



**The California State University**

OFFICE OF THE CHANCELLOR



# **Commissioning Guideline for CSU Capital Projects**

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# ACKNOWLEDGEMENT

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# SECTION 1: **Introduction**

## **Purpose of the Document**

The purpose of this commissioning guideline is to outline the commissioning process and identify players' roles and responsibilities. It specifically provides information to guide the campus representative or University involved in a commissioning project. This document provides definitions of various commissioning terms; outlines the commissioning tasks chronologically during each phase of the project; and provides a description of each team player's responsibility throughout all phases of the project.

## **Commissioning Objectives**

The objective of commissioning is to provide documented confirmation that a facility fulfills the functional and performance requirements of the building campus, occupants, and operators. To reach this goal, it is necessary for the commissioning process to establish and document the campus criteria for system function, performance, and maintainability; as well as to verify and document compliance with these criteria throughout design, construction, start-up, and the initial period of operation. For the process to work successfully, it is important that the campus, commissioning agent, design team, contractors, and operators work together as a team throughout their involvement with the project.

An additional objective is to comply with the 2016 California Energy Code. Section 120.8 "Nonresidential Building Commissioning" requires commissioning for all nonresidential buildings (including Nonresidential, High-Rise Residential Hotel/Motel Occupancies, and Covered Processes) of 10,000 square feet or more. If the building is less than 10,000 square feet, a design review is still required under this section.

## **Systems to be Commissioned**

A systematic process of quality control and assurance should apply in every construction project. However, under prevailing construction practices, the level of appropriate rigor and the respective tasks of the project team will vary with project objectives, complexity, and criticality of the systems. Commissioning is a systematic process of quality control and assurance, and is required, for all capital projects.

Section 120.8 of the 2016 California Energy Code requires commissioning for all building systems and components covered by California Energy Code Sections 110.0, 120.0, 130.0 and 140.0. In general, this covers:

- Mechanical systems, including the heating, ventilating and air conditioning systems and controls and plumbing systems, including domestic hot water systems,
- Electrical systems, including lighting--occupancy sensor lighting controls and daylight dimming control systems
- Building envelope components (if considered in the Owner's Project Requirements)

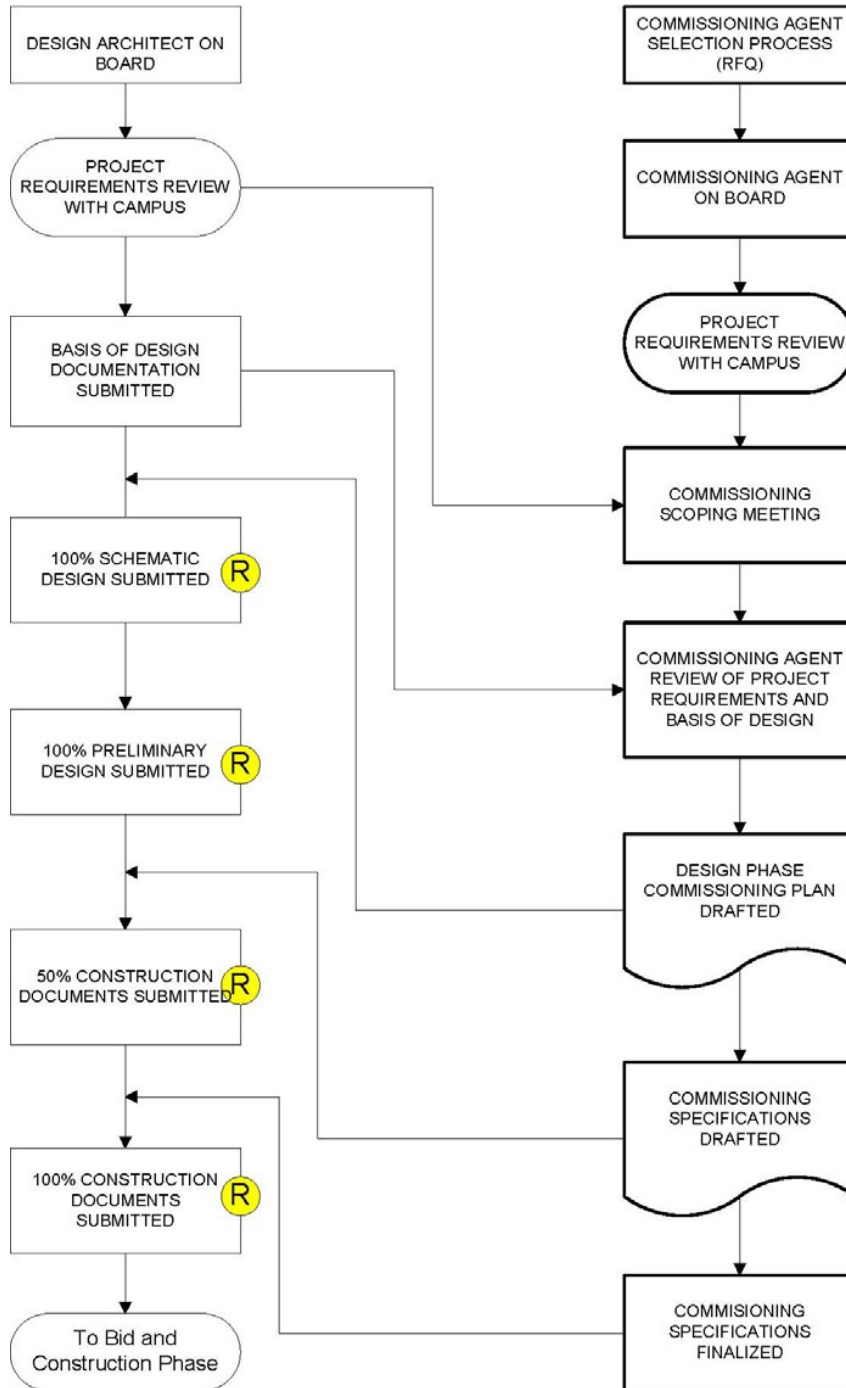
The following questions are intended to assist the University in deciding the appropriate commissioning rigor

to apply to specific systems and equipment.

