

BEYOND
SMART CITIES

**LEED®IMPLEMENTATION GUIDE
FOR CONSTRUCTION PROFESSIONALS**

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SUSTAINABILITY SPECIALIST ONLINE CURRICULUM COURSE



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COMMISSIONING ACTIVITIES

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LEARNING OBJECTIVES

- The Concept of the Commissioning Process
- Commissioning Documentation
- General Contractor & LEED Commissioning : Contractor's Role
- Costs and Benefits of Commissioning



THE COMMISSIONING PROCESS

☑ The commissioning process is **the integrated application of a set of engineering techniques and procedures to check, inspect, and test every operational component of the project**—from individual functions such as instruments and equipment, up to more complex entities such as subsystems and systems.

☑ **Commissioning Process:** a quality focused process for enhancing the delivery of a project.





LEED EA PREREQUISITE FUNDAMENTAL COMMISSIONING & VERIFICATION



INTENT

To support the design, construction, and eventual operation of a project that meets the owner's project requirements for energy, water, indoor environmental quality, and durability.

REQUIREMENTS

Implement or have a contract in place to implement the following fundamental best practice commissioning procedures

- ☑ Document the Owner's Project Requirements (OPR) and the basis of design documentation.
- ☑ Incorporate commissioning requirements into the construction documents.
- ☑ Develop and utilize a commissioning plan.
- ☑ Verify installation, functional performance, training, and operating and maintenance documentation.
- ☑ Complete a commissioning report.

LEED EA CREDIT: POSSIBLE 6 POINTS ENHANCED COMMISSIONING

INTENT

To further support the design, construction, and eventual operation of a project that meets the owner's project requirements for energy, water, indoor environmental quality, and durability.

REQUIREMENTS

In addition to the Fundamental Building Commissioning prerequisite, implement or have a contract in place to implement the following additional commissioning tasks:

- ☑ A commissioning authority independent of the design team shall conduct a review of the design prior to the construction documents phase.
- ☑ An independent commissioning authority shall conduct a review of the construction documents near completion of the construction document development and prior to issuing the contract documents for construction.
- ☑ An independent commissioning authority shall review the contractor submittals relative to systems being commissioned.
- ☑ Provide the owner with a single manual that contains the information required for re-commissioning building systems.
- ☑ Have a contract in place to review building operation with O&M staff, including a plan for resolution of outstanding commissioning-related issues within one year after construction completion date

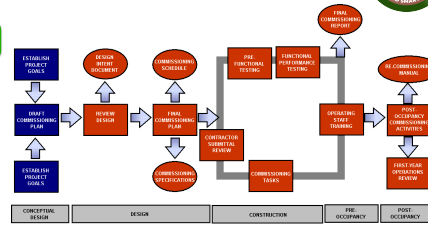


COMMISSIONING DOCUMENTATION



Design Intent Document

- Basis of Design
- Commissioning Plan
- Specifications
- Start-up Verification
- Functional Test Plans
- O&M/Training Info



DESIGN INTENT

- ✓ Critical to a successful Commissioning Process
- ✓ Conveys the owner's "big-picture" needs
- ✓ Defines benchmark for determining success
- ✓ Utilized and updated by Commissioning team throughout the Cx Process
- ✓ Living Document



SAMPLE DESIGN INTENT CONTENT



- ✓ Project goals and design goals: Overall LEED™ Rating
- ✓ Measurable performance criteria: Applicable codes and standards, General efficiency, Energy goals, Tolerances of the IEQ objectives
 - ✓ Envelope U-values
 - ✓ Chiller kW/ton
 - ✓ Annual Energy Use Goal
- ✓ Operation plan & maintenance requirements
- ✓ Types of tenants, occupancy req's, operating schedule
- ✓ IEQ criteria: space temperature, relative humidity, indoor air quality, noise level, and illumination level



COMMISSIONING DOCUMENTATION



Design Intent Document

Basis of Design

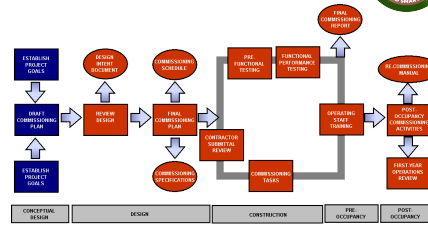
Commissioning Plan

Specifications

Start-up Verification

Functional Test Plans

O&M/Training Info



BASIS OF DESIGN

- ☑ Required input from Design Engineers into the Commissioning Process
- ☑ Completed prior to the end of Construction Docs
- ☑ Documents engineering detailed assumptions
- ☑ Used to complete design reviews, submittal reviews, and write functional tests
- ☑ Utilized and updated by Commissioning team throughout the Cx Process



