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**PART 1 – GENERAL**

**1.1 DEFINITIONS**

- 1.1.1 Building Envelope: the overall physical structure that provides separation between conditioned spaces and the outdoor environment, or any indoor environment substantially different from the outdoor.
- 1.1.2 Validate: To witness and validate successful performance of systems and equipment, or record deficiencies; after deficiencies are repaired, validate a successful demonstration. These validations of the tests become references for the Consultant's certification.
- 1.1.3 Witness: The Commissioning Authority will observe as required and record summary of test results.
- 1.1.4 Commissioning Authority: Commissioning authority in charge of the commissioning process and recommends final acceptance.
- 1.1.5 Independent Third Party Agent: Independent agent specialized in the installation and testing of the systems and equipment and is retained by the Contractor or Owner.

**1.2 REFERENCES**

- 1.2.1 Section 01 91 13 - Facility Commissioning - General
- 1.2.2 ASHRAE Guideline 0-2013 - The Commissioning Process
- 1.2.3 CSA Z320-11 - Building Commissioning
- 1.2.4 NIBS Guideline 3 - 2012 - Exterior Enclosure Technical Requirements for the Commissioning Process
- 1.2.5 LEED 2009 - Green Building Rating System Reference Guide

**1.3 DOCUMENTS**

- 1.3.1 In case of discrepancies or conflicts between documents, documents will be governed in the order specified in Division 1.

**1.4 COMMISSIONING OBJECTIVES**

- 1.4.1 Objectives of commissioning process are:
  - 1.4.1.1 To support quality management through monitoring and checking of installation;

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- 1.4.1.2 To verify system performance through functional performance testing of completed installation;
  - 1.4.1.3 To move completed facility from “static completion” state to optimal “dynamic” operating state;
  - 1.4.1.4 To transfer facility from Contractor to Owner in such a manner that provision of a quality facility to Owner has been assured.
  - 1.4.1.5 To enhance operating and maintenance through delivery of quality driven, comprehensive training and instruction to Owner’s operating personnel.
  - 1.4.1.6 To provide accurate and useful historical records, such as, as-built drawings, test certificates, etc. to Owner. Such records provide important data for operating and maintaining systems as well as future system testing, maintenance or renovations, trouble shooting and repairing the components of systems.
  - 1.4.1.7 To extend commissioning activities into operational phase in order to verify performance levels under a range of operating conditions; such as change of seasons. This process will help to avoid unforeseen or hidden operating and maintenance expenses that may develop later on.
  - 1.4.1.8 Commissioning shall be considered complete when all of the objectives of the commissioning process, as specified herein, have been achieved.

## **1.5 COMMISSIONING MEETINGS, SCHEDULING, AND REPORTING**

- 1.5.1 The Contractor shall include the commissioning plan in their construction schedule and shall schedule for all tests in the construction schedule.
- 1.5.2 Commissioning meetings shall be scheduled as required. The meetings shall address commissioning related responsibilities as well as all specified testing, documentation, O&M manuals, training, and post construction requirements. The testing schedules and results of all tests shall be reviewed at the meetings.
- 1.5.3 The Contractor shall attend commissioning meetings, as called by the Commissioning Authority
- 1.5.4 The Contractor shall schedule work to include specified Commissioning related tasks. Cooperate with the Owner’s Commissioning Authority, and coordinate subtrades as required, to successfully demonstrate and verify commissioning related tests.
- 1.5.5 The Contractor shall schedule work to include specified Commissioning related testing prior to Owner’s demonstration and Owner’s training.
- 1.5.6 Test forms, reports and submittals associated with the building envelope systems shall be directed to the Consultant and Commissioning Authority.

**1.6 WARRANTY**

1.6.1 Involvement of Commissioning Authority does not void any guarantees or warranties nor does it relieve Contractor of any contractual responsibilities.

**1.7 RESPONSIBILITIES OF COMMISSIONING AUTHORITY**

1.7.1 Responsibilities of Commissioning Authority are as follows:

1.7.1.1 Design Phase:

1.7.1.1.1 Provide commissioning document to form part of the Bid documents.

1.7.1.2 Bid Phase:

1.7.1.2.1 Review Bid documents, design drawings and specifications to ensure testing and commissioning requirements are included.

1.7.1.2.2 Provide commissioning related comments for incorporation in Bid documents.

1.7.1.2.3 Participate in Bid review meetings to ensure Bidders are aware of testing and commissioning requirements.

1.7.1.3 Construction Phase:

1.7.1.3.1 Review Contractor's shop drawing submission for commissioning related issues.

1.7.1.3.2 Prepare commissioning plan based on the contractor's schedule and installation methodology;

1.7.1.3.3 Observe the installation throughout the construction stages.

1.7.1.3.4 Review building envelope related inspection and testing reports for commissioning related issues.

1.7.1.3.5 Supervise the commissioning, including scheduling.

1.7.1.3.6 Issue deficiency reports noting any issues that may have an impact on the commissioning of the equipment or system.

1.7.1.3.7 Attend construction site meetings as required to discuss commissioning related items and any impact on Project schedule.

1.7.1.3.8 Set-up and chair commissioning meetings.

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- 1.7.1.3.9 Witness and validate mock-up reviews and system tests; note deficiencies and issue progress reports.
  - 1.7.1.3.10 Work with the project team to expeditiously resolve any commissioning related problems that may arise due to site conditions.
  - 1.7.1.3.11 Co-ordinate with Owner, training and instructions provided by Contractors, Manufacturers and Suppliers.
  - 1.7.1.4 Post-Construction Phase:
    - 1.7.1.4.1 Prepare final report on commissioning, identifying any deficiencies that may be outstanding.
    - 1.7.1.4.2 Recommend additional training and/or instruction of operating and maintenance personnel deemed necessary over and above that already provided.
    - 1.7.1.4.3 Complete system checks with Contractor and third-party testing agency:
      - 1.7.1.4.3.1 Once during the first month of building operation.
      - 1.7.1.4.3.2 Once in the sixth month of building operation (in a season opposite to turn-over – Summer or Winter).

