

Building commissioning standard



UNIVERSITY OF
TORONTO

Facilities & Services



Commissioning Process

Overall Building Commissioning

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1. Introduction

1.1. General

1.1.1. The Commissioning Process is intended to **direct** the commissioning activity in the execution of **the Building systems** for all new, expanded or renovated systems. It is not intended to provide installation direction, but instead to provide a process and responsibility matrix ensuring consistent delivery of the commissioning task.

1.2. Purpose

1.2.1. The purpose of this document is to set out the University of Toronto commissioning process for all projects involving changes to existing and new buildings systems and equipment installations supplemental to the processes and documents listed in CSA standard Z320-11 in regards to **responsibilities, procedure and deliverables**, and to add references to standard ANSI/ASHRAE/IES where applicable.

1.2.2. The purpose of this document is also to ensure all the project stakeholders have read and understand the process and use this document.

1.2.3. The intended audience for this documents are the ones listed under Responsibilities section



2. Definitions

Terms	Definition
Basis of Design (BOD)	Documentation of the primary thought processes and assumptions behind design decisions that were made to meet the owner's project requirements (OPR). The basis of design describes the systems, components, and methods chosen to meet the OPR.
Beneficial Occupancy	When the building can be occupied for its intended purpose. When it is functionally complete.
Calibration Tolerance Limits (CTL)	The acceptable variation in instrument indication for a given input, for which no adjustment is required. The CTL is derived from the Instrument Manufacturer Limits. The CTL is within the Process Calibration Tolerance Limit of an instrument.
Change	Any addition to, deletion from, or modification to an aspect, material, facility, utility, equipment, logic or practice within the scope of the Building system. This differs from a deviation due to unplanned events requiring temporary actions to be remediated to the initial conditions prior to the unplanned event.
Commissioning Authority	An individual or company identified by an owner to lead the commissioning activity in the implementation of the commissioning process.
End Device	A device in the field that measures, monitors or controls
Functional Performance Testing	A range of tests under actual load, conducted to verify that specific systems, subsystems, components, and interfaces between the systems conform to a given criteria.
Internet Protocol (IP) Address	A numeric label assigned to each Internet Protocol capable device.
Minimum training requirements check sheet	Check sheet provided for each equipment, when the contractor wishes to perform training on equipment prior to meeting the

	requirements for final handover. The list shall indicate the status of the documents.
Network Switch	A network device that connects devices together on a computer network
Occupancy	When the building is substantially complete and can be occupied.
Operating Instruction for Emergency Work	A detailed narrative providing, in building operators' layman language, the specific instructions for start-up, shut down and seasonal changeover of the systems/components. This shall be provided including all relevant details such as: exact type and specific location of each device and interlocks; list of conditions to be fulfilled prior to attempting the equipment start up (correct valve positioning, etc)
Operational Training	Training of the Property Manager and Facilities Representative (individuals who use, operate, or maintain) using current versions of the commissioning documents including operations and maintenance manuals. The training shall be designed specifically for each group delivered both in classroom and on-site.
Operation and Maintenance Manual	An operations manual details modes of operation with associated diagrams to illustrate the sequence of operation for each system and interaction between systems. The maintenance manual describes maintenance requirement and sequences, with the required bill of material.
Owner's Project Requirement (OPR)	Document that provides the explanation of the ideas, concepts and criteria that are considered to be very important to the owner. The OPR cites specific measurable goals for the owner's objective. The OPR is defined by the PPR.
Patch Panel	A device with a number of ports between field environments and network (EMRS) switches
Process Calibration Tolerance Limits (PCTL)	The maximum allowable deviation of a quality subject to measurement from the true value before there is an impact on the control of the process.