SAMPLE BASIS OF DESIGN CONTE

- ☑ Htg & Clg loads & design assumptions
- ☑ Engineering calcs (i.e. piping sizing, duct static, duct sizing, pump head, diversity factors)
- ☑ Outdoor weather conditions
- ☑ General ventilation strategies & requirements
- ☑ Filtration requirements
- ☑ Control system point list
- ☑ System and control requirements & maintenance personnel capabilities



COMMISSIONING DOCUMENTATION



Design Intent Document

Basis of Design

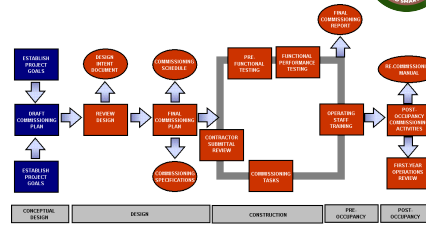
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COMMISSIONING PLAN

✓ Plain language document that describes the Commissioning Process

✓ Includes responsibility matrices showing each member's involvement

✓ Owner

✓ Design Professionals

✓ Contractors

✓ Commissioning Provider

✓ Provides sample forms used during design and construction for commissioning



SAMPLE COMMISSIONING PLAN



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4.3	Develop Commissioning Specifications for 100% CDs.....
4.4	Commissioning Scoping Meeting.....
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COMMISSIONING DOCUMENTATION



Design Intent Document

Basis of Design

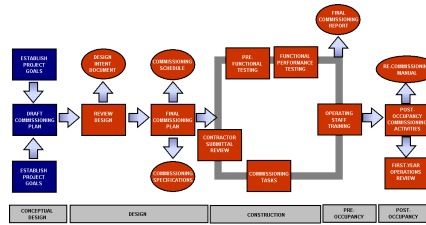
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CX SPECIFICATIONS

- ☒ Provide contractor's responsibilities for Commissioning
- ☒ Division 1, Section 01810 is Commissioning Requirements
- ☒ Additional Sections may be needed for more detailed information
 - ☒ 01811: Mechanical Systems
 - ☒ 01812: Electrical Systems
- ☒ Integrate with other specifications
 - ☒ Scheduling
 - ☒ Closeout
 - ☒ O&M Data
 - ☒ Training
- ☒ Requires coordination
 - ☒ Specification writer
 - ☒ Commissioning provider
 - ☒ Design Professionals



COMMISSIONING DOCUMENTATION



Design Intent Document

Basis of Design

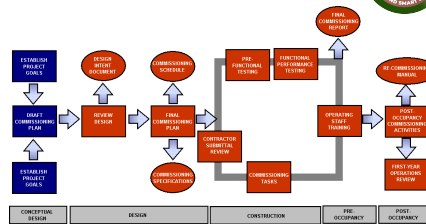
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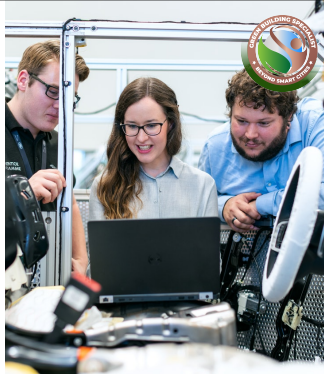
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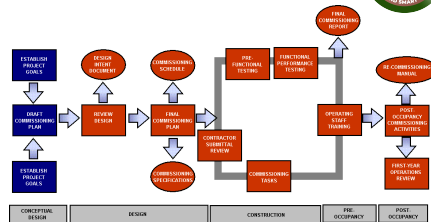
START-UP VERIFICATION

- ✓ Work with contractor's to verify that start-up is completed
- ✓ Use *Pre-functional Checklists* to document completion
- ✓ Start-up is completed prior to Functional Testing



COMMISSIONING DOCUMENTATION

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FUNCTIONAL TESTING & ANALYSIS

✓ Heart of Commissioning

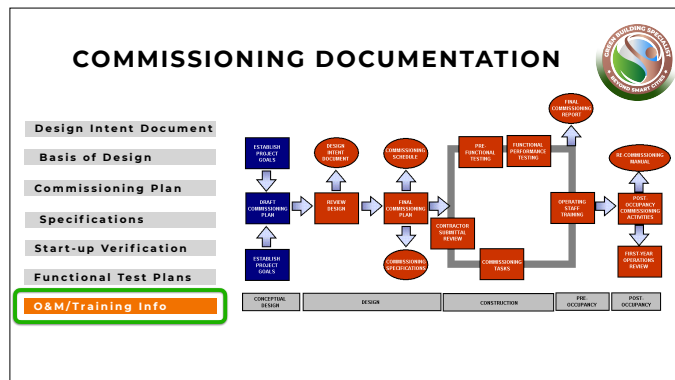
- ✓ Design Intent is verified
- ✓ Most time-intensive Cx activity
- ✓ Requires collaboration between: Owner, Contractor, Cx Provider
- ✓ Cx Provider writes detailed procedures
 - ✓ Test each system
 - ✓ Test under all modes of operation






