**CONTENTS**

Part 1 GENERAL 2

1.1 DESCRIPTION 2

1.2 COMMISSIONING TEAM 4

1.3 DEFINITIONS 4

1.4 RELATED DOCUMENTS 5

1.5 ROLES AND RESPONSIBILITIES DURING CONSTRUCTION 6

1.6 SCOPE OF WORK 7

1.7 COMMISSIONING TIMELINE 8

1.8 QUALITY ASSURANCE 9

1.9 COMMISSIONING DOCUMENTATION 9

2.0 PRODUCTS 10

2.1 TEST EQUIPMENT 10

2.2 ACCESS AND INFORMATION 10

3.0 EXECUTION 11

3.1 MEETINGS 11

3.2 DOCUMENTATION, FAILURE AND APPROVAL OF TESTS 12

3.3 SUBMITTALS 13

3.4 COMMISSIONING PLAN 13

3.5 INSTALLATION CHECK AND STARTUP 14

3.6 FUNCTIONAL TESTING 15

3.7 INTEGRATION TESTING 15

3.8 PHASED HAND OVER PROCEDURES 16

3.9 PERFORMANCE TESTING 17

3.10 DEMONSTRATIONS TO OWNER PERSONNEL 17

3.11 DEFERRED AND SEASONAL COMMISSIONING 18

3.12 THE COMMISSIONING REPORT 18

# General

## DESCRIPTION

### Commissioning is a quality-oriented systematic process of ensuring that all systems perform interactively according to the design intent and the owner’s operational needs.

### Commissioning during the design is intended to achieve the following specific objectives:

#### Verify the Owner’s Project Requirements (OPR) and Basis of Design (BOD) are clearly documented and they meet the Owner’s goals and objectives.

#### Verify commissioning intent for the construction phase is adequately reflected in the contract documents.

### Commissioning during the construction phase is intended to achieve the following specific objectives, according to the Contract Documents:

#### Provide resolution to issues and details not fully developed during design.

#### Verify and document that applicable equipment and systems are installed according to the contract documents and manufacturer’s recommendations, and that they receive adequate start-up and functional testing by installing contractors.

#### Verify and document performance of equipment and systems against design intent, detailing where performance is not met and facilitating the Commissioning Team to create resolutions.

#### Verify that Operations and Maintenance (O&M) handover documentation is complete.

#### Verify that owner’s operating personnel have adequate time to be familiar with the project, received demonstrations and training, provide comment regarding the handover to the owner and any additional support that maybe required.

### Commissioning of all the Mechanical, Electrical, Plumbing, Architectural, Fire and Life Safety, systems and process activities are applicable, as defined in contract documents.

**COMMISSIONING ORGANIZATIONAL CHART:**

Owner

Project Manager

Integrated Design Team

Cx Provider

Construction Manager

General Contractors

Mechanical Contractor

Electrical Contractor

M&E Coordinator/

Cx Manager

Documented Deliverables

Design

Document Flow

Cx Meeting/Coordination Flow

## COMMISSIONING TEAM

### The commissioning team shall consist of representatives of each contractor, including project superintendent, installers, suppliers, and specialists deemed appropriate for performing tasks related to the commissioning process.

#### Owner/Project Manager (PM)

#### Commissioning Provider (CxP),

#### Architect and design Engineers (A/E)

#### UBC Transition Team

#### Construction manager (CM)

#### M&E Coordinator or Cx Manager – applicable to the project

#### Electrical commissioning agent (CxAg)

#### Mechanical commissioning agent (CxAg)

#### Equipment vendors

#### Any other installing contractors or supplier of equipment.

## DEFINITIONS

Commissioning Provider (CxP) – The entity identified by the Owner who leads, plans, schedules and coordinates the commissioning team to implement the commissioning process. This is an independent contractor working under a separate contract directly with the Owner. This contractor provides the Owner an unbiased, objective view of the systems: installation, documentation, operation, performance and witnessing of tasks and tests.

