UNIVERSITY OF TORONTO | Facilities & Services

Building commissioning standard

Revision 04

Last updated November 1, 2024

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1. Introduction

1.1. Project life cycle

1. The purpose of this standard is to identify the minimum acceptable commissioning process (Cx) for all new construction and renovation projects for the St. George Campus. This standard is not intended to provide installation direction; however, it provides a quality-focused process and responsibility matrix that ensures enhanced delivery that meets the Client's (University of Toronto) objectives and criteria, and seamless handover of the building systems at the conclusion of the project.
2. The commissioning process begins at project design phase and continues through the 10-month warranty period including the EMRS integration graphics check.
3. This standard shall be read in conjunction with the Deliverable Standard.

1.2. Design Phase

1. During the Design Phase, the Commissioning Team works to verify that the design documents meet and properly convey the Owner's Project Requirement (OPR), if applicable, and the Client's standards:

- General requirements: deliverable standard, tri-campus energy modeling and utility performance design standard, building commissioning standard
- Div 14: elevator design standard
- Div 21: sprinkler and standpipe design standard
- Div 22 and 23: mechanical design standard
- Div 25: building automation system design standard
- Div 26: electrical design standard, lighting and lighting control design standard
- Div 27: communications infrastructure specifications, standards and practices
- Div 28: security and access control system specification design standard, fire alarm system design standard

1.3. Construction Phase

1. During the Construction Phase, the Commissioning Team works to verify that systems and assemblies are performed in a manner that will achieve the OPR.

1.4. Occupancy and Operations Phase

1. The Occupancy and Operations Phase of the Commissioning begins at Ready-for-Takeover. The Commissioning activities begins at this point should continue through the end of the contractual warranty/correction period.

1.5. Definitions

Terms	Definition
Basis of Design (BOD)	A "living document" that is updated at each phase of design to the appropriate level of detail required for that phase. It is the document that conveys the understanding of the project and how the design solution will address the user requirements. It is also a record of the assumptions and decision-making process driving the design.
Commissioning Agent (CxA) /Prime CxA	An individual or company identified by the Client to lead, plan, schedule, and coordinate the Commissioning Team in the implementation of the commissioning process (refer to ASHRAE Standard 202-2018). Specialty CxA to be coordinated and/or engaged by the Prime CxA.
Commissioning Plan (CX Plan)	A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the Commissioning (refer to ASHRAE Standard 202-2018).
Commissioning Process (Cx)	A quality-focused process for enhancing the delivery of a project. The process focuses on verifying and documenting that all the commissioned systems and assemblies are planned, designed, installed, tested, operated, and maintained to meet the Owner's Project Requirements (refer to ASHRAE Standard 202-2018).
Commissioning Team	The team of specialists and related Client (University of Toronto) staff who are responsible for the management of actions and the generation of deliverables by the CxA, as outlined in the contract between the Client and the CxA and in the Cx Plan. The members of the project Commissioning Team will consist of the commissioning agent and any support personnel, the Prime Contractor, Subcontractors, the Client's facility staff, vendors as required, and the architect/engineer (refer to ASHRAE Standard 202-2018).
Construction checklists	Forms to verify that appropriate material and components are on-site, ready for installation, correctly installed, functional, and in compliance with Owner's Project Requirements (OPR).

