

<b>SUBJECT:</b> UCF Building Energy Systems Commissioning Procedure	<b>Effective Date:</b> 10/16/15	<b>Procedure Number:</b> FS 2015 UES0003	
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	<b>Responsible Authority:</b> Director, Utilities & Energy Services (U&ES)		

**APPLICABILITY/ACCOUNTABILITY:**

This procedure applies to all UCF facility improvements, renovations, and capital projects, regardless of funding source.

**PROCEDURE STATEMENT:**

The building energy systems commissioning procedure is to be used as a guide by all UCF stakeholders throughout the design and construction process. The systematic process will ensure that all commissioned building energy systems are planned, designed, tested, operated, and maintained to meet the Owner’s Project Requirements (OPR).

**DEFINITIONS:**

**Basis of Design (BoD):** a document from the Engineer of Record comprising two components: Design Criteria and Design Narrative. These documents record the concepts, calculations, decisions, and product selections used to meet the OPR and to satisfy applicable regulatory requirements, standards, and guidelines.

**Commissioning Authority (CxA):** the Director, Utilities and Energy Services, or his/ her designee, or a 3<sup>rd</sup> party qualified entity who leads, plans, schedules and administers the commissioning (Cx) Process

**Commissioning Plan (Cx Plan):** a document that outlines the scope and defines responsibilities, processes, schedules, and the documentation requirements of the Cx Process

**Construction Equipment Checklist:** a list of data and inspections that must be verified to ensure proper system or component installation, operation, and function. Verification checklists are developed and used during all phases of the Cx Process to confirm that the OPR is being achieved.

**Owner:** the University, on the behalf of the University of Central Florida Board of Trustees

**Owner Project’s Requirements (OPR):** a written document that details the project requirements and the expectations of how the building and its systems will be used and operated.

These include project goals, measureable performance criteria, cost considerations, benchmarks, success criteria, institutional knowledge, and supporting information.

**Functional-Performance Test (FPT):** a test that verifies the proper operation of equipment or a system. Tests require operation 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 the control system's sequences of operation, and components are verified to be responding as the sequences state.

**Systems Manual:** a manual assembled by the CxA with assistance from the architect/engineer (A/E) and construction team. The systems manual will include, at a minimum, the OPR; BoD; specifications; submittals; project record documents, including control schematics; sequences of operation; control set-points; alarm notifications; and other relevant documentation needed to understand the operation of the commissioned systems in accordance with the latest ASHRAE Standards.

**Issues and Resolution Log:** a formal and ongoing record of problems or concerns – and their resolutions – that have been raised by members of the Cx team during the course of the Cx process. Items not conforming to the project specifications or documents will be entered into the Cx Issues Log and left open until the UCF Owner's representative accepts or acknowledges the issue is resolved by either the contractor and/or design team.

## **PROCEDURES:**

- 1. Initiation of the commissioning (Cx) process:** The Cx process begins at project inception. All projects will be commissioned using the latest ASHRAE Standards. ASHRAE delineates the Owner's responsibilities, including the CxA selection and development of the OPR, and a comprehensive list of Cx requirements. The level and selection of systems to be commissioned at the beginning of the project will be determined based on energy intensity, consumption, criticality, complexity, quantity, and outcome observed when the equipment and systems' functional test sampling has commenced.
  - a. Once a project is funded and a project folder has been established, the Facilities Planning and Construction (FP&C) Associate Director or his/her designee should coordinate with the Utilities and Energy Services (U&ES) Energy Service department to schedule an OPR development workshop with all the pertinent UCF stakeholders. The meeting shall take place prior to commencement of pre-design, and include the end user(s), Owner, FP&C, Facilities Operations (FO), Quality Assurance/Quality Control (QA/QC), U&ES, Environmental Health and Safety (EH&S), and other pertinent departments or leadership, as required.
  - b. U&ES and FP&C will conduct the OPR meeting and issue the first draft to the design team.

- c. The design team will review the OPR comments and incorporate them into the project design; with review by the CxA at various milestones to include concept design, advanced schematic design, design development, and 50% and 100% construction documents.
- d. The design team must provide a comprehensive energy model prior to each of the UCF design workshops, using the ASHRAE 90.1 2010 baseline. The energy model software, Energy Plus, will be used to validate the OPR, ensuring the design complies with the university's mandatory LEED credits and achieves the prescribed water and energy efficiency over the baseline building. This will also ensure the approach and method is in line with the university's sustainability initiatives.
- e. The design team will respond in writing to the UCF project manager to all comments presented on the issues and resolution log items that have been identified by the CxA and accepted by the Owner, including the BoD. Responses will indicate where each comment has already been addressed, not where each comment will be addressed.
- f. Prior to issuing 100% construction documents, the Owner must accept the energy model and BoD.
- g. Once the construction team has been selected (or a GMP has been accepted), the UCF PM will conduct a kick-off meeting to review the Cx Plan with U&ES.
- h. The construction team will then incorporate the Cx Plan activities into its milestone schedule and provide updated copies to the Owner's representatives and key project stakeholders as the project progresses.
- i. The construction team will review the Cx checklist and perform, complete, and verify that all systems have been started up per the original equipment manufacturer, and will ensure completion of startup documents, functional checks, and point-to-point of all building automation inputs/outputs (I/O) are confirmed with the U&ES building automation group with complete graphics – all prior to the functional test with the CxA.
- j. The Test and Balance (TAB) must be complete and signed by the EOR and reviewed by the CxA prior to certificate of occupancy.
- k. The construction team will then provide copies of all as-builts to key stakeholders and the CxA prior to the functional test with UCF, or by a third party commissioning agent.
- l. The construction team will provide all pertinent Owner required training prior to UCF's acceptance of the facility, along with the equipment and warranty matrix, to the Facility Operations Computerized Maintenance Management System Coordinator.