FUNCTIONAL TESTING & ANALYSIS

- ✓ Different methods of verification
 - ✓ Contractors test system and Cx Provider documents results
 - ✓ At-Risk Commissioning Provider performs and documents testing
- ✓ Cx Provider analyses test results
- ✓ Testing Completed Prior to Substantial Completion






O&M / TRAINING INFORMATION

- ✓ Tailor O&M and Training information for each project
- ✓ Who are facility staff:
 - ✓ Maintenance Contractor
 - ✓ "In-house" Crew that cares for several Bldgs
 - ✓ Full-time staff dedicated to this building
- ✓ Capabilities of Facility Staff
- ✓ Complexity of systems

COMMISSIONING -CONTRACTOR OVERVIEW

- ☑ Contractors must interface with commissioning agents and participate in the various phases of comprehensive building commissioning activities.
- ☑ In general, contractors are responsible for filling out the construction checklists and returning them to the Commissioning Agent (CxA).
- ☑ Contractors are responsible for responding to any issues discovered during commissioning.
- ☑ The CxA generally oversees the testing; the contractors execute the testing.



CONTRACTOR BEST PRACTICES

- ☑ Participate in Cx kick-off meetings.
- ☑ Review the Basis of Design (BOD), Owner's Project Requirements (OPR), and commissioning requirements of the specifications to understand the responsibilities and tasks for the general contractor and subcontractors throughout the project
- ☑ Meet with the design and engineering team and the CxA to fully understand the commissioning scope, BOD and OPR
- ☑ Write the outlines of the commissioning requirements (BOD, OPR) into the work scopes of the MEP and low voltage contractors, including re-commissioning of the systems
- ☑ Provide line items on the Project Schedule for all commissioning activities including design review, submittal review, pre-functional testing and start-up, re-calibration, documentation, and re-commissioning.



CONTRACTOR BEST PRACTICES

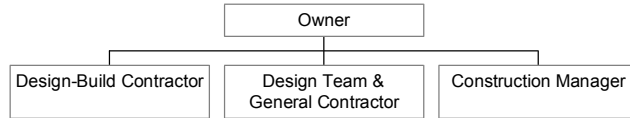
- ☑ Provide for separate meetings with the design and engineering team, CxA, and MEP and low-voltage contractors
 - ☑ Remember that commissioning is a discrete separate process from construction observation (punch list), start-up, TAB – testing, adjusting, and balancing, or final punch-out list.
 - ☑ Ensure the building's operating staff is fully knowledgeable about operating the equipment and systems. (Typically, this information is provided by the equipment manufacturer, general contractor, or subcontractors).
- Documentation**
- ☑ The contractor should ensure that commissioning requirements are incorporated into the Owner's Project Requirements, Basis of Design, and construction documents. The commissioning specifications in construction documents inform the contractors and subcontractors of their roles and responsibilities throughout the commissioning process.



CX PROVIDERS



- ✓ **Avoid Conflict of Interest**
- ✓ **Provide objective and unbiased point of view**
 - ✓ Cx Provider shouldn't have ultimate authority & responsibility to **design** or **install** any Cx'd systems
 - ✓ Cx Provider shouldn't be contracted by someone with ultimate authority & responsibility over Cx'd systems



CX PROVIDER QUALIFICATIONS

- ✓ **Knowledge of the common installation, maintenance, & operational pitfalls**
- ✓ **Experience troubleshooting the Cx'd systems**
- ✓ **Prior Cx experience for at least 2-5 similar Cx'd projects (depends on size & complexity)**
- ✓ **Can be composed of a team of experts to handle particularly complicated buildings**
- ✓ **Doesn't hold other responsibilities related to the project**



COMMISSIONING BENEFITS

- ✓ **Formal, quality assurance method**
- ✓ **Documented performance**
- ✓ **Reduces or eliminates contractor callbacks**
- ✓ **Capitalizes**
- ✓ **Passes design and construction knowledge to operators**
 - ✓ Systems Manual
 - ✓ Complete training program
 - ✓ Complete O&M data