Terms	Definition
Contract documents	The documents that form the basis of a contract between an owner and Prime Contractor. These include specifications, drawings, tender forms, change orders, addenda, and site instructions (refer to CSA Z320-11).
Architect (Design Team)	A group of consultants responsible for the design of the project in its entirety. Depending on the project, the design team shall include all core disciplines such as, architectural, mechanical, electrical, structural, and civil. For most projects, the architect is the prime consultant that manages the deliverables for the design team.
Facilities & Services (F&S) Team	A group of individuals from the following departments who represent Facilities and Services: Building Operations and Utilities, Infrastructure Planning and Implementation, F&S IT, F&S ACG, Sustainability, Area Managers, Property Management, Caretaking, Elevator Operations, Fire Prevention, and other individuals assigned by the Client.
Infrastructure Planning and Implementation Commissioning Coordinator (IPI CxC)	A representative from Client's F&S Infrastructure Planning and Implementation team who oversees that the commissioning activities are performed per the Client's Commissioning Standard and that all the required documentation for the project handover is provided.
Integrated System Testing plan	A written specific document, prepared by the Integrated Testing Coordinator, outlining the required tests and necessary functional results to conduct integrated fire protection and life safety systems testing. (refer CAN/ULC-S1001-11, "Integrated Systems Testing of Fire Protection and Life Safety Systems")
F&S IT	Representative of the Client's F&S Information Technology department, responsible for providing and maintaining all F&S LANs, switches, EMRS points migration, IP addresses and access.
F&S Automation and Control Group (F&S ACG)	Representative of the Client's F&S Automation and Control department, responsible for oversight of the project's Building Automation System (BAS) design, who reviews and comments on the related deliverables of the Client's BAS Design Standard.
Facility Guide	A basic building systems description (including the System Narrative) and operating plan with general procedures and confirmed facility operating conditions, set points, schedules, and operating procedures for use by facility operations to properly operate the facility (refer to ASHRAE Standard 202-2018).
Functional Performance Testing	A full range of tests under actual load, conducted to verify that specific systems, subsystems, components, and interfaces between systems conform to a given criterion. These tests are typically used to verify that a sequence of operation is correctly implemented and that the design intent has been met. They are typically performed after equipment is placed in full operation (refer to CSA Z320-11).
Manufacturer's Operation and Maintenance Manual	A detailed document that provides the operating and maintenance requirements and associated data for the safe and efficient operation of specific pieces of equipment and systems (refer to CSA Z320-11).
Operational Training	To operate the building in accordance with the OPR and design capabilities, the Facilities and Services Representatives (individuals who use, operate, or maintain) are trained on the installed equipment and systems, using current

Terms	Definition
	versions of the commissioning documents including systems manuals. The training shall be designed specifically for each group and digitally video recorded.
Owner/Owner's Representative	The entity that represents the interests of the facility, which belongs to the Client (refer to CSA Z320-11).
Owner's Project Requirements (OPR)	A document that details the requirements of a project and the expectations for how it will be used and operated, including project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, training requirements, documentation requirements, and supporting information (refer to ASHRAE Standard 202-2018).
Prime Contractor	Also known as the general contractor or Construction Manager. In the context of the design standards, the Prime Contractor is defined in the Canadian Construction Documents Committee (CCDC)-2, CCDC-5B, or Integrated Project Delivery (IPD) contracts.
Project Manager (PM)	The Project Manager is a person delegated authority to act on behalf of the Client. This person may be an employee of the Client or an external third party assigned by the Client.
Static Verification/Pre-Functional Testing	The Commissioning Team shall verify and/or perform static verification before start-up activities and functional performance testing. During static verification, the Commissioning Team verify and document that all system elements are in accordance with the design requirements and correctly installed, connected, and labelled (refer to CSA Z320-11).
System Manual	A system-focused composite document that includes the contract documents, Facility Guide and operation manual, maintenance information, training information, commissioning records, and additional information used by the Client for occupancy and operation (refer to ASHRAE Standard 202-2018). In addition, it includes System Narrative.
System Narrative	System Narrative includes a detailed description of the design philosophy, design intent, and design criteria for each system. It also Includes details of system type, composition, location of areas served in the building and function of major components. Each system description includes specific instructions for operating conditions (normal, seasonal change over, operating while on emergency power, operating in emergency and/or any special mode) with set points, schedules, operating sequences, and procedures. The document includes maintenance checklists based on the manufacturer maintenance manuals and site-specific conditions clearly identifying required routine inspection tasks noting required frequency of maintenance.
Training Plan	A written document that details the expectations, schedule, duration, and deliverables for Commissioning Activities related to training of project operations and maintenance personnel, users, and occupants (refer to ASHRAE Standard 202-2018).