- Is the system under consideration simple or complex, both in operation and design?
- Does the equipment operate independently of other equipment and systems?
- Can the facility afford the equipment's malfunction without endangering the occupants' health, safety and comfort?

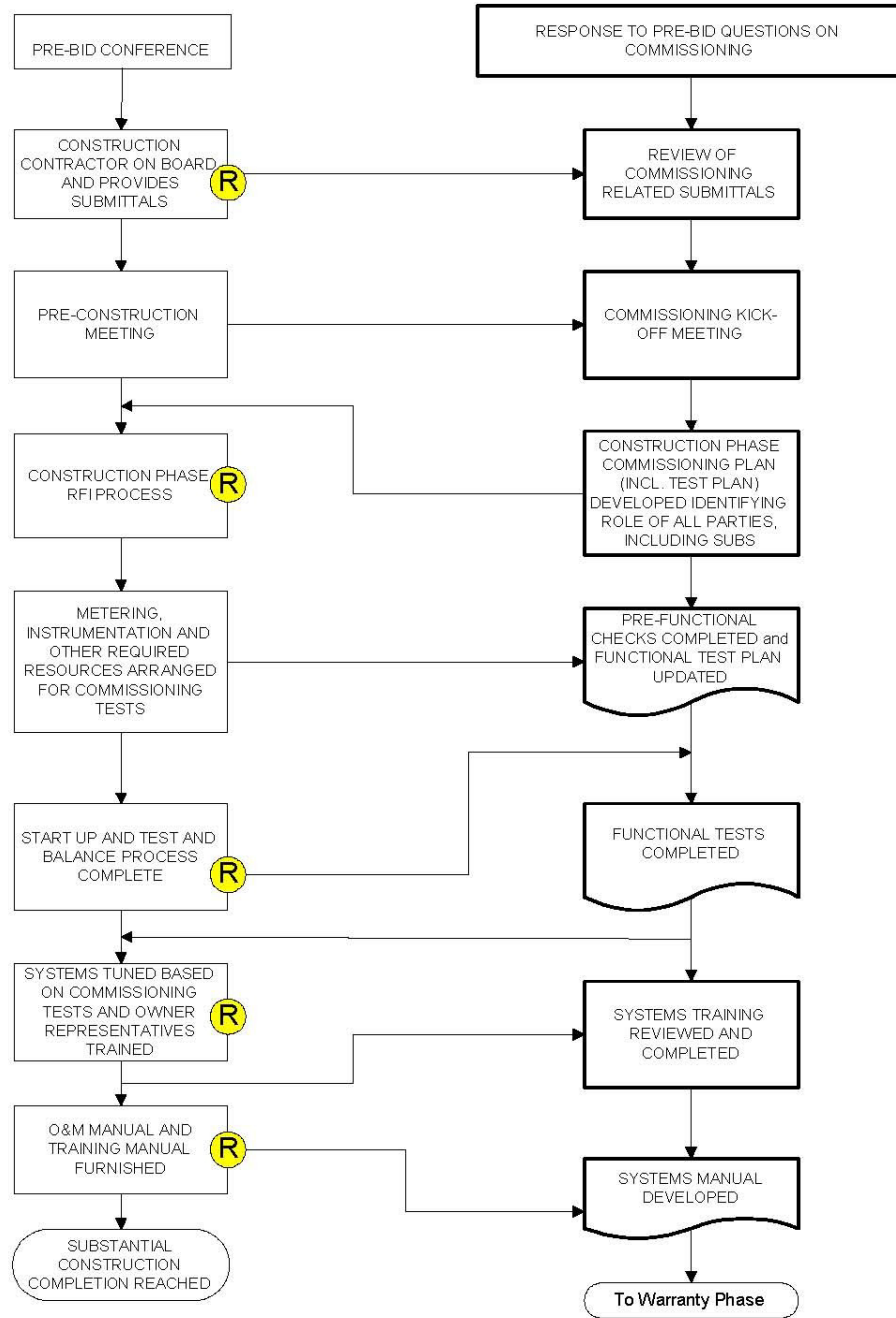
If the system is simple and some degree of latitude in equipment operation can be afforded, then a less rigorous commissioning scope may be acceptable. However, if the answer to any one of the questions above indicates a more complex system, then a comprehensive commissioning process is strongly recommended.

Figure 1 shows the commissioning process during the design phase of a project. This could vary depending on when the University contracts the commissioning agent. Figure 2 shows the commissioning process during the bid and construction phases of a project.



**R** Each Design Phase submittal reviewed by Commissioning Agent, with documented comments to the University

**FIGURE 1 – DESIGN PHASE COMMISSIONING PROCESS**



**(R)** Construction period RFI and other submittals reviewed by Commissioning Agent, with documented comments to the University/Engineer

**FIGURE 2 – BID AND CONSTRUCTION PHASE COMMISSIONING PROCESS**

## Funds for Commissioning CSU Capital Projects

Commissioning is required, for all CSU projects 10,000 square feet in area or greater. Commissioning for projects less than 10,000 square feet consists of a design review that may be performed by the engineer of record. Additional commissioning of projects under 10,000 square feet is the campus choice. Leased buildings, parking lots and other non-energy related facilities are exempted from commissioning.