Contractor’s Commissioning Agent (CxAg) – Individuals, each having authority to act and report on behalf of the entity they represent, explicitly organized to implement the commissioning tasks required for within their respective contracts and aiding in the overall Cx process through coordinated actions, within the Cx Team.

Transition Team – A UBC operations team, where UBC representatives are assigned to the project. Their intention is to interface with UBC stakeholders, in order to facilitate information flow, building commissioning and building handover.

Monitoring Based Commissioning – Monitoring based commissioning (MBCx) combines ongoing building energy system monitoring with standard commissioning practices, this is achieved by incorporating permanent monitoring points, devices and meters to gather, store and retrieve, for the use by the Commissioning Team. The aim is to derive, monitor and adjust system parameters, with the availability of dynamic data, with dynamic operations, resulting in actions that promote reliable and efficient performance over the building lifecycle.

## RELATED DOCUMENTS

### Work under this contract shall conform to requirements of Division 01, 20 through 28 specification sections and associated design drawings, which form the contract documents.

### This section includes general administrative and procedural requirements for the commissioning process, to supplement other sections in Division 01 and 20 through 28, , which specify testing of components, systems, and assemblies, controls and control sequences and demonstration of integrated systems.

### Related documents include:

#### Project Documents (reference and information only):

##### Owner’s Project Requirements

##### Basis of Design

#### Guidelines and Industry Standards:

* ASHRAE Guideline 0 The Cx Process
	+ ASHRAE Guideline 0.2 The Existing Building Cx Process
	+ ASHRAE Guideline 1.1 HVAC&R Technical Requirements for the Cx Process
	+ ASHRAE Guideline 1.5 The Cx Process for Smoke Control Systems
* ASHRAE Standard 202: Cx Process for Building and Systems
* CAN/CSA Z320-11: Building Commissioning Standard & Check Sheets
* IES DG-29-11: The Cx process applied to lighting and control systems
* CAN/ULC-S1001-11: Integrated Systems Testing of Fire Protection and Life Safety Systems
* NIBS Guideline 3: Exterior Enclosures
* Building Cx Association: New Construction Building Commissioning Best Practices, November 2015

#### UBC Guidelines:

* 01 92 00 Monitoring Based Commissioning
* 01 33 00 Submittal Procedures
* 01 45 00 Quality Control
* 01 78 23 Operation and Maintenance Data
* 01 79 00 Demonstration and Training

#### Industry Rating System:

* Leadership in Energy and Environmental Design Version 4

## ROLES AND RESPONSIBILITIES DURING CONSTRUCTION

### Commissioning observation and witnessing of contractor demonstrated pre-functional, functional, integrated testing is the responsibility of the CxP and Design Engineer.

### All commissioning team members’ will work together to fulfill their contracted responsibilities and meet the objectives of the contract documents. The CxP shall coordinate the reports to the owner.

### The CM and CxAg(s) shall have responsibility for implementing the commissioning plan, with leadership, coordination, consultancy and review from the CxP.

### The CxP and CM with assistance from trade contractors and vendors are responsible for producing a final commissioning plan (see section 3.4), with all required commissioning tests and sequences. The CM shall obtain from the contractors and vendors all commissioning related documentation and submit it to the CxP for incorporation into the final version of the Commissioning plan (see section 1.9).

### The commissioning team shall attend commissioning meetings during construction and post handover, cooperate with the CxP and participate in commissioning coordination and scheduling.

