### **Commissioning Scheduling**

There will not be a separate commissioning schedule. The Contractor will be required to incorporate commissioning activities into the master construction schedule. The Commissioning Manager will assist the Contractor, as needed, to understand the relationship between construction and commissioning activities. The Facilities Management Commissioning Authority will regularly review the master construction schedule in order to coordinate the availability of Facilities Management staff for critical commissioning activities.

Master construction schedule commissioning milestones will include, but not be limited to, O&M manual submissions; training agenda submissions; training delivery; prefunctional checklist completion; functional performance testing; system manual and on-going commissioning plan submissions; as-built drawing submissions; and the warranty information hand-off. Some of the activities may require multiple milestones due to some systems following a different construction schedule than others.

### **Submittal Reviews**

The Commissioning Manager will identify submittals associated with systems to be commissioned that need to be reviewed by the Commissioning Manager and Facilities Management staff. The Facilities Management Commissioning Authority, AU Other Departments, and the Commissioning Manager will review the submittals concurrent with the Design Team.

The Contractor will send copies of the selected submittals to the Facilities Management Commissioning Authority and to the Commissioning Manager simultaneous with issuing them to the Design Team for review. The Facilities Management and AU Other Departments reviewers will submit their comments to the Commissioning Manager who will consolidate all comments and forward them to the Design Team. The Design team will incorporate the commissioning comments, at their discretion, into their formal submittal review responses to the Contractor. The Design Team will provide written responses to each submittal review comment to the Commissioning Manager.

Commissioning submittal review comments will focus on the same areas as the commissioning design reviews (e.g., compliance with the OPR, clarity of the design, integration coordination, accessibility and maintainability, O&M training and documentation requirements, and the ability to test and validate system operation). Refer to Section 7 for the Document Review Template.

The Commissioning Manager and Facilities Management Commissioning Authority will be given access to all approved submittals after processing by the Design Team.

### **Operations & Maintenance (O&M) Manual Reviews**

Early submission of the O&M manuals will help ensure they are complete and approved prior to the start of the AU Facilities Management staff training. The manuals will serve a critical part of the training program.

The Commissioning Manager will identify O&M manuals associated with systems to be commissioned that need to be reviewed by the Commissioning Manager and Facilities Management staff. The Facilities Management reviewers will submit their comments to the Commissioning Manager who will consolidate all comments and forward them to the Contractors.

### **Training Agenda Reviews**

All training session(s) will have a Training Agenda. The Training Agenda requires specific detailed information about the content of its respective session. The agenda will be completed by the Contractor responsible for the training session and will be reviewed by the Facilities Management Commissioning Manager and the Project Team. The Facilities Management reviewers will submit their comments to the Commissioning Manager who will consolidate all comments and forward them to the Contractors.

During delivery of the training sessions, each approved Training Agenda form will be used to document attendees of the training session and to formalize American University's acceptance of the training

### **Prefunctional Checklists Review**

The Commissioning Agent will finalize Prefunctional Checklists (PFCs) customized for each system to be commissioned after reviewing approved submittals, requests for information, change orders, supplemental instructions, and other construction phase modifications and/or additions. The Commissioning Agent will issue final PFCs to the Facilities Management Commissioning Manager for review and comment via Cx Alloy. Upon incorporation of accepted Facilities Management Commissioning Manager comments, the Commissioning Manager will upload final PFCs for completion and sign-off by the Contractor during final system checkout on Cx Alloy.

The PFCs shall be used to document that key system-level installation, startup, programming, coordination, integration, and testing activities have been completed. These are not contractor quality control checklists for each piece of equipment but system-level confirmation of readiness for the system's Functional Performance Test. The General Contractor will be responsible for overseeing the completion of the checklists by the Subcontractors because each system typically requires the participation of multiple Subcontractors to be complete and ready for testing.

### **Finalize Functional Performance Tests**

The Commissioning Manager will finalize Functional Performance Test Procedures (FPTs) for each system to be commissioned after reviewing approved submittals, requests for information, change orders, supplemental instructions, and other construction phase modifications and/or additions. These will be uploaded to Cx Alloy.

### **Prefunctional Checklists Completion**

The prefunctional checklists are used to document that the systems are fully installed, connected, started-up, programmed, integrated and have successfully passed a contractor-only dry run. Fully executed Prefunctional Checklists are the Contractor's validation that the systems are ready for successful Functional Performance Testing witnessed by the Commissioning Team.

These checklists are primarily inspections and procedures to prepare the equipment or system for initial operation (e.g., oil levels, fan belt tension, labels affixed, gauges in place, sensor calibration, etc.). However, some checklist items entail simple testing 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). Each piece of equipment is to receive full checkout by the Contractors. No sampling strategies will be permitted.