Funding for commissioning the projects is included as a separate line item on CPDC Form 2-7. This budget is based on approximately 0.5% of the construction budget with higher percentage for smaller projects and lower percentage for larger projects. This budget may not be adequate to provide full MEP commissioning on certain smaller capital projects. Campus may choose to supplement with additional funding to provide additional commissioning or negotiate with the commissioning agent and scale back the scope of services for commissioning to match with the available funds. It is recommended that campuses utilize funds on these smaller projects late in the design phase to obtain more commissioning services in construction.

The campus should be able to obtain more commissioning services for larger capital projects (>\$30M) due to the fact that there is a certain fixed amount of commissioning activities on every project, irrespective of the construction budget.

Above budgets have been established based on typical CSU average project. Campus may negotiate a reduced scope of services with the service provider for a complicated project like a Science laboratory building. Campus may also negotiate a reduced fee with the service provider for a less complicated project or a project with multiple mechanical systems. An example of such a project may be a Student Housing Project.

## Definitions

**Basis of Design.** The documentation of the primary thought processes and assumptions behind design decisions are made to meet the campus objectives. The Basis of Design describes the assumptions used for sizing and selection of systems (i.e. codes, standards, operating conditions, and design conditions, weather data, interior environmental criteria, other pertinent design assumptions, cost goals, and references to applicable codes, standards, regulations and guidelines). The Basis of Design is written by the design team and increases in detail as the design progresses. Refer to *Submittal Requirements and Procedure Guide for CSU Capital Projects* for more information.

**Campus Project Requirements.** (Also referred to as Design Intent or Owner's Project Requirements.) A document that provides the campus vision for the planned facility and expectations for how it will be used and operated. It also provides a detailed explanation of the rationale behind the ideas, concepts and criteria that are defined by the campus to be important and to be tracked through design and construction. These concise concepts are likely to originate from the campus program. The requirements may be written by the University, the commissioning agent, or the design team in consultation with the campus. The University Project Requirements remain relatively fixed from their initial development unless budget or other factors require a modification.

This document should be developed before Schematic Design is started. A simple template for this document can be found in Appendix 3 at the end of this narrative.

**Campus Representative.** Person designated by the University to manage the project and make all



appropriate decisions on behalf of the University (approve schedule, design, change orders, etc.).

**Commissioning.** A systematic process of ensuring that building systems perform interactively according to the contract documents, the campus objectives and operational needs. This is achieved ideally by developing and documenting Campus Project Requirements beginning in the design phase with reviews of design and contract documents; and continuing through construction and the warranty period with actual verification through review, testing and documentation of performance.

**Commissioning Agent.** An independent party or engineer-of-record, at the University's discretion, implementing the overall commissioning process. Independence is recommended to assure unbiased performance without conflict of interest.

**Construction Manager.** The person designated to manage day-to-day activities of a construction process, including supervision and providing on-site management authority. The construction manager works closely with the commissioning agent and contractors to ensure that both the construction and commissioning processes move forward smoothly. In some instances, the Campus may also serve as the construction manager.

**Construction Phase Commissioning Plan.** An update of the commissioning plan developed during the design phase, which outlines the roles and responsibilities of each project team member, specifies procedures for documenting commissioning activities and resolving issues, and sets a preliminary schedule for conducting commissioning activities during the construction phase of the project. It is updated as construction progresses.

**Contract Documents.** Documents binding on all parties involved in the construction of the project, including, but not limited to, drawings, specifications, change orders, addenda, requests for information, and commissioning plan. Any formal documentation that affects a contractual requirement is considered to be a contract document. The contract document's initial form is the bid set of plans and specifications.

**Contractor and Equipment Suppliers.** Those who provide completed systems that are constructed and operate to meet design objectives in accordance with the contract documents. They also assist in the development and execution of the functional performance test procedures and training of building operators.

**Construction Coordination Drawings.** Drawings that eliminate logistical and spatial conflicts between equipment and systems installed by the various trades, and also facilitate fabrication and installation of an individual contractor's system. Coordination drawings are generated by a contractor prior to system installation and show additional detail and resolution beyond what is provided in the original drawings.

**Design Record.** A collection of documents that address all aspects of design starting with the Campus Project Requirements, Basis of Design, through the Performance Metrics.

**Design Phase Commissioning Plan.** The commissioning plan developed during the design phase which outlines each team member's role and responsibilities, sets protocols for communication and reviews, specifies procedures for documenting commissioning activities and resolving issues, and sets the initial schedule for commissioning activities during the design phase of the project.

**Design Team.** The design team generally includes the campus representative, an architect, an HVAC mechanical designer/engineer, an electrical designer/engineer, and other specialty sub consultants. The design team develops the building's design, including documents, plans, and specifications, that meet

campus expectations for the building. They also monitor construction activities and review as-built drawings and documentation for compliance with the contract documents.

**Functional Tests.** Tests that evaluate the dynamic function and operation of equipment and systems using manual (direct observation) or monitoring methods. Functional testing is the assessment of the system's (rather than just component's) ability to perform within the parameters set up in the Basis of Design. Systems are tested under various modes, such as during low cooling or heating loads, high loads, component failures, varying outside air temperatures, fire alarm, power failure, etc. The systems are run through all the control system's sequences of operation to determine whether they respond as the sequences state. Functional tests are performed after Pre-functional checklists are complete.

**Performance Metrics.** Measurable indicators that allow verification that a specific Campus Project Requirement or element in the Design Narrative has been met.

Performance Metrics are identified throughout the design of the project with as many as possible being generated during the development of the Campus Project Requirements. Metrics at the equipment or component level are generally identified later in design. The design team and commissioning agent are responsible for their development. Ideally one or more performance metrics are developed for each Campus Objective and discrete design description element.

**Pre-functional Checklist.** A checklist to ensure that the specified equipment has been provided, is properly installed, and initially started and checked out adequately in preparation for full operation and functional testing (e.g., belt tension, fluids topped, labels affixed, gages in place, sensors calibrated, voltage balanced, rotation correct, etc.).