### Final acceptance of any system is the responsibility of the Design Team’s Engineer(s) of Record.

### A Quality Assurance/Quality Control (QA/QC) representative for each contractor is to be named to the CM, the responsibilities of this person include:

#### Review equipment upon delivery onsite.

#### Quality of installation work and report on progress.

#### Review quality of paperwork, ensure timely delivery and collate to deliver to the CM.

#### Verify that commissioning tasks are complete and systems are functional, prior to turn over to CM.

### Timely and accurate documentation is essential for the commissioning process to be effective. Documentation required as part of the commissioning plan shall be exchanged between the CxP and the CM but not to be limited to:

#### Pre-start, and start-up procedures (CM).

#### Progress and status reports, including issues noted (CM & CxP).

#### Minutes from commissioning meetings (CxP).

#### Commissioning reports (CM & CxP).

#### As-built records (CM).

#### Demonstration agenda and materials (CM).

#### Operation and Maintenance (O&M) manuals (CM).

#### Deferred and Seasonal Testing Plan (CM & CxP).

## SCOPE OF WORK

### This specification section is to be used in conjunction with all other contract documents. The commissioning process does not relieve contractors from the obligations to complete all portions of work in satisfactory and fully operational manner.

### Furnish labor and material to accomplish and complete commissioning as specified herein. Complete interim commissioning of systems during initial season operation and follow-up with seasonal testing to complete commissioning and ensure correct operation.

### System installation, start-up testing, calibration, functional tests, integrated tests, performance testing, preparation of O&M manuals, demonstration and training, deferred and seasonal testing is the responsibility of the CM, Division 20 through 28 contractors and equipment suppliers/vendors.

### The commissioning plan shall include the following tasks and actions:

#### Documentation of the construction process.

#### Ensuring the basis of design as well as the design intent is carried out.

#### Completion and execution of a Commissioning Plan (see section 3.4).

#### Reporting and communicating the project schedule progress.

#### Installation review with QA/QC verification

##### Orientation and integrity checks.

##### Point to point testing.

##### Pressure and integrity testing.

##### Water fill and treatments.

##### Review of manufacturer’s recommendations.

#### Equipment start-up procedures:

##### Using the Cx schedule, coordinate equipment start-up.

##### Ensure multiple trades are aware of tasks being performed and their attendance requirement.

#### Functional tests:

##### Coordinate trades, tasks and systems, so that dedicated time can be spent with minimal interference of conflicting tasks and trades.

##### Ensure all equipment is effectively communicating with systems.

#### Main Plant start-up:

##### Coordinate main plant start-up after manufacturer’s pre-requisites and associated equipment functional testing, QA/QC verified.

#### Integrated system tests:

##### Prepare and execute integration testing as per the Commissioning Plan.

#### Provide on-site demonstrations for the systems specified, with reference to the Demonstrations and Training section.

#### Seasonal and Deferred Testing.

#### Confirmation of Performance.

## COMMISSIONING TIMELINE

**Project Progression Cx STAGES CONSTRUCTION MILESTONES**

10-Month Warranty Review

Handover

Construction Environment
(Site Clean)

Permanent Power On

Building Envelope Seal

Permanent Water On

Installation and Quality Control

Main Plant Start Up

Installation Review

Equipment Start Up

Functional Testing

Integration Testing

Demonstrations

Seasonal and Deferred Testing

Confirmation of Performance

## QUALITY ASSURANCE

SPEC NOTE: When completing the design review, check that the Division 01 has sufficient reference in QA/QC, therefore consistently empowering the following paragraph.

### The Contractor shall provide a QA/QC process for approval by the Consultant and review by UBC. The Contractor is responsible for QA/QC review of installation and commissioning tasks, for all installed and operating equipment or system. Any items that are discovered, which may hinder the commissioning plan, shall be brought into the Issues Log and open for a commissioning team discussion for a resolution.

### The Contractor shall have responsibility for QA/QC for the duration of the project

## COMMISSIONING DOCUMENTATION

### The CM and CxP shall oversee and maintain the development of commissioning documentation, which is required to be converted into a PDF format and delivered to an electronic filing system. The documentation shall be organized by system and sub-system, which shall include, but is not limited to, the following:

#### Reviewed contractor submittals.

#### Installation review record.

#### Equipment start-up procedures.

#### Functional tests.

#### Integrated system tests.

#### Demonstrations and Training record.

#### Seasonal and deferred testing.

#### Confirmation of performance.

### Any installation, start-up or commissioning reports for equipment or systems, shall be issued to the CM within 14 days of works being carried out by any contractor.