Project Planning Report (PPR)	Specifies all desired functional requirements and/or special facilities consistent with the academic priorities and requirements. PPR's are prepared for all individual Capital Projects and Infrastructure Renewal Projects for which Project Committees are established.
Static Verification	The verification and documentation that all system elements are in accordance with the design requirements, correctly installed, connected and labelled with consideration for accessibility.
Startup Verification	The verification that documentation is complete, sensors are calibrated, control wiring integrity checked, correct response of all points in system verified with correct response of all end devices in the system.
System Description with narrative	A detailed description of the design philosophy, design intent, and design criteria for each system. Includes details of system type, composition, location of areas served in the building, and function of major components.
System Operation Manual	A system focused composite document that includes the design and construction documentation, facility guide and operation manual, maintenance information, training information, Commissioning Process record, and additional information of use to the owner during occupancy/operation

3. Responsibilities

3.1. Project Manager

- 3.1.1. Represents the interests of the facility as directed by the University. Act as Owner Rep.
- 3.1.2. Provides project final delivery requirements as directed by the University
- 3.1.3. Explanation of ideas, concepts and criteria considered important to the University
- 3.1.4. Identification of specific, measureable expectations deliverable to the University

3.2. Designers (mechanical, Electrical et al.)

- 3.2.1. Develops the design so that the completed facility will function as intended by the University as communicated through the Owners Project Requirement (OPR), functionally described in the Basis of Design, and informed by the University Design Standards.
- 3.2.2. Provides detailed design requirements for the intended facility or facility change.
- 3.2.3. Reviews the constructed work, process changes if necessary and identifies deficiencies in the contractor's work.
- 3.2.4. Ensures adherence of the design to Regulations, Standards and Practices including those specific to the University in the execution and product delivered.

3.3. Contractor / Vendor

- 3.3.1. Responsible to execute the specific directions of the detailed design requirements provided by the Designers.
- 3.3.2. Responsible to execute the detailed design requirements as specified in compliance to all Regulations, Standards and University accepted practices.
- 3.3.3. Execute the component and system commissioning in accordance with the Commissioning Authority's requirements.

3.4. Commissioning Authority (CxA)

- 3.4.1. As defined in the CSA Standard Building Commissioning, Z320-11 (or latest standard) and in accordance to ASHRAE/ANSI/IES when specifically referenced, provides the commissioning of the installation from the design phase to the complete operational cycle including preparation of manuals and training oversight and sign off. The standard CSA Z320-11 applies in its entirety except when specifically mentioned otherwise:
 - 1. Form and lead the commissioning activity and team preparing an organizational chart with role definition describing responsibilities and accountabilities, to be reviewed and accepted by the Project Manager.
 - 2. Develop and utilize a commissioning plan to manage time and resources that includes timeline for commissioning procedures for all aspects of building and commissioning phases. Identify with the

Project Manager the specific items to be commissioned based on Project Manager's priorities and project risk.

3. Development of site procedures and checklists with specific deliverables to verify acceptance of installation, start up, and final performance testing, both individually and systematically within the facility at specified component, system and environmental conditions as defined by the Owners Project Requirement (OPR).
4. Prepares updated OPR document that addresses items as outlined in ANSI/ASHRAE/IES Standard 202-2013 section 6.2.3
5. Review the Contractor's inclusion of submittals into the construction documents for all Building Systems to be commissioned. This review must be concurrent with the review of the Architecture / Engineer of record and all comments are to be submitted to the Project Manager.
6. Construction phase responsibilities include participation in full and complete review and verification of the receipt of as designed components in collaboration with the Architect or Design Engineers of record.
7. Onsite verification of proper installation, with pretesting as possible, of system components during construction with continuous Project Manager feedback through prompt communication and follow up. Ensure correction of deviations immediately using specifications and Project Manager representation as required.
8. Conduct site visits, as required, to witness compliance with the procedures and checklists developed for installation verification, start-up testing, and functional performance testing for the various building systems to be commissioned.
9. Accountable to act as a Project Manager representative to document, administer and onsite verify all aspects of design, selection, installation, start up and final commissioning for all defined aspects of the facility, as specified by the Project Manager.
10. Coordinate and witness the training of designated facilities representatives, i.e. building operations personnel. All training shall be recorded. Commissioning agent shall co-ordinate recording and editing of the recording.
11. Oversee through review and critique the Operations and Maintenance Manual to describe building systems defining components and systems operating methodology and generally accepted maintenance practices. The document development and definition to be reviewed and approved by the Facilities Representative or designated representative. Document to include equipment bill of materials and OEM maintenance recommendations to be provided in both hard copy and electronic versions.
12. Provides System manual as outlined in ANSI/ASHRAE/IES Standard 202-2013 section 14 and informative appendix L, including system description with narrative and Operating Instruction for Emergency Work.. System manuals shall be provided to the owner for the use in building operation and training of personnel.