### **Test, Adjust and Balance (TAB) Report Review**

The TAB Contractor will prepare a balancing report documenting that all air and hydronic systems have been adjusted and are within acceptable design values. The Commissioning Agent and the Commissioning Manager will review the report submitted by the TAB Contractor, concurrent with the Design Team as the TAB Contractor completes work on individual systems (i.e., not all systems need to be balanced before the reporting process begins). The Commissioning Manager will verify that all required data has been collected, that the measured results follow the design documents, and that any non-compliance items have been resolved and rebalanced prior to the start of Functional Performance Testing.

The Facilities Management reviewers will submit their comments to the Commissioning Manager who will consolidate all comments and forward them to the Design Team. The Design team will address these comments, incorporating them as appropriate into their formal TAB report review response to the Contractor. The Design Team will provide written responses to each TAB report review comment to the Commissioning Manager.

### **Functional Performance Test Plans**

The Commissioning Agent will prepare and distribute Functional Performance Test Plans prior to the start of Functional Performance Testing. This will allow the Construction Team to review the proposed testing schedule; to understand which test procedures will be conducted during a specific testing period; to schedule the appropriate people to be in attendance for each test; and to verify that the necessary equipment is available when testing begins.

### **Functional Performance Testing**

Functional Performance Testing is the technical culmination of the Commissioning process for systems acceptance by the Commissioning Agent and should be performed prior to Substantial Completion.

The Commissioning Agent will field-direct, witness, and document the Functional Performance Test Procedure (FPT) for each system to be commissioned. Although the Commissioning Agent directs the tests, the Contractors will manipulate the systems and controls in accordance with the FPTs reviewed and accepted by all team members before the start of testing.

### **Commissioning Action List**

The Commissioning Agent will maintain a Commissioning Action List on Cx Alloy - starting in the Design Phase and continuing through the Closeout Phase - to track the status of all Commissioning- related items. The Commissioning Action List includes process-related and technical-related issues associated with successful completion of the Commissioning process.

For each deficiency found during Functional Performance Testing, the Commissioning Agent will add the item to the Commissioning Action List. The Commissioning Action List is the vehicle for communicating, tracking, and documenting the status and correction of each deficiency. These issues are tracked using Cx Alloy.

### **Functional Performance Re-Testing**

The Commissioning Agent will field-direct, witness, and document Functional Performance Re-Testing for each system that failed to pass its initial FPT. For systems tested with a sampling strategy, as defined in the Final Functional Performance Test Procedures, additional samples will need to be tested during re-testing if the failures of the initial sample exceed the failure rate threshold.

The extent and level of rigor of retesting will be as the Commissioning Manager deems necessary to confirm successful resolution of the initial deficiencies without sacrificing performance elements which had originally passed the system FPT.

Although the Commissioning Manager directs the re-tests, the Contractors will manipulate the systems and controls. Facilities Management representatives will witness and participate in the Functional Performance Re-Testing as determined by Facilities Management.

### **Training Delivery**

After the Training Agendas have been reviewed and accepted by the Project Team, the Commissioning Manager will begin to schedule the individual training sessions. The Contractor will formally document each training session through training agendas, attendance sheets and meeting minutes.

### **Warranty Phase Activities**

#### **As-Built Documentation Review**

The AU Project Manager will provide the Facilities Management Commissioning Manager with as-built documentation including, but not limited to, (1) record installation drawings and (2) the final building automation system controls manual. The as-built building automation system controls manual will include the final “as commissioned” system schematics, sequences of operations, setpoints, and alarm limits.

These documents will be reviewed by the Commissioning Agent and Facilities Management staff. The Facilities Management reviewers will submit their comments to the Commissioning Manager who will consolidate all comments and forward them to the AU Project Manager for resolution by the Design and Construction Teams.

#### **Deferred Testing**

Functional Performance Tests (FPTs) may need to be deferred until after Substantial Completion for a variety of reasons. The most common reasons include (1) HVAC systems may need to have different weather conditions than those at the end of construction and (2) commissioned systems may need to have a load put on them before testing can be considered meaningful. FPTs that occur after Substantial Completion will be conducted, documented, and tracked in a manner identical to the Acceptance Phase process.

#### **Final Commissioning Report**

Following resolution and/or acceptance of all Commissioning Action Items, the Commissioning Agent will prepare the Final Commissioning Report on Cx Alloy. The report will be a compilation of documentation (both technical and process-related) associated with the Commissioning process. It will be prefaced with an Executive Summary documenting the final system status compared to the Owner’s Project Requirements document.

The Commissioning Agent will submit the Commissioning Report to the Commissioning Manager for review.

#### **Systems Manual**

The Commissioning Manager will collect and compile the Systems Manual. At a minimum, these documents shall include the following for the commissioned systems:

1. Owner's Project Requirements
2. Basis of Design
3. Integrated Building Systems Operating Instructions
4. System Schematic Diagrams
5. As-Built Control Sequences of Operation and Initial Setpoints
6. Planned Maintenance Activities and Recommended Frequencies
7. Recommended Control System Sensor & Actuator Calibration Frequencies
8. Recommended Building Automation System Trend Logs for On-Going Commissioning Monitoring and Evaluation
9. Recommended System Re-Testing Frequencies