## SECTION 2:

# Selection of Commissioning Agent

## Recommended Qualifications

It is desired that the firm designated as the Commissioning Agent satisfy as many of the following requirements as possible:

- Previous experience in providing commissioning services for projects
- Extensive experience in the operation and troubleshooting of HVAC systems, energy management control systems
- Extensive field experience
- Knowledgeable in building operation and maintenance and O&M training
- Knowledgeable in test and balance of both air and water systems
- Experienced in energy-efficient equipment design and control strategy optimization.
- Direct experience in monitoring and analyzing system operation using energy management control system trending and stand-alone data logging equipment
- Excellent verbal and writing communication skills.
- Highly organized and able to work with both management and trade contractors
- Experienced in writing commissioning specifications
- Membership with the Building Commissioning Association and/or AABC Commissioning Group

## Independent Commissioning Agent versus Design Team

In general, it is recommended that the Commissioning Agent be an independent party that is not affiliated with the design team, contractor, equipment manufacturer or any other party with a contractual financial interest in the project. For certain projects, qualified members of the project design or construction team may act as the Commissioning Agent as long as they meet the recommended qualifications listed in Section 2.1 and have commissioning experience with the systems involved in the project.

The duties and responsibilities of project team members performing the tasks of the Commissioning Agent are the same as those of an independent Commissioning Agent as outlined in this guideline document.

## Request for Proposal

A sample Request for Proposal for Commissioning Services has been provided in Appendix 1 to assist the campus in obtaining proposals for commissioning services.

## SECTION 3:

# Commissioning Process

The basic commissioning process is integrated with the phases of construction and should begin in the design phase and continue through construction and the warranty period. Commissioning enhances communication among project team members and ensures that they all understand the project goals. This allows the project team to identify problems early, before they can affect later phases of the project and cause delays. A brief description of each phase and expected commissioning activities are outlined below.

## Pre-Design and Design Phase (Pre-Design, Schematic, Preliminary & Construction Documents)

### Activities

- a. **Campus Project Requirements (also known as Owner's Project Requirements).** Unless the document has been produced by the Campus or the design team, the commissioning agent should assist or take the lead in developing the Campus Project Requirements documentation for the project. The campus objectives may be developed through a meeting of owner stakeholders with the design team and commissioning agent in attendance. At a minimum, the commissioning agent reviews the Campus Project Requirements for clarity and completeness.
- b. **Basis of Design.** The design team develops formal Basis of Design documentation. The commissioning agent and university ensure that these documents are written and updated, and review them for clarity, completeness and compliance with the campus objectives and earlier design narratives.
- c. **Commissioning Agent Selection.** The University may select a commissioning agent from the list of approved service providers on the CSU website, or select a qualified engineer of their choice.
- d. Additional Resource: Sample RFP in Appendix 1
- e. **Commissioning Scoping Meeting.** The commissioning agent assembles the commissioning team and holds a scoping meeting with the team to communicate the campus goals, needs and expectations for building operation and function and to identify commissioning responsibilities. Items discussed in this meeting are used to develop the scope and rigor of the commissioning effort.
- f. **Commissioning Plan.** The commissioning agent develops the design phase commissioning plan.
- g. **Commissioning Specifications.** The commissioning agent develops detailed commissioning specifications to be included by the design team in the final contract document. The specifications comprise commissioning-related requirements that will be the contractor's responsibility, including equipment installation and start-up, documentation and functional testing. In addition, the commissioning agent may recommend enhanced language regarding

training, documentation, installation, and system checkout for inclusion in non-commissioning sections of the specifications.

- h. **Design Review.** The commissioning agent attends selected design team meetings and formally reviews and comments on the design at various stages of development (ideally at least once during schematic design, preliminary design, and construction document phases). Potential system performance problems, energy-efficiency improvements, indoor environmental quality issues, operation and maintenance issues, and other issues may be addressed in these design reviews, depending on the commissioning agent's scope and the needs of the project. The commissioning agent ensures that the design follows and meets the original Campus Project Requirements. The commissioning agent does not approve the design, but makes recommendations to facilitate commissioning and improve building performance. It is the responsibility of the University to evaluate and discuss all findings with the design team and implement those approved.
- i. **The commissioning agent will conduct a design review on the projects that they are responsible for commissioning.** The reviews will take place at the schematic design phase, preliminary design phase, 50% construction documents, 95% construction documents and a final back check. The CXR forms relating to design review will be completed by CxA and coordinated with the design team for sign-off. If the project is under 10,000 ft<sup>2</sup>, unless commissioning is being performed on the project, it is assumed that a design review and completing the CXR forms will be performed by the engineer of record.

## Responsibilities

### UNIVERSITY

- a. University is responsible for developing the Campus Project Requirements (Owner's Project Requirements).
- b. University sends out requests for proposals (RFPs) or requests for qualifications (RFQs) for commissioning services.
- c. University selects commissioning agent.
- d. University coordinates commissioning scoping meeting to develop overall commissioning goals.
- e. University ensures that the commissioning roles and scope for all members of the design and construction teams be clearly defined in each party's contract and project specifications.
- f. University reviews the draft construction phase commissioning plan developed by the commissioning agent.
- g. University discusses all findings presented by the commissioning agent during formal design reviews with the design team.
- h. University reviews the commissioning specification language and draft construction phase commissioning plan developed by the commissioning agent.