### The Commissioning Report, that is compiled by the CxP, shall be issued to UBC as an independent document to the O&M manuals, in 2 Revisions:

#### Commissioning Handover Report; documenting Cx tasks, actions and results, up to and including Handover. This shall include the Deferred and Seasonal Testing Plan.

#### Final Commissioning Report; a complete report, containing all commissioning related requirements, 1 month prior to warranty expiration.

# Products

## TEST EQUIPMENT

### All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance within the tolerances specified in the specifications. If not otherwise noted, equipment used shall have a valid calibration from a Calibration Laboratory Assessment Service (CLAS) certified calibration laboratory, for the duration of the project. All equipment shall be calibrated in according to the manufactures recommended intervals and when dropped or damaged. Calibration tags shall be affixed to equipment where appropriate. Calibration certificates must be presented to the CxP prior to the commencement of the testing.

### Test Equipment Calibration – Contractors will comply with test manufacturer’s calibration procedures and intervals; each piece of equipment shall have a minimum of 3 months remaining on the calibration certificate and remain in calibration for the duration of the commissioning period.

### Recalibrate test instruments immediately after instruments have been repaired resulting from being dropped or damaged. Affix calibration tags to test instruments. Furnish calibration records to CxP upon request.

### Proprietary test equipment and software required by any equipment manufacturer for programming and/or start-up, whether specified or not, shall be provided by the manufacturer of the equipment. Manufacturer shall provide the test equipment, demonstrate its use, and assist in the commissioning plan as needed. Proprietary test equipment (and software) shall become the property of the Owner upon completion of the commissioning process.

### Special equipment, tools and instruments only available from a vendor, or specific piece of equipment required for pre-functional, functional, integrated testing shall be provided by the contractor and/or vendor and included in the contractor’s base bid price.

## ACCESS AND INFORMATION

### System logins and e-mail alerts, with confirmation from the CM and CxP, and shall be provided to:

#### Project Manager

#### Commissioning Provider

#### Transition Team

#### A/E representative

### Access codes that are required to access equipment parameters, to allow for adjustments and operational changes, shall be recorded and supplied to the owner as part of the Operations and Maintenance documentation.

# Execution

## EXECUTION

### The CM has overall responsibility to ensure that QA/QC is upheld by all contractors and that systems are commissioned in a coordinated and complete manner.

### Commissioning process / work shall be a team effort to ensure that all equipment and system have been completely and properly installed and function together correctly to meet the design intent. System performance parameters shall be documented for fine tuning of control sequences and operational procedures, coordinate system documentation, equipment start-up, control system calibration, and performance testing.

### The CxP shall lead the Cx Team to facilitate solutions, whilst implementing the Cx Plan. Where issues are realized, the Cx Team shall document, track, discuss and implement resolutions. The Cx Team is to present issues with suggested resolutions, the responsibility to accept, direct or create a resolution for implementation is the relevant member of the Design Team as required.

### Detailed testing shall be performed on all installed equipment and system to ensure that operation and performance conform to contract documents. All tests shall be performed by the responsible trade contractor, accepted for quality by the CM, evaluated and witnessed by CxP and Design Engineer. After each grade of checklist and test are complete the system will be upgraded to the next test. Once a system(s) has been completed and passed all functional and integration tests it will be ready for acceptance by the CM, with recommendation for turn-over from the CxP and Engineer of record to the Owner.

## MEETINGS

### Initial Meeting. The CxP, through the CM, will schedule, plan and conduct an initial commissioning meeting. The contractor and its responsible parties are required to attend. The meeting will review commissioning intent, with relation to the project and align expectations on how the process will be delivered. The meeting shall be held prior to any contractor submittals being gathered and issued to the design team for review.