- m. Issues and resolutions from the functional test outlined in the commissioning plan must be completed prior to issuing and obtaining a certificate of occupancy, with a copy of the system's manual provided to the Owner.
  - n. UCF will conduct a 10 month post-occupancy survey, in conjunction with the CxA, under LEED IEQ Credit 7.2 -Thermal Comfort. Responses from the survey deemed deficient or noncompliant with the original design intent will be issued back to the design and contract team to address while under the warranty period.
- 2. Owner's Project Requirements (OPR):** The OPR commissioning requirements will be developed by UCF's key internal stakeholders and the CxA during the pre-design phase, and include at a minimum:
- The facility use and operating schedule
  - Energy and efficiency goals
  - Indoor space requirements, such as temperature, ventilation, etc.
  - A list of all systems/equipment to be commissioned
  - The project schedule
  - Testing and sampling procedures
  - Training requirements
  - Submittal requirements
  - The Cx report format

The OPR will be included in all pertinent contract documents for informational purposes and will be updated regularly throughout the Cx process to reflect any changes necessitated by the Owner, with revision control.

**3. Commissioning plan:** This provides the organizational plan and requisite documentation, including:

- An overview of Cx process specific to the current project
- Roles of the third party and / or in-house Cx team
- Cx activities and schedules
- A list and formats of all Cx evaluations and testing forms
- A list of systems to be commissioned and specific evaluation procedures for each

**4. BoD:** The BoD lists the design team's approach to meeting the OPR, and provides the Owner with a better understanding of the design issues. The BoD is submitted by the design team to both the Owner and the CxA and should contain:

- Design assumptions and attention to the OPR
- Consideration of design alternative opportunities for improved performance

- Proper location of equipment
- Coordination of applicable technical and code requirements
- UCF acceptance prior to issuance of contract documents

**5. Contractor and supplier requirements:** The applicable Cx process specifications and requirements shall be included in all contracts with contractors, subcontractors, suppliers, service providers, and manufacturers for the systems and equipment being commissioned. Contractors, suppliers, etc., shall provide the required documentation as defined in the contract documents. Examples of these documents include submittals, shop drawings, installation manuals, operations and maintenance (O&M) manuals, and existing conditions documentation.

**6. Design review:** The CxA shall perform a review of the design documents to ensure that they comply with the OPR including the BoD and the energy model. The design review focuses on test requirements, sequences of operation, accessibility for maintenance and operations, and design of essential system equipment. The CxA shall provide a design review report with comments, questions, and observations to the Owner and design teams for compliance with the OPR. This design review is not a UCF Building Code Office review or peer review.

**7. Commissioning submittal review:** The Cx team shall review the requisite submittal documents for all systems being commissioned, to ensure that they comply with the OPR. The CxA shall submit a written report to the Owner and design authority, and will include a copy in the final commissioning report.

**8. Construction observation and testing:** The proper installation, operation, and systems interaction shall be tested and verified for all equipment listed in the Cx plan. This step in the process shall consist of:

- A systems evaluation, including detailed equipment information such as model, serial numbers, nameplate data, and condition of equipment upon delivery
- Establishment of specific test procedures and sampling quantities for systems containing a large number of components
- Execution of test procedures repeated as often as needed until the systems are in compliance with requirements. The CxA witnesses and documents these tests in conjunction with key UCF stakeholders, building liaisons, Facilities Operations, and end users. Any equipment or system that fails to meet requirements in a timely manner is assigned an issue number and recorded in the issue and resolution log.

**9. Issues and resolution documentation:** The Cx team shall develop a formal Issues and Resolution Log, and document any open or continuing item from the Cx progress reports. The log will list all continuing items, along with the person/organization responsible for their

resolution. The log will be maintained throughout the project until all issues are resolved or accepted by the Owner.