### **COMMISSIONING AGENT**

- a. Pre-Design and Design Phases: If brought on board in this phase, actively coordinate the commissioning work effort. Provide a brief written assessment to the University at completion of the design phase on the progress of the commissioning effort.
- b. Pre-Design Phase: If brought on board in this phase, develop commissioning plan and specification recommendations for the design team use (advisory).
- c. Pre-Design Phase: If brought on board in this phase, develop commissioning specification recommendations for each system to be commissioned.
- d. If not already developed, take the lead in creating the Campus Project Requirements (Owner's Project Requirements) with assistance from the stakeholders and the design team.
- e. Commissioning agent reviews Basis of Design documentation produced by the design team for clarity, completeness and compliance with the Campus Project Requirements documentation and reports findings to the University.
- f. Commissioning agent attends selected design team meetings.
- g. Commissioning agent reviews design at various stages of development (ideally at least once during schematic design, design development, and contract document phases). The commissioning agent reports all findings to the University.
- h. Commissioning agent develops a draft construction phase commissioning plan and submits the plan to the University and design team for review.
- i. Commissioning agent develops commissioning specifications to be included in the final contract documents and submits the specifications to the University and design team for review. These specifications shall also include "Contractor and Equipment Suppliers" requirements listed in paragraph 3.3.2. Verify that the specifications contain the requirements called for in the California Green Building Standards Code. Commissioning Agent coordinates a controls integration meeting(s) where the electrical and mechanical engineers and the Commissioning agent discuss integration issues between equipment, systems and disciplines to ensure that integration issues and responsibilities are clearly described in the specifications.

### **DESIGN TEAM**

- a. Design team develops and updates formal Basis of Design as the design process continues.
- b. Design team addresses in writing all findings and recommendations presented by the commissioning agent during formal design reviews.
- c. Design team reviews and incorporates the commissioning and related specifications developed by the commissioning agent.
- d. Design team specifies State of California Title 24 Energy Efficiency Standards Acceptance Requirements for code compliance.

## **CONTRACTOR AND EQUIPMENT SUPPLIERS**

Generally, there is no participation at this phase unless the project delivery is Design-Build or CM-at-Risk.

## **MECHANICAL REVIEW BOARD (MRB)**

- a. As part of the Mechanical Systems Review, MRB member reviews Basis of Design documentation produced by the design team for clarity, completeness and compliance with the Campus Project Requirements documentation and reports findings to the University.
- b. MRB member reviews system design at various stages of development and reports all findings to the University.

## **Bidding Phase**

### **Activities**

- a. During the bidding phase, contractors review the contract documents and submit bids for constructing the project.
- b. **Pre-Bid Conference.** The commissioning agent may be asked to attend the pre-bid conference(s) to answer any questions about commissioning and may review bids, alternates, and addendums to ensure that commissioning, and the Campus Project Requirements, are not compromised by the changes.
- c. **Bid Addenda.** The commissioning agent may be asked to answer bid commissioning questions from the Design Team in preparation of bid addenda.

### **Responsibilities**

#### **UNIVERSITY**

In the pre-bid conference, the University advises that commissioning is part of the project.

#### **COMMISSIONING AGENT**

Commissioning agent may attend the pre-bid meeting(s) to answer any commissioning questions and may review contractor bids relative to commissioning for the Campus.

#### **DESIGN TEAM**

No special commissioning tasks.

## **Construction Phase**

### **Activities**

The main construction phase commissioning tasks are listed below.

- a. **Commissioning Kickoff Meeting.** The commissioning agent coordinates a construction phase commissioning kickoff meeting. The meeting should include the Campus, construction manager, design team, commissioning agent, and respective representatives from the general contractor and mechanical, electrical, controls, and testing, adjusting & balancing (TAB) subcontractors. At this meeting, the commissioning agent outlines the roles and responsibilities of each project team member, specifies procedures for documenting commissioning activities and resolving issues, and reviews the preliminary construction phase commissioning plan and schedule. Team members provide comments on the plan and schedule, and the commissioning agent uses these suggestions to help finalize the commissioning plan and schedule.
- b. **Commissioning Meetings.** During construction the commissioning agent may coordinate entire meetings devoted to commissioning issues.
- c. **Submittals.** As the Owner's advocate, the commissioning agent reviews contractor submittals of equipment to be commissioned during the normal submittal review process. The commissioning agent reviews and comments on each submission and forwards them to the University or the design team.
- d. Additional information requested in the specifications by the commissioning agent includes installation and start-up procedures, operation and maintenance information, equipment performance data, and control drawings prior to formal O&M manual submittals. This data is used by the commissioning agent to become familiar with the systems and to write functional test procedures. Campus support for obtaining these additional documents from the contractors is critical.
- e. **Changes Impacting Systems to be Commissioned.** All Requests for Information (RFIs) and change orders applicable to the commissioned systems shall be provided to the commissioning agent for review for impacts on commissioning and Campus Project Requirements.
- f. **Pre-functional Checklists and Start-up.** The installation, start-up and initial checkout of the equipment and systems are executed and documented by the contractor on Pre-functional checklists provided by the commissioning agent and on manufacturer checklists shipped with the equipment. These checklists are submitted to the commissioning agent, who makes sure they are complete before functional testing begins. The commissioning agent may witness some of the start-up execution and will spot-check selected items on the checklist prior to functional testing.
- g. **Functional Testing.** After developing written test procedures, the commissioning agent manages, witnesses, and documents the functional tests, with the actual hands-on execution of the test procedures typically carried out by subcontractors, particularly the controls contractor. Acceptable performance is reached when equipment or systems meet specified design parameters under specified conditions during different modes of operation, as described in the commissioning test requirements of the specifications and commissioning plan. Some testing is completed by monitoring system operation over time through the building automation system or dataloggers and is not normally completed until a few weeks after occupancy. The commissioning agent does not normally retest systems that have been tested



and approved by regulatory authorities. The commissioning agent may prepare test plans for, assist with execution of, and document tests of commissioned equipment overseen by regulatory authorities and should ensure that such tests meet the testing rigor desired by the Campus.