### Commissioning Meetings. Other meetings will be planned and conducted by the CxP as construction progresses. These meetings will cover coordination, deficiency resolution, and planning issues. These meetings will be held at least bi-monthly, becoming more frequent as the project demands, as frequently as once per week.

### System intent meetings. Prior to any substantial sequence programming, minuted meetings shall take place between the engineer of record, CxP, CxAg and the hands on programmer, to review the following items:

#### Functional intent

#### Sequence of operation

#### BACNet points that are available

#### System graphical interface

#### Alerts, alarms and reporting

### Three specific meetings will be held for:

#### Mechanical sequence of operations

#### Lighting sequence of operations

#### Fire alarm cause and effect

#### Security and access

## DOCUMENTATION, FAILURE AND APPROVAL OF TESTS

### Equipment shall be grouped into sub-systems and systems, to form start up and commissioning packs, for the documentation of testing. The groupings shall be at the discretion of the Cx Team. Each pack shall become a System Report and have a comment area for the CxP, a comment and sign off for the CM and A/E.

### The CxP notes each satisfactorily demonstrated function during testing. Final approval of the Performance Tests, by the Owner’s Representative, is made after review by the CxP and A/E, with acceptance and sign off from the CM.

### As inspections and testing progress, with issues being identified, the CxP shall engage with the commissioning team and contractor.

#### The CxP will document all issues and the contractor’s response and intentions, with an entry into the Issues Log. Corrections of minor issues identified may be made during the tests at the discretion of the CxP

#### Resolutions are made at the lowest management level possible. Other parties are brought into the discussions as needed. Final interpretive authority is with the A/E. Final acceptance authority is with the CM.

#### The contractor corrects the issue, making an entry of resolution into the Issues Log, certifying that the equipment is ready to be retested and notifies the Cx Team. The contractor shall reschedule testing.

### The contractor shall submit in writing to the CM at least as often as commissioning meetings are being scheduled, the status of each outstanding issue identified during commissioning. Discussion shall cover explanations of any disagreement and proposals for their resolutions.

### The contractor shall not consider retesting a justified reason for a claim of delay or for a time extension

### Failure Due to Manufacturer Defect. If 10% (or three, whichever is greater) of identical pieces of equipment fail to perform to the contract documents (mechanically or substantively) due to a manufacturing defect, not allowing it to meet its submitted performance specification, all identical units may be considered unacceptable by the A/E. In such case, the contractor shall provide the Owner’s Representative with the following:

#### Within one week of notification from the Owner’s Representative/CM, the contractor or manufacturer’s representative shall examine all other identical units making a record of the findings. The findings shall be provided to the CM within two weeks of the original notice.

#### Within two weeks of the original notification, the contractor or manufacturer shall provide a signed and dated, written explanation of the problem, detailed cause of failure(s), etc., and all proposed solutions. The proposed solutions shall not significantly exceed the specification requirements of the original installation.

#### The A/E will determine whether a replacement of all identical units or a repair is acceptable.

#### Two examples, where applicable, of the proposed solution shall be installed by the contractor and the A/E shall be allowed to test the installations for up to one week, upon which the A/E will decide whether to accept the solution.

#### Upon acceptance, the contractor and/or manufacturer shall replace or repair all identical items, at their expense. The replacement/repair work shall proceed with reasonable speed beginning within one week from when parts can be obtained.

## SUBMITTALS

SPEC NOTE: This review is intended primarily to aid with informing the Commissioning Team of items to consider and implement for system Commissioning and secondarily to verify compliance with equipment specifications.