1.6. Referenced documents

1. ASHRAE Guideline 0-2019 The Commissioning Process
2. ASHRAE Guideline 1.1-2007 HVAC&R Technical Requirements for the Commissioning Process
3. ASHRAE/IES Standard 202-2018 The Commissioning Process for Buildings and Systems
4. ASHRAE Standard 241, Control of Infectious Aerosols
5. ASHRAE Guideline 1.4-2019 Preparing Systems Manual for Facilities
6. CAN/ULC-S1001-11 Standard for Integrated Systems Testing of Fire Protection and Life Safety Systems
7. CSA Z320-11 Building Commissioning

2. Commissioning process

2.1. Commissioning Team responsibilities

1. This section is to supplement the Roles and Responsibilities Matrix Appendix B.

2.1.1. Commissioning Agent (CxA)

Design

1. Lead the Commissioning Team and activities.
2. Review the BOD.
3. Develop the Cx Plan, systems manual outline, and system narrative.
4. Provide an organizational chart with role definition describing responsibilities and accountabilities, to be included in the Cx Plan and reviewed and accepted by the Project Manager.
5. Coordinate with the Project Manager the specific items to be commissioned based on Project Manager's priorities and project risk assessments.
6. Review the design documentation and verify if the systems can be commissioned to meet the design intent. Make recommendations to rectify design deficiencies with respect to the commissioning activities.
7. Ensure that commissioning specifications are included in the contract documents in order to satisfy the commissioning scope.
8. Develop Integrated System Testing plan for fire protection and life safety system (CAN/ULC-S1001-11).

Construction

1. Provide a timeline for commissioning procedures for all aspects of building and commissioning phases in conjunction with the Prime Contractor and their committed schedule.
2. Provide a list of equipment / systems that need to be commissioned. For lighting projects, a recent calibration certificate shall be included.
3. Review Prime Contractor submittals of equipment and provide comments to the Project Manager.

4. Review the Prime Contractor's inclusion of submittals into the System Manual for all building systems to be commissioned.
5. Review all change orders.
6. Document all issues. Create and manage the Commissioning Issues and Resolution Log until all issues are resolved.
7. Provide criteria for the Prime Contractor to develop the construction checklists.
8. Develop the functional performance test procedures.
9. Verify acceptance of installation, start up, and final performance testing, both individually and system-wide within the facility at specified component, system and environmental conditions as defined by the Owners Project Requirement (OPR).
10. Conduct field observations and provide site verification reports to confirm proper components and installation of systems. Ensure correction of deviations from design documentation.
11. Conduct functional performance testing and trend log analysis to demonstrate the result that are acceptable as per the contract documents (Mechanical & Electrical Issued for Construction set).
12. Review and approve the content of training agenda that was provided by the Prime Contractor.
13. Coordinate with the F&S IPI CxC, through the Project Manager, all demonstration and training sessions and ensure appropriate attendees from the Client.
14. Ensure the systems are operational to demonstrate functionality prior to the training.
15. Review the construction schedule and ensure that items identified in Appendix A are provided and accepted by the Client two weeks prior to training.
16. Review and provide comments on O&M manuals and facility guides. Provide final review and approval.
17. Coordinate and witness the training of designated Owner's Representatives in coordination with the Project Manager. All training shall be digitally video recorded in mp4 format. The Commissioning agent is

responsible for recording and editing of the training videos, bookmarks shall be included to guide to the specific topics.

18. Ensure the commissioning procedures for lighting include:
    - Check and verify central lighting control systems and dimming systems.
    - Check and verify lighting fixtures are connected and operating in the ON/Off position properly.
    - Check and verify automatic controls are connected, functioning properly and in accordance with the sequence of operations.
    - Check and verify emergency lighting system, including battery lighting system, are connected and functioning properly, and in accordance with Design Team's sequence of operation.
    - Carry out lighting level tests as required and directed by Commissioning Plan.
    - Perform tests as required by Commissioning Plan.
19. Oversee the testing procedures in compliance with CAN/ULC-S1001-11, "Integrated Systems Testing of Fire Protection and Life Safety Systems".
20. Verify the airflow requirements during normal and infection risk management modes of operation (occupied and unoccupied) for each space based on the ASHRAE standard 241 Equivalent Clean Airflow Calculator provided by the Design Team.
21. Review the equivalent clean airflow calculations indicating how the systems and equipment are achieving the target equivalent clean airflow.
22. Perform review of systems and assemblies in the design documents to evaluate compliance with the IRMM systems and provide an issues log for the design team to adjust the design documents to align with the OPR.