- h. **O&M Manuals.** The design team and commissioning agent reviews the operation and maintenance manuals and verifies that they are complete, clear, explicit, and available for use during the training sessions.
- i. **Systems Manual.** The commissioning agent compiles a Systems Manual that consists of the design record; space and use descriptions; single line drawings and schematics for major systems; control drawings; sequences of control; table of key setpoints and implications when changing them; time-of-day schedules; seasonal adjustment, startup and shutdown; instructions for energy savings operations and descriptions of the energy savings strategies in the facility; recommendations for recommissioning frequency by equipment type; energy tracking recommendations; and recommended standard trend logs with a brief description of what to look for in them. The Systems Manual with O&M Manuals will form Master O&M Manual. Verify that the Systems Manual contains the requirements called for in the California Green Building Standards Code.
- j. **Systems Training.** Ideally, enhanced systems training requirements are included in the specifications. The commissioning agent assists the Campus in ensuring that adequate training plans are used by the contractor and that the training is completed per the contract documents. The commissioning agent may provide training agendas in the specifications to the contractor's/manufacturer's trainers to review and use. The agendas should list, among the other things, the areas of particular concern to the Campus that should be covered in the training.
- k. **Commissioning Record.** Shortly after occupancy, the commissioning agent typically writes a final commissioning report, which summarizes the commissioning effort and gives the commissioning agent's disposition on each piece of commissioned equipment relative to installation and start-up, functional performance, O&M documentation, and training. The Commissioning Record also contains the commissioning plan, functional tests, individual commissioning reports and reviews, and issues log. Verify that the report contains the requirements called for in the California Green Building Standards Code.

## Responsibilities

### CAMPUS

The roles of the Campus, construction manager, and contractor site supervisor are sometimes blurred, and some projects do not have a construction manager. The following tasks should be divided between the construction manager and Campus, as appropriate, for the specific project.

- a. Campus *and* construction managers review the updated construction phase commissioning plan scope, roles and responsibilities, communication and resolution protocols, and general schedule.

- b. Campus *and* construction managers review regular commissioning progress reports and memoranda submitted by the commissioning agent.
- c. Campus *or* construction manager sees that the commissioning agent receives all RFIs and change orders impacting commissioning activities.
- d. Campus *or* construction manager attends periodic construction meetings and commissioning meetings as necessary and discusses commissioning progress report and issues with team members.
- e. Campus *and* construction managers participate with the design team and contractors to resolve issues raised by the commissioning agent in a timely manner.
- f. Campus identifies a lead facility maintenance contact and arranges for facility operating personnel to assist in field commissioning activities and attend training sessions.
- g. Campus *and* construction managers support the development and execution of a training plan.
- h. Campus receives and reviews Systems Manual and Commissioning Record submitted by commissioning agent and makes the final decision regarding satisfactory completion of commissioning activities and initial acceptance of system operation.

### **COMMISSIONING AGENT**

- a. Commissioning agent refines the construction phase commissioning plan, including scope, responsibilities, and schedule, and submits the plan to the Campus and construction manager for review.
- b. **Coordination:** Coordinate as required to ensure that commissioning activities occur in a logical and efficient manner and provide effective and regular communications with all parties on commissioning related items. Monitor to ensure that commissioning activities are appropriately incorporated into the contractor's project construction schedule.
- c. **Construction Meetings:** Monitor meeting minutes and participate in the meetings if necessary, to coordinate or discuss commissioning issues.
- d. Commissioning agent coordinates a construction phase commissioning kickoff meeting.
- e. Commissioning agent coordinates commissioning meetings with various team members as necessary.
- f. Commissioning agent develops and updates a record of all issues and findings throughout the construction phase. Issues are presented without delay to the project and construction managers, and to contractors according to predetermined protocols.
- g. Commissioning agent reviews all commissioned equipment submittals.
- h. Commissioning agent reviews all RFIs and contractor change order requests regarding systems to be commissioned.
- i. Commissioning agent provides Pre-functional checklists to the contractors.
- j. Commissioning agent reviews all Pre-functional checklists completed by the contractors, spot

checks some equipment, and witnesses the start-up and checkout of critical pieces of equipment.

- k. **Construction Progress:** Monitor construction progress and conduct periodic site observations sufficient to confirm commissioning activities are being appropriately completed consistent with the progress of the completion of the work.
- l. **Pipe and Duct Pressure Tests:** Review piping pressure testing and flushing documentation and ductwork testing and cleaning documentation sufficient to assess that proper procedures were followed, and satisfactory results were obtained.
- m. **Test and Balance Reports:** Review air and water balancing reports. Conduct related site observations as may be warranted. Provide written assessment to the University recommending acceptance of the test and balance report.
- n. Commissioning agent writes detailed functional test procedures for all commissioned equipment.
- o. Commissioning agent manages and witnesses all functional tests and documents findings and recommended corrective measures.
- p. **Utility meters:** Confirm calibration certificates of utility meters (gas, water, electric) are provided. Confirm integrity of utility meters data into building automation systems.
- q. **Trend Logs:** Analyze functional performance trend logs and monitoring data to verify planned system performance is realized. Provide written assessment recommending acceptance to the University.

### **DESIGN TEAM**

- a. Design team reviews the updated construction phase commissioning plan.
- b. Design team attends the construction phase commissioning kickoff meeting.
- c. Design team reviews all commissioning findings requiring their participation for resolution.
- d. If requested, members of the design team present a systems overview during facility staff training.