### The contractors are to provide Cx specific information when collecting and issuing a submittal for review. At minimum, submittal package will include:

#### Manufacturer and model number

#### Manufacturer installation and operation manual

#### Sequences of operation

#### Control drawings, points list and communication protocol

#### Performance data

#### Manufacturer testing forms, including factory testing where applicable

### The CxAg and CxP will review submittals related to the commissioned equipment for the consideration of items as follows:

#### Special requirements for the installation and operation and risk to warranty of the equipment

#### Communication protocol, note of points available and points that are of importance for system operation and performance

#### Manufacturers start-up requirements and notice periods for site attendance requests

#### Bespoke testing requirements or procedures

#### Any performance characteristics or requirements that may affect operations of equipment when integrated into a system

#### Equipment specific start up and testing procedures and forms

## COMMISSIONING PLAN

### The commissioning plan is intended to be the documented intent of how the commissioning process is to be coordinated, scheduled, documented and implemented.

### The CxP will develop a project specific commissioning plan framework and lead the effort to completion. All contractors are to allocate time for their commissioning representative to supply information in a collaborative effort, with agreement to a logical and successful plan execution. The plan shall include, but is not, limited to, the following items.

#### Detail of project team, organizational chart, with agreed coordination and communication protocol

#### Team allocation of responsibilities

#### Commissioning stages and milestones

#### Project specific listing of systems that are to be commissioned

#### Issues Log

#### Commissioning Schedule

#### Expected Cx documentation list, formatted to create, indexed system packs

#### Installation Inspection forms

#### Start up plans

#### Functional testing procedures and checklists

#### Integration testing procedure

#### Performance testing procedure

#### Training, orientation and demonstration schedule

#### Phased handover procedures

#### Deferred and seasonal testing plan

## INSTALLATION CHECK AND STARTUP

### The QA/QC representative of each contractor shall inspect all installed equipment, ensure that all equipment pre-requisites are implemented and approve the equipment for start-up.

### The requirement of start up testing is to ensure that equipment is orientated, operational and has the ability to communicate, prior to their integration into a system or sub-system.

### The contractor shall submit the full startup plan to the CxP and CM for review, 4 weeks prior to any start ups, on a system basis.

### All contractors and vendors shall test their installed equipment to confirm that they individually operate, coordination requirements shall be stated in the Start Up Plan and confirmation of attendance of the relative commissioning team members shall be made during the commissioning meetings.

### The primary role of the CxAg in this process is to be present during testing, ensure that there is written documentation that each of the manufacturer-recommended procedures has been completed and that the start up plan is adhered to.The CxP will observe at minimum all primary plant and 20% of all other start up

### The CM and A/E as necessary, shall observe the procedures for each piece of primary equipment, unless there are multiple units, in which case a sampling strategy may be used.

### The CxAg shall execute startup and provide the CxP and A/E, through the CM, with a signed and dated copy of the completed installation and start up documentation.

### The CxAg shall ensure that the contractors clearly list any outstanding items of the initial startup and construction checklist procedures that were not completed successfully, on an attached sheet. The CxAg shall make an entry into the Issues Log for reference to the Cx Team.

## FUNCTIONAL TESTING

### The requirement of functional testing is to ensure that as a system is brought into operation, all of the components, equipment and sub-systems are operating as intended.

### Functional testing of a system is carried out over a period of time and may include works from multiple contractors with allocation of the system to them, for their purpose of testing.

### Testing shall document and prove that a system has the potential to perform to the intent of the contractual documents. Functional testing of systems include the following tasks and operational milestones:

#### Testing, Adjusting and Balancing.

#### Prove the ability to communicate and adjust to control demands.

#### To operate with expected and reliable function.

#### To derive operational reference points for operation, which can be tuned to maximize performance.

### The CM and A/E as necessary, shall be notified and invited to observe the procedures

### The CxAg coordinate, represent and be involved in all relevant functional testing, that is being performed with equipment and systems that their contractor have provided.

### The CxP will observe at minimum 20% of all functional testing, be present onsite to observe items of complication, indicated in the start up plan.

### The CxAg, contractors and vendors shall execute functional testing and provide the CxP and A/E, via the CM, with a signed and dated copy of the completed documentation.

### The CxAg shall ensure that the contractors clearly list any outstanding items that were not completed successfully, on an attached sheet, with possible resolutions. The CxAg shall make an entry into the Issues Log for review by the Cx Team.