Occupancy and Operation

1. Gather, assemble, review, and handover the complete Systems Manual and submit to the Client as prerequisite for achieving Ready-for-Takeover.
2. Systems Manual shall be as outlined in ANSI/ASHRAE/IES Standard 202-2018 section 14 and appendix L. System Manuals shall be provided to the Client for the use in building operation and training of personnel.

3. Provide monthly follow up report on the status of outstanding issues prior to the start of the warranty period. All open deficiencies and issues shall be resolved before the 10-month warranty review.
4. Conduct a 10-month warranty review with the Project Manager and the Owner's Representative to ensure that any warranty issues are identified prior to the end of the warranty period.
5. Post occupancy operation commissioning, including delayed and seasonal testing and warranty issues, shall be performed as outlined in ANSI/ASHRAE/IES Standard 202-2018 section 16.

Ready-for-Takeover

1. During this time period, the building systems are monitored and operated using the building level BAS. In order for the project to satisfy the requirements for "Ready-for-Takeover", the building BAS must be integrated to the Client's Energy Management and Reporting System (EMRS). Upon completion the F&S Team can operate and monitor the interfaced BAS equipment remotely.

2.1.2. Client (University)

Pre-design

1. Develop the draft OPR.

2.1.3. Project Manager

Design

1. Include commissioning tasks in Design Team's scope and contract.
2. Review the BOD.
3. Coordinate the review of the CxA documents with the CxA and the Client including IPI CxC.
4. Ensure the Design Team responds to all CxA and Client's design review comments.
5. Manage resolution of the Client and CxA design review comments.

6. Review Cx Plan and Integrated Systems Testing plan.
7. Ensure that the Design Team and the Client, including IPI CxC reviews the Cx Plan.
8. Ensure the CxA responds to all Design Team and Client's Cx plan review comments.

Construction

1. Provide an electronic copy of all construction documents, BOD, addenda, requests for information, change orders, and approved submittals and shop drawings related to commissioned equipment to the CxA. All documents shall be in the searchable and editable PDF format.
2. Provide latest copies of the OPR to the CxA.
3. Facilitate the coordination of the commissioning work by the CxA.
4. Attend commissioning meetings.
5. With the Prime Contractor and CxA, ensure that commissioning activities are scheduled into the master schedule.
6. In collaboration with the IPI CxC, arrange for Client's personnel to attend various field commissioning activities, commissioning meetings, and training sessions according to the training and Cx Plan and as necessary.
7. Participate in issue resolution.

Occupancy and Operations

1. Ensure that the Prime Contractor's commissioning responsibilities, required prior to Ready-for-Takeover, are completed, including addressing remaining open issues.
2. Arrange all demonstration and training session with F&S Team.
3. Provide CxA needed access to the building and building automation system during occupancy.
4. Support any ongoing commissioning activities.

2.1.4. The F&S Team

Pre-design

1. IPI CxC confirms if Cx is required for the project.

2. IPI CxC to provide guidance in developing the OPR requirements.

Design

1. IPI CxC to review the construction documents including the BoD.
2. IPI CxC to review the Cx Plan and provide comment.

Construction

1. IPI CxC to coordinate with CxA to ensure project close-out documents are being developed and completed prior to training and Ready-for-Takeover.
2. IPI CxC to support Project Manager, F&S ACG, and CxA to expedite EMRS integration if required.

Occupancy and Operations

1. Support Project Manager to resolve any major deficiencies that have developed during the warranty period.
2. Provide the deficiency list to all F&S divisions.
3. Lead communications with the building client or occupants on the deficiency items.

2.1.5. Architect (Design Team)

Design

1. Develop the design documentation including the BOD.
2. Respond and incorporate design review comments by CxA.
3. Review and incorporate commissioning requirements in the specifications.
4. Review and comment on the Integrated Systems Testing plan.
5. Review functional performance test procedures.

Construction

1. Integrate CxA submittal review comments.
2. Respond to commissioning-related requests for information.
3. Review equipment and systems submittals.
4. Review Functional Performance Test reports.

5. Work to resolve design-related issues identified during commissioning.
6. Attend and participate in commissioning meetings.
7. Review and approve O&M manuals and Facility Guides.
8. Review as-built drawings.
9. Provide an updated BOD.

Occupancy and Operations phase

1. Review as-built drawings and ensure that all changes issued by the consultant are incorporated.
2. Provide specifications for Systems Manual.
3. Provide the final BOD for Systems Manual.
4. Respond to any outstanding design-related issues.