### **CONTRACTOR AND EQUIPMENT SUPPLIERS**

- a. Contractor facilitates the coordination of the commissioning work by the commissioning agent to ensure that commissioning activities are incorporated into the master schedule.
- b. Contractor furnishes a copy of all construction documents, RFIs, addenda, change orders, and approved submittals and shop drawings related to commissioned equipment to the commissioning agent.
- c. Contractor includes requirements for submittal data, O&M manuals, commissioning tasks and training in each purchase order or written subcontract.
- d. Contractor ensures that all subcontractors execute their commissioning responsibilities

according to the contract documents and schedule.

- e. Contractor attends construction phase commissioning kickoff meeting and other meetings scheduled by the commissioning agent.
- f. Contractor is responsible for coordinating and executing the training of campus personnel.
- g. Contractor prepares O&M manuals, according to the specifications.
- h. Contractor provides required metering and instrumentation for the Functional Tests as specified by the Commissioning Agent.

## Warranty Period

### Activities

- a. **Seasonal Testing.** Seasonal testing is conducted to verify proper operation during, at minimum, both winter and summer conditions. Presumably, one of the “seasons” was tested at building turnover. The testing should be performed by the appropriate contractor and witnessed by the commissioning agent and building operators. However, the campus may have their operations staff and commissioning agent execute the tests and bring contractors back only if there are issues to be resolved.
- b. **Near Warranty End Review.** The Commissioning Agent may also be tasked with returning a few months prior to the expiration of the contractor’s one-year warranty to interview facility staff and review system operation. Acting as the campus technical resource, Commissioning Agent assists the facility staff in addressing any performance or warranty issues. If there are still any outstanding issues, the campus shall address them with the contractors or design team.

### Responsibilities

#### CAMPUS

- a. Campus works with the commissioning agent to review system operation prior to equipment warranty expiration. The Campus works with contractors to resolve any issues raised by the commissioning agent.
- b. Campus ensures that facility staff provides support to the commissioning agent during seasonal testing.

#### COMMISSIONING AGENT

- a. Commissioning agent coordinates, supervises and documents required seasonal testing.
- b. Commissioning agent reviews system operation and performance prior to expiration of equipment warranties and assists facility staff in resolving outstanding warranty and performance issues.
- c. Commissioning Agent makes any revisions to the Systems Manual.

**DESIGN TEAM**

Design team may be asked to participate in the near warranty end review.

**CONTRACTOR AND EQUIPMENT SUPPLIERS**

- a. Contractor executes seasonal functional testing, witnessed by the commissioning agent, according to the specifications.
- b. General contractor ensures that subcontractors correct deficiencies and make necessary adjustments to O&M manuals and as-built drawings for applicable issues identified in any seasonal testing.

## SECTION 4:

# **Commissioning Scope of Services as Described in the “CSU Commissioning Master Enabling Agreement”**

Further guidance on the commissioning scope of services for the California State University System is found in the commissioning Master Enabling Agreement (MEA).

<http://www.calstate.edu/cpdc/ae/review/commissioning.shtml>

## APPENDIX 1:

# Resources for Commissioning Information

### Web Sites Containing Commissioning Documents

AABC Commissioning Group	<a href="http://www.acgcommissioning.com">http://www.acgcommissioning.com</a> Commissioning Guideline and information on selecting a commissioning provider
American Society of Heating, Refrigerating & Air Conditioning	<a href="http://www.ashrae.org">http://www.ashrae.org</a> Commissioning Guidelines 0 and 1
Building Commissioning Association	<a href="http://www.bcxa.org">http://www.bcxa.org</a>
National Institute of Health Model Commissioning Guide	<a href="http://des.od.nih.gov/farhad2/Commissioning/nih_cx_guide/ComGuideTitle.htm">http://des.od.nih.gov/farhad2/Commissioning/nih_cx_guide/ComGuideTitle.htm</a>
NEBB	<a href="http://www.nebb.org/search.htm">http://www.nebb.org/search.htm</a> (Certification Program and Manuals)
Oregon Office of Energy	<a href="http://www.energy.state.or.us/bus/comm/bldgcx.htm">http://www.energy.state.or.us/bus/comm/bldgcx.htm</a> (Benefits of Cx, Case Study, the full text of Commissioning for Better Buildings in Oregon) [rcx]
PECI	<a href="http://www.peci.org/">http://www.peci.org/</a> (Cx conference announcement, downloadable Model Cx Plan and Guide Specifications, Cx information sources, Cx & O&M training locator database)
Texas A&M Energy Systems Lab	<a href="http://www-esl.tamu.edu/">http://www-esl.tamu.edu/</a> (retro-commissioning process and software, for purchase) [RCX]
University of Washington	<a href="http://depts.washington.edu/fsesweb/fdi/index.html">http://depts.washington.edu/fsesweb/fdi/index.html</a> Univ. Cx guide specs distributed throughout the specs. Vol's 1-4)
USDOE / FEMP	<a href="http://www.eren.doe.gov/femp/">http://www.eren.doe.gov/femp/</a> (full text of GSA/USDOE Building Commissioning Guide; early version of Model Cx Plan and Guide Specifications)
USDOE	<a href="http://www.eren.doe.gov/">http://www.eren.doe.gov/</a> (Links to commissioning documents. Search on "commissioning.")
Seattle City Light	<a href="http://www.ci.seattle.wa.us/seattle/light/conserves/business/bdgcama/cv6_bcam.htm">http://www.ci.seattle.wa.us/seattle/light/conserves/business/bdgcama/cv6_bcam.htm</a> (standardized test procedures and case studies)
Whole Building Design Guide	<a href="http://www.wbdg.org/index.htm">http://www.wbdg.org/index.htm</a> National Institute of Building Sciences

## Procedural Guidelines, Specifications and Functional Tests

\* Denotes documents available on electronic disk. [RCX] = dedicated solely to retrocommissioning; [rcx] = contains some data on, retro-commissioning. D = for design phase, C = for construction phase. All CAPS denotes document is more comprehensive than lower case.