### The CxP will work with the relevant members of the Cx Team to facilitate solutions for issues that hinder functional testing and the Cx Process.

## INTEGRATION TESTING

### Integration testing brings the systems from a state of individual substantial completion to full dynamic operation. During the testing process, unexpected, conflicting and incorrect system operations are identified, recorded and corrected. The completion of testing shall result in expected and reliable functioning of all complementary systems, in all modes and demand loading.

### The CxP shall define the integration tests and the Cx Team shall implement all testing.

### Before test procedures are finalized, the contractor shall provide to the A/E and the CxP all requested documentation and a current list of changes affecting equipment or systems, including an updated points list, program code, control sequences, and testing parameters.

### Using the testing parameters and requirements in the technical specifications, the CxP shall update/develop specific test procedures and forms to verify and document proper operation of each piece of equipment and system. Each contractor or vendor, as appropriate, shall provide assistance to the CxP in developing the final test procedures. Prior to finalization, the A/E shall review and concur with the test procedure.

### The control systems shall be sufficiently tested and approved by the CxP before it is used, to test, trend and verify integration functionality of other components or systems.

### Test Methods:

#### Simulating conditions shall be allowed, though timing the testing to experience actual conditions is encouraged wherever practical.

#### Overriding sensor values to simulate a condition, such as overriding the outside air temperature reading in a control system to be something other than it really is, is acceptable.

#### Using a signal generator which creates a simulated signal to test and calibrate transducers and DDC constants is generally recommended over using the sensor to act as the signal generator via simulated conditions or overridden values.

#### Rather than overriding sensor values, and when simulating conditions is difficult, altering set points to test a sequence is acceptable.

#### Relying on indirect indicators for responses or performance shall be allowed only after visually and directly verifying and documenting, over the range of the test parameters, that the indirect readings through the control system represent actual conditions and responses.

#### Integration testing shall be performed under conditions that simulate actual conditions as closely as is practically possible. The contractor(s) assisting the CxP in executing the test shall provide all necessary materials, system modifications, etc., to produce the necessary flows, pressures, temperatures, etc., necessary to execute the test according to the specified conditions. At completion of the test, the contractor(s) shall return all affected equipment and systems to their approved operating settings.

## PHASED HAND OVER PROCEDURES

### Phased handover, if required, shall be discussed, planned and accepted by all parties.

### A plan shall be produced by the CxP, with collaboration from all parties, that references the following items:

#### Systems that are effected.

#### Risks associated.

#### A schedule, indicating all phases of handover.

#### The occupant requirements and expectations of each phased handover.

#### The level of operation and performance expected from the systems during the period between each phased handover.

#### The requirements and supervision of the systems for safe, reliable and effective operation of the systems.

### The Cx Team shall all agree with the plan, prior to final acceptance and notice to proceed from UBC.

## PERFORMANCE TESTING

### The CxP shall define performance testing, with the Cx Team overseeing, witnessing, and documenting the performance of all equipment and systems. The CxP in association with the contractor and facility staff shall execute the tests. Performance testing shall be conducted after the integration testing has been satisfactorily completed and in agreement with UBC.

### Project specific performance testing shall be executed to verify system operation with efficient parameters under a variable and understood load. The control systems shall be tested and adjusted to ensure effective and reliable performance.

### Performance testing and verification may be achieved by manual testing or by monitoring the performance and analyzing the results using the control system’s trend log capabilities or by stand-alone data loggers. The Cx Team may substitute specified methods or require an additional method, with the approval of the A/E and Owner’s Representative/CM, to prove the successful implementation of the KPIs listed in the following table. The CxP will advocate for the method that is most appropriate for facility, systems, occupants and UBC.