2.1.6. Prime Contractor

Construction

1. Review the commissioning requirements in the construction contract documents.
2. Include the amount of time allotted for their participation in the Commissioning Process.
3. Integrate the necessary time for commissioning in the construction schedules.
4. Provide management oversight to subcontractors and installers for commissioning activities.
5. Assign specific individuals as managers and contact points for subcontractors' and installers' commissioning activities.
6. Submit the required equipment and system submittals for commissioned systems as per the Cx plan. Adhere to the Cx plan to fulfill commissioning obligations.
7. Attend the commissioning scoping and coordination meetings.
8. Communicate and coordinate with the Commissioning Team as necessary.
9. Assist the Commissioning Team and other Contractors in equipment and system performance verification.

10. Confirm that installers and manufacturers are executing their commissioning responsibilities for the specified systems, including:
    - Construction checklists, start-up and initial checkout
    - Pre-Functional test activities
    - Functional testing
    - Training and O&M documentation
    - Addressing commissioning issues
    - Inspection of installed system and adjustment
11. Provide documentation from subcontractors and installers required by the CxA, for assembly of the project System Manual. All submittals required in the Cx plan shall be in the format specified by the Deliverable Standard.
12. Provide the building operation and maintenance training.
13. For lighting project, after start-up and successfully pre-functional performance testing, a CSA/ESA form shall be submitted to confirm the result of pre-functional performance testing and indicate that system is ready for functional testing and commissioning.

Occupancy and Operations

1. Perform testing and training requirements.
2. Respond to any open commissioning issues.

Appendix A - Project Ready-for-Takeover checklist (for internal Client use)

	The following takeover procedures/documentation have been received by the Client's Facilities & Services Department	**Date Received**
1	List of addressed deficiencies including resolution plan for open items	
2	Assembled Systems Manual including record drawings (refer to U of T Deliverable Standard for content)	
3	Tagging/identification of equipment, valves, etc.	
4	Third party commissioning successful systems functional performance testing results	
5	Conduct systems training	
6	Keys have been transferred	
7	EMRS Integration is complete and verified	

NOTE: Training shall be conducted only after items #1 to #4 inclusive have been completed to the Client's and the consultant's satisfaction.

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

Please sign on the next page confirming U of T Facilities & Services Department's acceptance of operating and maintenance responsibility for this equipment/facility, subject to the comments below. Attach a deficiency list if applicable and return the original form.

Comments:

U of T Project Manager

Print Name: _____

Signature: _____

Date: _____

U of T Director of Utilities

Print Name: _____

Signature: _____

Date: _____

U of T Director of Property Management, Fire Prevention & Elevator Services

Print Name: _____

Signature: _____

Date: _____

Appendix B - Roles and responsibilities matrix

Task ID	Project Phase	Task	Project Manager (PM)	Architect	Commissioning Agent (CxA)	Prime Contractor	BAS Contractor	Infrastructure Planning and Implementation Commissioning Coordinator (IPI CxC)	Facilities & Services (F&S) Team	F&S IT	F&S Automation and Control Group (F&S ACG)	Deliverable	Deliverable Status Completed /Ongoing/Not started /NA
1	**Design**	Owner Project Requirement (OPR) update *(Original OPR defined by Project planning report and RFP to Design Engineer)*	O	R	U/P			I	P	P	P	Updated Owner Project Requirement (OPR) at the end of CD	
1.1	**Schematic Design**	Development Basis of Design, (BOD)	O	R	U			I	P	P	P	Basis of Design	
1.1.1		Verification of BOD against OPR and standards	O	U	R			I	P	P	P	BOD Verification Report	
1.1.2		Development of Design Specifications/Drawings	O/P	R	U			I	P	P	P	Design Specifications/Drawings	
1.1.3		Cx Design Review	O	U/P	R			I	P	P	P	Cx Design Review Report/ Issues Log	
1.2	**Design Development**	Update Basis of Design, (BOD)	O	R	U			I	P	P	P	Updated Basis of Design	
1.2.1		Verification of BOD against OPR and standards	O	U	R			I	P	P	P	Updated BOD Verification report	
1.2.2		Development of Design Specifications/Drawings	O/P	R	U			I	P	P	P	Updated Design Specifications/Drawings	
1.2.3		Cx Design Review	O	U/P	R			I	P	P	P	Updated Cx Design Review Report/ Issues Log	
1.2.4		Submission EMRS Estimated integration Time and Cost	O/U	U	U			I	I	R	I	Memo indicating time and cost.	
1.3	**Construction Documents**	Update Basis of Design, (BOD)	O	R	U			I	P	P	P	Updated Basis of Design	
1.3.1		Verification of BOD against OPR and standards.	O	U	R			I	P	P	P	Updated BOD Verification report	
1.3.2		Development of Design Specifications/Drawings	O/P	R	U			I	P	P	P	Updated Design Specifications/Drawings	
1.3.3		Cx Design Review	O	U/P	R			I	P	P	P	Updated Cx Design Review Report/ Issues Log	
1.3.4		Development Cx Plan	O	U/P	R			P	P	P	P	Cx Plan	
1.3.5		Cx Specification	O	U/P	R			P	P	P	P	Cx Specification	
1.3.6		Develop Systems Manual Outline	O	P	R/U			P	P	P	P	Systems Manual Structure	
1.3.7		Training Requirements Outline	O	U/P	R/U	U	U	P	P	P	P	Training Requirements Outline and updated specs	
1.4	**Tender Documents**	Design Specifications/Drawings	O	R	U	U	U	I	P	P	P	Design Specifications/Drawings(updates)	
1.4.1		Cx Design Review	O	U/P	R			I	P	P	P	Updated Cx Design Review Report/ Issues Log	
1.4.2		Closure of Final Design Review Report/ Issues Log/Verification Report	R	P	P			P	P	P	P	Sign off closed Final Design Review Report/ Issues Log/Verification Report	
2	**Construction**												
2.1	**IFC Documents**	Issue IFC Design Specifications/Drawings	O	R	U	U	U	I	I	I	I	IFC Design Specifications/Drawings	
2.1.1		Cx IFC Design Review Report/ Issues Log	O	U/P	R	U	U	I	I	I	I	Updated Cx Design Review Report/ Issues Log	
2.1.2		Issue IFC Basis of Design, (BOD)	O	R	U	U	U	I	P	P	P	IFC Basis of Design,	
2.1.3		Verification of BOD against OPR and standards	O	U	R			I	P	P	P	Updated BOD Verification report	
2.1.4		Closure of IFC Design Review Report/ Issues Log/Verification Report	R	P	P			P	P	P	P	Sign off closed IFC Design Review Report/ Issues Log/Verification Report.	
2.2	**Start of Construction**												
2.2.1		Develop Construction Schedule	O	P	U	R	P	I	I	I	I	Construction Schedule	
2.2.2		Develop Cx Schedule	O	P	R	U	U	I	I	I	I	Cx Schedule	
2.2.3		Update Construction Schedule	O	P	U	R	P	I	I	I	I	Updated Construction Schedule(with Cx Schedule)	
2.2.4		Cx Plan Update	O	I	R	U	U	I	I	I	I	Updated Cx Plan	
2.2.5		Submittal /Shop drawing Review	O	P	P	R	P	I	P	P	P	Reviewed Submittal/Shop Drawing	
2.2.6		Submittal Review (BAS)	O	P	P	R	P	I	P	P	P	Reviewed Submittal/Shop Drawing (BAS)	
2.2.7		BAS Submittal Review Session	O	P	P	R	P	I	P	P	P	Minutes of Meeting	
2.2.8		F&S Review of Accepted ,Reviewed /Reviewed as noted BAS submittal Review	R	U	U	U	U	I	P	P	P	Reviewed Report Memo	