Source	Guide-lines	Guide Specs	Sample Tests
Appendix VII Idaho New Building Commissioning Guidelines. State of Idaho, 2000. Available at: <a href="http://www2.state.id.us/adm/pubworks/archengr/commg197.htm">http://www2.state.id.us/adm/pubworks/archengr/commg197.htm</a>	YES	No	No
Building Commissioning Assistance Handbook Appendices. Seattle City Light, 1999. (standardized functional test procedures <a href="http://www.ci.seattle.wa.us/seattle/light/conserve/business/bdgcoma/cv6_bcam.htm">http://www.ci.seattle.wa.us/seattle/light/conserve/business/bdgcoma/cv6_bcam.htm</a> )	No	No	*YES
Procedural Standards for Building Systems Commissioning, National Environmental Balancing Bureau (NEBB), 1999. 301-977-3698	Yes d, c	Some d, c	Some
A Practical Guide for Commissioning Existing Buildings, PEI and Oak Ridge National Labs (ORNL), 1999. NTIS 1-800-553-6847 [RCX]	YES	No	No
Model Commissioning Plan and Guide Commissioning Specifications, USDOE/PECI, 1997. NTIS: # DE 97004564 1-800-553-6847. <a href="http://www.peci.org/cx/mcpgs.html">http://www.peci.org/cx/mcpgs.html</a>	*Some D, c	*YES D, C	*YES
Building Commissioning Guide, U.S. GSA. & USDOE, 1995, revised in 1998 (Ver. 2.2). Ver. 1 by Enviro-Management & Research, Inc. Version 2.2 available on the web: <a href="http://www.eren.doe.gov/femp/techassist/bldguide.pdf">http://www.eren.doe.gov/femp/techassist/bldguide.pdf</a>	*Yes D, C	No	No
The HVAC Commissioning Process, ASHRAE Guideline 1-1996, 1996. ASHRAE Publications Dept., 1791 Tullie Circle, NE, Atlanta, GA 30329.	Yes d, C	Some d, c	No
The Building Commissioning Handbook, The Association of Higher Education Facilities Officers (APPA), written by John Heinz and Rick Casault, 1996. APPA, 1643 Prince Street, Alexandria, VA 22314.	YES d, C	YES C	No
Beyond Lighting DSM: Life After Green Lights, Montgomery Co., MD, 1995. [RCX] Existing building commissioning case study with sample process and detailed procedures. 70 pgs. 301-217-6000.	Yes	No	Yes
Engineering and Design Systems Commissioning Procedures, U.S. Army Corps of Engineers, 1995 (ER 1110-345-723). Dept. of the Army, U.S. Army Corps of Engineers, Washington, DC 20314-1000.	Some d, c	Some d, c	No
Commissioning Specifications, C-2000 Program, Canada, 1995. C-2000 Program, Energy Mines & Resources, Energy Efficiency Division, 7th Floor, 580 Booth St., Ottawa, Ontario, Canada K1A 0E4.	No	*YES C	No
Model Construction Document Specifications and A/E Services Contract Clauses. Bonneville Power Administration/John Heinz, U. of WA, 1995. 503-230-7334. Also available on the Univ. of Washington web site below.	No	*YES C	Some
Commissioning Guidelines, Instructions for Architects & Engineers, State of WA., 1995. Dept. of General Admin., Div. of Engin. & Arch., (360) 902-7272.	Yes d, c	No	No
Commissioning of HVAC Systems, seminar/workshop training materials, Univ. of Wisconsin, Madison, 1994. 800-462-0876 or 608-262-2061	Some C	Some C	Some



Source	Guidelines	Guide Specs	Sample Tests
Laboratory HVAC Systems: Design, Validation and Commissioning, ASHRAE collection of 11 papers, 1994.	Yes C	No	No
Commissioning Smoke Management Systems, ASHRAE Guideline 5-1994. ASHRAE Publications Dept., 1791 Tullie Circle, NE, Atlanta, GA 30329.	Yes d, c	No	No
Standard HVAC Control Systems Commissioning and Quality Verification User Guide, U.S. Army Const. Engineering Research Labs, 1994. Facilities Engineering Applications Program, U.S. Army Engineering and Housing Support Center, Ft. Belvoir, VA 22060-5516. FEAP-UG-GE-94/20.	No	No	Yes
Contractor Quality Control and Commissioning Program—Guidelines and Specification, Montgomery Co. Gov., St of Maryland, 1993. 301-217-6071.	*Yes c	*YES C	*Some
HVAC Systems Commissioning Manual, Sheet Metal and Air Conditioning Contractors' National Association (SMACNA), 1993. SMACNA, 4201 Lafayette Center Dr., Chantilly, VA 22021.	Yes c	Some c	Some
Commissioning Guide, Public Works Canada, Western Region, 1993. 403-497-3770.	Some d, c	Yes d, C	No
Guide Specification for Military Construction—Commissioning of HVAC Systems, Dept. of the Army, U.S. Army Corps of Engineers, 1993. Washington, DC 20314-1000	No	*Some c	*YES
Building Commissioning Guidelines, Bonneville Power Administration/PECI, 1992. 503230-7334.	YES d, C	Some c	Some
HVAC Functional Inspection and Testing Guide, U.S. Dept. of Commerce and the General Services Administration, 1992. NTIS: 800-553-6847.	No	No	YES
Thermal Energy Storage (TES) Commissioning Guidelines, California Institute for Energy Efficiency, San Diego State University, 1991. San Diego State University, Energy Engineering Institute, San Diego, CA 92182.	Yes C	No	Yes
AABC Master Specification, Associated Air Balance Council. (Primarily for how the TAB fits into the commissioning process) AABC National Hdqrs, 202-737-0202.	No	*Yes d, C	No