13. Preparation, verification and completed execution of project turnover.
14. Conduct a 10 month warranty review with the Facilities Representative to ensure that any warranty issues are identified prior to the end of the warranty period.
15. Review building operation with the Facilities Representative over the first year of operation and develop a plan for resolving outstanding commissioning related issues including how occupants may report Internal Air Quality (IAQ) concerns, how these IAQ issues will be investigated / addressed, and how the results will be reported back to the occupants.
16. Post occupancy operation commissioning, including delayed and seasonal testing and warranty issues, shall be performed as outlined in ANSI/ASHRAE/IES Standard 202-2013 section 16..

3.5. Facilities Representative

- 3.5.1. The Facility User, Operator and Maintainer to whom the mechanical electrical and controls aspects are delivered.
- 3.5.2. Ensure the installed project as designed and demonstrated through the commissioning process is manageable in the daily operation of the facility to meet the Owners Project Requirements within the Operations responsibilities.

3.6. Information Technology

- 3.6.1. The provision of resources, both equipment and human, to implement system components as defined in the detailed design requirements provided by the Designers.

4. Procedure

4.1. General

The Building System commissioning process shall conform to the following structure:

- a) Owners Project Requirement (OPR)
- b) Basis of Design (BoD)
- c) Static Verification (IQ)
- d) Startup Verification (OQ)
- e) Functional Performance Testing (PQ)
- f) System Description with narrative
- g) Operating Instruction for Emergency Work
- h) Operational Training

i) System Operation Manual

4.2. Commissioning Documentation

4.2.1. Updated OPR document that addresses items as outlined in ANSI/ASHRAE/IES Standard 202-2013 section 6.2.3.

4.2.2. Verification of "As Built" versus "Detailed Design Requirement".

4.2.3. Table identifying "Detailed Design Requirement" and corresponding "As Built" found in the field

4.3. Operational Training

4.3.1. Operating instruction for emergency work for interim U of T operational takeover of building systems.

4.3.2. Minimum training requirements check sheet for training prior to meeting the requirements for final handover.

4.4. System manuals

4.4.1. System manuals as outlined in ANSI/ASHRAE/IES Standard 202-2013 section 14 and informative appendix L, including System description with narrative and Operating Instruction for Emergency Work. System manuals shall be provided to the owner for use in building operation and training of personnel.

4.5. Operations and Maintenance Manuals

Operations and Maintenance manuals (as per ANSI/ASHRAE/IES Standard 202-2013 14.2.3 – Section 3 – Buildings, System, and Assemblies Information for Commissioned Systems and Assemblies) consist of

- a) Copy of Building and Equipment Specification
- b) Copy of approved submittals including Final Sequence of Operation
- c) Copy of Manufacturer's Operation and Maintenance data
- d) Copy of Warranties
- e) Contractor and Supplier Listing and Contact information

They are to be provided by contractor for inclusion by Commissioning Agent into the System Operating Manual.

4.6. Post occupancy operation commissioning

Post occupancy operation commissioning, including delayed and seasonal testing and warranty issues, shall be performed as outlined in ANSI/ASHRAE/IES Standard 202-2013 section 16.