Appendix B - Roles and responsibilities matrix

Task ID	Project Phase	Task	Project Manager (PM)	Architect	Commissioning Agent (CxA)	Prime Contractor	BAS Contractor	Infrastructure Planning and Implementation Commissioning Coordinator (IPI CxC)	Facilities & Services (F&S) Team	F&S IT	F&S Automation and Control Group (F&S ACG)	Deliverable	Deliverable Status Completed /Ongoing/Not started /NA
2.2.9		Develop and issue Inspection Report (Pre Cx Templates)	O	I	R	U	U	I	I		I	Inspection Report (Pre Cx Templates)	
2.2.10		Develop and Issue Test Procedures ,FPTs (Pre Cx Templates)	O	I	R	U	U	P	P		P	Test Procedures ,FPTs (Pre Cx Templates)	
2.2.11	Ongoing during construction	Cx Meetings Minutes and Agenda	O	P	R	P	P	P	I	I	I	Minutes of Meeting/s	
2.2.12	Ongoing during construction	Cx Site review and verification	O	P	R	U	U	P	I	I	I	Cx Site review report/Issues Log/(Updates)	
3	**Commissioning**												
3.1	**Pre Commissioning**	Static Verification (As built vs. Design Documentation)											
3.1.1		Complete Pre Functional Testing checksheets for all system elements	O	P	R	P	P	I				Completed pre functional testing checksheets	
3.1.2		Complete Sensor /End device Calibration Report	O	P	R	P	P	I		I	I	Sensor /End device Calibration Report	
3.1.3		Complete Point to Point Wiring Report	O	P	R	P	P	I		I	I	Point to Point Wiring Report	
3.1.4		Complete System Installation Verification (As built to Design Control Schematics) and contractor start-up sheet	O	P	R	P	P	I		I	I	System Installation Verification red line Mark up. Complete start-up sheet	
3.1.5		Complete DDC/Control panel Installation Review .	O	P	R	P	P	I		I	I	DDC/Control panel Installation Report with Snap shots	
3.1.6		Completed Power to Controllers with UPS operation tests	O	P	R	P	P	I		I	I	Power to Controllers with UPS operation report	
3.2	**Commissioning (Functional performance testing)**	Functional Verification (As built vs. Design)											
3.2.1		Develop the Functional Performance Test procedure	O	P	R	P	P	I	P	P	P	Functional Performance Test Procedure	
3.2.2		Generate /Update Issues and resolution Logs	O	P	R	P	P	I	P	P	P	Updated Issues Log	
3.2.3		Update Shop drawing Variances	O	P	R	P	P	I	I	I	I	Updated Shop drawing Variances	
3.2.4		Verification Communication Wiring from Field controllers to Network controller.	O	P	R	P	P	I		U	U	Signed off Installation Check sheets	
3.2.5		Verification of Communication Wiring from Network controller to patch panel. (Installation Check sheets and Fluke reports)	O	P	R	P	P	I		U	U	Signed off Installation Check sheets	
3.2.6		Temporary GUI Verifications	O	P	R	P	P					Updated FPTs	
3.2.7		Bacnet system compliance verifications	O	P	R	P	P	I		U	U	Banat system compliance verifications	
3.2.8		Conduct Functional Performance testing (FPT)	O	P	R	P	P	P	P	I	P	Completed Functional test reports	
3.2.9		Approve as-built drawings	O	R	P	P	P	I	I			As-built drawing approval	
3.3	**Field Cx Documentation Submission (for BAS Projects)**	Assimilate Field Cx Documentation	O	I	R	I	I	I	I	U	I	Completed Field Cx Documentation Package	
3.4	**Training**	Develop Training Plan	O		R	P	P	O	P		P	Training Plan	
3.4.1		System Operational Training (Mech/Electrical) including videotaping trainings (video recording training)	O		R	P	P	O	P		P	Training Review reports for each system	
3.4.2		Administrate building operation and maintenance training	O		P	R	P	O	P		P	Training Record	
3.4.3		BAS Training Module A including videotaping trainings	O		R	I	P	O	P		P	Training Review report	
3.4.4		BAS Training Module B including videotaping trainings	O		R	I	P	O	P		P	Training Review report	
3.4.5		BAS Training Module C including videotaping trainings	O		R	I	P	O			P	Training Review report	
4	**Occupancy and operation**												
4.1	**EMRS Compliance Testing**	EMRS Database Verification	O		I	I	I	O		R	I		