### Key performance indicators for this project have been identified as:

|  |  |  |
| --- | --- | --- |
| KPI | Description of Importance | Method of Proof |
|  |  |  |
|  |  |  |

## DEMONSTRATIONS TO OWNER PERSONNEL

### For detailed requirements, refer to Section 01 79 00 Demonstration and Training.

### The CM and contractors shall be responsible providing qualified personnel, coordination, scheduling, documentation and ensuring that “optimum” demonstrations to the Owners facility staff is completed.

### The CM shall organize the demonstration to the Owner’s personnel for commissioned equipment and systems. The CxP will be in attendance to aid in facilitation and consider further requirements of UBC.

### Provide, to the Owner and CxP through the CM, a demonstration plan 60 days before the planned demonstrations covering the following elements:

#### Equipment.

#### Intended audience.

#### Location of demonstrations.

#### Objectives.

#### Subject covered (special operation, log in/out, alarms, resets, etc).

#### Duration of demonstrations on each subject.

#### Instructor for each subject.

#### Methods of demonstration (classroom lecture, manufacturer’s quality video, site walk through, actual operational demonstrations, written handouts, etc.).

## DEFERRED AND SEASONAL COMMISSIONING

### During the warranty period, deferred and seasonal testing shall be completed as part of this contract. The CxP shall coordinate this activity through the CM, with consultation with UBC. Tests will be executed, with presence of the CxAg and CxP, deficiencies should be corrected by the appropriate contractor with the CxP witnessing and documenting. Any final adjustments to the O&M manuals and as-builts due to the testing shall be made by the contractor.

### The CM and CxP shall publish a Deferred and Seasonal Testing Plan, with information from the CxAgs. The plan shall be reviewed and accepted by the Design Team and UBC, prior to handover. The plan is executed by the CM, any changes must be notified to the project team prior to acceptance.

#### Deferred Testing pertains to any testing that has to be performed post-handover, due to deficiency, agreed time restrictions or previously failed testing. System set up, storage and/or operation shall be agreed with the relative Engineer of Record and FMO staff.

#### Seasonal Commissioning pertains to testing under full load conditions and/or during peak cooling/heating season as well as part load conditions in the spring and fall. Simulations of peak load conditions shall be implemented wherever possible to allow for complete commissioning of the work.

#### The Plan shall indicate the following information:

##### What system is to be tested?

##### What is the reason for the testing and why it was not completed during the construction and commissioning period?

##### What items are required to be resolved prior to testing?

##### What members of the project team are required to participate in the testing?

##### What prerequisites are required for testing? (i.e. fuel, weather, timing, load or occupants)

##### What date and time is planned for performing the testing?

#### All deferred and seasonal commissioning will be performed by the contractors’ staff with the guidance and supervision of the CxAg, CM and CxP. The contractors will be responsible for testing and be responsible for any deficiencies that discovered from seasonal testing.

## THE COMMISSIONING REPORT

### The Commissioning Report is a stand alone documents that will be issued in 2 submissions:

#### Handover Submission:Will be complete with documentation of completed information and testing results at time of handover to UBC.

#### Final Submission:Will be a complete submission, issued 1 month prior to end of 1 year warranty period, complete with all information and testing results for the facility.

### The CxP is responsible to compile, organize and index the following Cx information:

#### Commissioning Plan.

#### Summary Commissioning Report including an executive summary, list of participants and roles, brief building description, overview of commissioning and testing scope, a general description of testing and verification methods, design narratives and criteria including sequences.

#### System reports shall contain the startup plan and report, approvals, corrections, functional testing checklists, completed integration and performance tests, trending and analysis, training plan and recommended re-commissioning schedule.

#### For each piece of commissioned equipment, the report should contain the disposition of the CxP regarding the adequacy of the equipment, documentation and training meeting the contract documents in the following areas:

##### Equipment meeting the equipment specifications.

##### Equipment installation.

##### Performance and efficiency.

##### Equipment documentation and design intent.

##### Operator demonstration and training.

### Recommendations for improvement to equipment or operations, future actions, implemented MBCx and possible areas for re-commissioning.

**\*\*\*END OF SECTION\*\*\***