4.7. Specific Roles & Responsibilities Matrix

Task	Proj. Mgr.	Facilities Rep.	Designer	Contractor	Operations (Control Tech./Building Eng.)	Commissioning Authority
Owner Project Requirement (OPR) update	*	*	*	*	*	R
Basis of Design (BoD)	P	P	R			P
Design	P	P	R			P
Commissioning Procedures						
1. System Description Narrative	P	P	P			R
2. Verify OPR to BoD	P	P	P			R
3. Confirm Design matches BoD including design standards	P	O	P			R
4. Prepare Commissioning Reports (100% SD, 100% DD, 100%CD)	P	O	P			R
5. Verify equipment matches spec (IQ)	P			P		R
6. Verify operating parameters (OQ)	P			P		R
7. Verify overall performance (PQ)	P			P		R
8. Operating Instruction for Emergency Work	P	O	P	P	O	R



Task	Proj. Mgr.	Facilities Rep.	Designer	Contractor	Operations (Control Tech./Building Eng.)	Commissioning Authority
9. Minimum training requirements check sheet	P	O		P	O	R
10. Schedule and plan training	P	O		P	O	R
11. Operations and Maintenance Manuals	P	O	O	R	O	O
12. System Operating Manuals	P	O	P		O	R
13. Operational Training	P	P		R	P	R
14. Signoff Project Turnover Document	P	P	P	P		R
15. Provide List of Outstanding Non Conformance Issues	P	P	P		P	R
16. Post Occupancy operation commissioning	P	O	P	P	O	R
17. 10 month warranty review		P				R

R:Responsible P:Participating O:Oversight Blank:Not Required

* OPR defined by Project Planning Report (PPR)

1.Occupancy to be obtained between OQ and PQ

2. Beneficial Occupancy to be obtained after Operational Training

5. Acknowledgment of reading and understanding the University of Toronto overall building commissioning process document

5.1. General

5.1.1. The purpose of this section is to ensure that internal and external stakeholders have read and understand on how to use this document

5.2. Process

5.2.1. This process shall be documented via a sign off document forwarded to the Administration Assistant of the Director of Utilities and Building Operations for filing at the end of the project by the Project Manager.

5.2.2. Updated training via the reading of this procedure will be required annually by the Facilities and Services, University Planning Design and Construction.

5.2.3. Individual projects will require acknowledgement of this requirement as part of the bid process:

5.2.4. The Project Manager shall provide sign off sheet at the onset of the project that will be signed off by internal and external stakeholders as they become involved at various stages of the project.

5.2.5. Parties involved:

- a) The functional areas responsible for the Management, Operation, Maintenance, Planning, Design and Construction of the building system inclusive but not restricted to personnel in Facilities and Services and University Planning Design and Construction.
- b) The Contracted service providers (consultants, contractors, etc.) that impact change into any aspect of the Building system, documentation of such training will be included in the completed Commissioning document as described in the Commissioning Documentation Section of this procedure.

6. System handover – Appendix A

University of Toronto

Date _____

UofT Facilities & Services Handover Acceptance Checklist
(to be used for Mechanical and Electrical Disciplines)

Equipment/System Description:

The construction/installation of the noted equipment/facility is now complete.
The following handover procedures/documentation have been received by UofT Facilities & Services Dept:

		Date Received by UT
1.	Operating and Maintenance Manuals, (Including all certificates)	_____
2.	As-built Drawings	_____
3.	Balancing	_____
4.	Systems/Equipment Commissioning completed, reports received	_____
5.	Deficiencies corrected	_____
6.	Tagging/Identification of Equipment, Valves, etc.	_____
7.	Training/Demonstration of System/Equipment completed	_____

PLEASE NOTE THAT STEP #7 (TRAINING/DEMONSTRATION) SHALL BE CONDUCTED ONLY AFTER ITEMS #1 TO #6 INCLUSIVE HAVE BEEN COMPLETED TO THE UNIVERSITY'S AND THE CONSULTANTS SATISFACTION. TRANSFER OF ANY KEYS WILL ALSO BE MADE AT STEP #7 ABOVE.

The warranty period for this equipment/facility is ____ year(s), starting on _____

For service within the warranty period, please call _____

Telephone: _____ Fax: _____

Please sign below confirming UofT Facilities & Services Dept. acceptance of operating and maintenance responsibility for this equipment/facility, subject to the comments below (or attach a deficiency list) and return the original of this form.

Comments:

UofT Project Manager _____ Date _____

_____ Date _____
University of Toronto – Director of Utilities