Appendix B - Roles and responsibilities matrix

Task ID	Project Phase	Task	Project Manager (PM)	Architect	Commissioning Agent (CxA)	Prime Contractor	BAS Contractor	Infrastructure Planning and Implementation Commissioning Coordinator (IPI CxC)	Facilities & Services (F&S) Team	F&S IT	F&S Automation and Control Group (F&S ACG)	Deliverable	Deliverable Status Completed /Ongoing/Not started /NA
4.2	**EMRS Graphical User Interface Programming**	EMRS Database programming								R			
4.2.1		EMRS GUI Functional Verifications	O		R	I	I		P	P	P		
4.2.2		Temporary GUI Database back up	O		P	P	R		P	U	U		
4.3	**EMRS Training**	Training Module D including videotaping training	O		P	P	P	O	P	R	P		
4.4	**Systems Manual**	Assemble Systems Manual	O	P	R	P	P	O	P	P	P	Updated Systems Manual	
4.4.1		Executive Summary	O	P	R	P	P	O	U	U	U	The executive summary contains an overview of the building design, construction, and operational requirements. The information is intended to provide general guidance on the intended operation, performance, and maintenance of the building in conformance to the OPR. The Design Team, along with contact information, is also provided to facilitate information transfer on original designs and	
4.4.2		Updated Owner's Project Requirements	O	P	R			O	U	U	U	Insert final copy of OPR developed and revised during the Cx. This provides the O&M staff, information on the original intent for the design and use of the building.	
4.4.3		Updated BoD	O	R	P			O	U	U	U		
4.4.4		Construction/Project Record Documents.	O	P	P	R	P	O	U	U	U		
4.4.5		Design Specifications	O	R	P			O	U	U	U		
4.4.6		Approved Submittals	O	P	P	R	P	O	U	U	U		
4.4.7		Manufacturer's Operations and Maintenance Data	O	P	P	R	P	O	U	U	U		
4.4.8		Warranties	O	P	P	R	P	O	U	U	U		
4.4.9		Contractor/Supplier Listing and Contact Information.	O		P	R	P	O	U	U	U		
4.4.10		Insert a copy of the completed facility operating plan with explanations of the intended use and operation of the facility.	O	P	R	P	P	O	P	P	P		
4.4.11		The final sequences of operation for all operating equipment including final commissioned set points of all equipment with operational adjustments and the set point normal intended ranges and limitations	O	P	R	P	P	O	U	U	U		
4.4.12		Routine building operations maintenance requirements.	O	P	R	P	P	O	P	U	P		
4.4.13		Emergency procedures and locations of applicable controls.	O	P	R	P	P	O	P	U	P		
4.4.14		Re Commissioning forms, procedures, checksheets, etc	O	P	R	P	P	O	U	U	U		
4.4.15		Utility Measurement and Reporting; include description of utility metering and monitoring systems.	O	P	R	P	P	O	U	U	U		
4.4.16		Training Plans and Materials	O	P	R	P	P	O	U	U	U		
4.4.17		Videotaping training	O		R	P	P	O	U	U	U		
4.4.18		Training Records	O		R	P	P	O	U	U	U		
4.4.19		Final Cx Report	O		R			O	U	U	U		
4.4.20		Cx Design and Submittal Review Reports.	O	P	R	P	P	O	U	U	U		
4.4.21		Testing Reports	O	P	R	P	P	O	U	U	U		
4.4.22		Issues and Resolution Logs.	O	P	R	P	P	O	U	U	U		
4.4.23		Resolution Plan for the Open Items.	O	P	R	P	P	O	U	U	U		
4.5	**Systems Handover Sheet**	Handover Sheet signature and submission	O		R			P	I	I	I	Handover Sheet Signed	
4.6	**10-month warranty review**	Conduct a 10-month warranty review	O		R			P	P			10-month Warranty Review	

Legend	Description of role
P=Participate	Provides input/or Review
R=Responsible	Develops deliverable or Executes or Leads the process
O=Oversight	Coordinates /Manages Process
U= Used By	Document recipient

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Task ID	Project Phase	Task	Project Manager (PM)	Architect	Commissioning Agent (CxA)	Prime Contractor	BAS Contractor	Infrastructure Planning and Implementation Commissioning Coordinator (IPI CxC)	Facilities & Services (F&S) Team	F&S IT	F&S Automation and Control Group (F&S ACG)	Deliverable	Deliverable Status Completed /Ongoing/Not started /NA
	I=Information only	Copy of the document to be forwarded for information and not necessarily will provide input.											
	* Special Circumstances												