**10. Systems manual:** This shall provide the information needed to operate, maintain, and train personnel on the building's systems, and should include:

- An executive summary
- Equipment and system installation manuals
- Facility design and construction: copies of OPR and BoD
- Building systems: equipment specifications, contractor submittals, manufacturers' O&M data
- Facility operations: equipment operating schedules, control sequences and set points, and the operating plan
- Training: the training plan and materials, and training records
- Approved submittals from the engineer of record (must be turned over to the Owner's CxA no later than 30 days from approval in the format of a single electronic file)
- Final commissioning report: Cx plan, testing and evaluation reports, design review report, and issues and resolution log

**11. Training plan:** O&M personnel and occupants shall be trained in the operation and maintenance of the commissioned systems. The training plan will be specific to the space use and operations necessary to maintain the facility throughout the life cycle, and will include:

- An outline of instructional topics addressing the design, operation, and maintenance of specific systems and equipment
- Training requirements within UCF Design and Construction Standards
- The location and minimum duration of training sessions, along with the instructors' qualifications, and training records

NOTE: A copy of the plan shall be included in the systems manual.

**12. Post-occupancy operation:** The post-occupancy activities begin at substantial completion and include any delayed or seasonal testing not yet completed. Any warranty issues should also be addressed at this time. The Owner or general contractor is responsible for contractor call-backs. At the conclusion of the post-occupancy operations, the systems manual, testing documentation, and final Cx report shall be submitted to the Owner.

Prior to issuing a certificate of occupancy, all items identified on the Issues and Resolutions Log must be complete and signed off by U&ES.

**13. Final Cx report:** The final Cx report is submitted to the Owner and summarizes the Cx process, building operations, the Cx Plan, and its results. An executive summary will identify all systems commissioned, and the location of the final OPR and BOD documents and project record drawings. It should also contain the following:

- The final Cx process plans
- Copies of design and submittals review reports
- A completed copy of the CxA evaluations and start-up and test forms
- Copies of all of the Cx progress reports
- A copy of the Issues and Resolutions Log and descriptions of measures taken to resolve all issues
- A list and explanation of any systems that do not perform in accordance with the OPR
- A resolution plan approved by the Owner for any incomplete issues or testing, and the party responsible for their resolution

**14. In-Warranty (LEED v 3.1 CR E&A):** Ten months after substantial completion and before the warranty expires, the CxA will visit the site and meet with the Owner's facility staff. The Owner may request all or a selected representative of the contracting team to be present for all or part of this walk-through. The meeting is intended for the following:

- To hear first-hand from the facility staff how the building systems are operating
- To understand what types of warranty calls have surfaced
- To answer questions that the facility staff may have regarding the building systems

After the meeting, the CxA will walk through the major mechanical rooms, observe the major pieces of equipment, and view the system from the Building Automation System operator's workstation. The outcome of this meeting may result in the following:

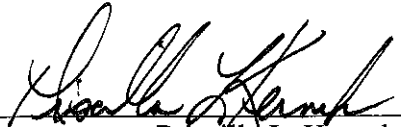
- Identification of additional warranty items for the contractors to address
- A recommendation from the CxA that additional training be provided

**13. Matrix of Responsibility:**

Project Phases	Event / Documentation	UCF	CxA	A/E	GC/CM	MEP/TAB contractor	BAS contractor
Project Initiation	Owner's Project Requirements (OPR)	Assist / Approve	Create/ Update	Review / Use	No Action	No Action	No Action
Design Phase	Cx Plan	Review	Create/ Update	Review	No Action	No Action	No Action
	BoD	Review / Approve	Review / Approve	Create/ Update	No Action	No Action	No Action
	Cx Specs	Review / Approve	Create/ Update	Review / Response	No Action	No Action	No Action
	Design Review	Review / Approve	Create/ Update	Review / Response	No Action	No Action	No Action
Construction Phase	Cx Submittal Review	Incorporate CxA comments	Review / Comment	Incorporate CxA comments	Provide / Revise	Provide / Revise	Provide / Revise
	Cx Kickoff Meeting	Attend	Lead	Attend	Attend	Attend	Attend
	Construction Observation and testing	No Action	Create/ Update	No Action	Review	Review	Review
	Issues and Resolutions Documentation	Review	Write / Update	Review	Verify Completion	Correct	Correct
	Systems Manual	Review	Write	Review	Provide info as needed	Provide info as needed	Provide info as needed
	Training Plan	Review / Attend	Review	Review / Attend	Schedule / Execute	Execute	Execute
	Post-Occupancy Operation	Observe	Lead, Document	Observe	Schedule	Participate	Participate
	Final Cx Report	Review / Approve	Write	Review	No Action	No Action	No Action
In-Warranty	10 Month Cx Review	Observe	Lead, Document	Observe	Schedule	Participate	Participate

**RELATED INFORMATION:**

ASHRAE 202 - Commissioning Process for Buildings and Systems  
 Leadership in Energy and Environmental Design - Building Design and Construction (LEED B, D&C)  
Current UCF Design, Construction, and Renovation Standards  
UCF Professional Services Guide  
<http://policies.ucf.edu/documents/3-111energysustainabilityfinal.pdf>  
<http://www.energy.ucf.edu/>

Approved By:	Date Approved:
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