## **1.8 RESPONSIBILITIES OF OWNER**

1.8.1 Responsibilities of Owner are as follows:

- 1.8.1.1 To provide operating personnel to attend training and instruction regarding specific components, equipment and systems.
- 1.8.1.2 To retain the services of independent third parties for system verification and certification as required in the document or by applicable codes.
- 1.8.1.3 To observe on-site installation, and testing of envelope systems.

## **1.9 RESPONSIBILITIES OF CONSULTANT**

1.9.1 Responsibilities of Consultant are as follows:

- 1.9.1.1 Review Contractor's shop drawings and submittals to ensure that the equipment and systems proposed are compliant with specification requirements;
- 1.9.1.2 Review Contractor's installation program to ensure that the installation sequences have been coordinated with the project schedule;

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## **1.10 RESPONSIBILITIES OF CONTRACTOR**

1.10.1 Responsibilities of Contractor are as follows:

1.10.1.1 Construction Phase:

1.10.1.1.1 To manage and ensure entire installation complies with the requirements of the Contract Documents;

1.10.1.1.2 Submit shop drawings complete with Contractor's Stamp of Review;

1.10.1.1.3 Prepare and submit the project specific Quality Assurance Program intended to be implemented on the project for Consultant and Commissioning Authority review.

1.10.1.1.4 Submit working detail (interference or installation) drawings, as required;

1.10.1.1.5 Complete commissioning data test forms;

1.10.1.1.6 Submit an installation schedule. This schedule shall include:

1.10.1.1.6.1 Time schedule of each activity, with lead and lag time allowed and indicated;

1.10.1.1.6.2 Shop drawings and working detail drawings submission;

1.10.1.1.6.3 Coordinated installation activities and sequences in compliance with the General Contractor's project schedule and other trade's installation schedule;

1.10.1.1.7 Submit a commissioning activities schedule. This schedule shall include:

1.10.1.1.7.1 time schedule for system and equipment commissioning activities which are in compliance with the timing and sequences of installation schedule stated above. Including but not limited to 'dry running' functional performance testing such that the formal test can be performed in a timely manner without impacting the overall project schedule or cause delay to Project completion;

1.10.1.1.7.2 Prepare and submit commissioning activity method statements for review and approval;

1.10.1.1.7.3 Prepare and submit commissioning activity records or report forms for review and approval;

1.10.1.1.8 Attend progress and commissioning meetings;

1.10.1.1.9 Promptly rectify or replace reported deficiencies and defects;

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- 1.10.1.1.10 Where required by codes and/or specification, retain manufacturers and/or independent third parties to provide service for testing and certification of the systems and training of Owner's personnel;
  - 1.10.1.1.11 Provide training and instruction to the Owner's operating personnel;
  - 1.10.1.1.12 Witness testing of systems assemblies by third party testing agency. Testing to be deemed satisfactory by the Consultant and Commissioning Authority once the requirements outlined in specification Section 01 45 00 Quality Control are met. If first test by the third-party testing agency is deemed not satisfactory by the consultant and/or the Commissioning Authority, contractor shall assume costs to repair the envelope until it meets the requirements as outlined in specification Section 01 45 00 Quality Control, additional testing by the third-party testing agency, additional time for the Commissioning Authority to witness testing, and additional time for the Consultant to witness additional testing.
  - 1.10.1.1.13 Pay for and be responsible for all inspections required by codes, specification and Authorities having Jurisdiction. Obtain and submit all Certificate of Approval for such inspections and verifications;
  - 1.10.1.1.14 Provide Operating and Maintenance Manuals for review by the Consultant and Commissioning Authority with all the commissioning activity results and reports incorporated;
  - 1.10.1.1.15 Obtain, issue and assign warranties for equipment and systems to the Owner;
  - 1.10.1.1.16 Provision of all necessary test equipment shall be the responsibility of the contractor. Provide recently validated calibration certificates for all equipment to be used for verification prior to functional performance testing commencement.
- 1.10.1.2 Post-Construction Phase:
- 1.10.1.2.1 Complete all commissioning procedures and activities and performance verification procedures which were delayed or not concluded during the commissioning phase;
  - 1.10.1.2.2 Complete system checks:
    - 1.10.1.2.2.1 Once during the first month of building operation;
    - 1.10.1.2.2.2 Once in the sixth month of building operation (in a season opposite to turn-over – Summer or Winter);
    - 1.10.1.2.2.3 Complete correction of all deficiencies revealed by these checks.

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1.10.1.2.2.4 Revise all “as-built” and operating and maintenance documents to reflect all changes, modifications, revisions and adjustment upon completion of commissioning;

1.10.1.2.2.5 schedule a 4 hour on site question and answer session for the operating and maintenance personnel 3 months after handover of the facility to the Owner.

### **1.11 RESPONSIBILITIES OF THE THIRD-PARTY TESTING AGENCY**

1.11.1 Perform envelope testing as requested by Dalhousie against the envelope requirements outlined in specification section 01 45 00 Quality Control. Functional Performance Testing of the envelope will be witnessed by the Commissioning Authority and Consultant as required. The third-party testing agency shall record and sign-off the procedures and findings for approved tests, which shall be submitted to the Consultant and Commissioning Authority for review.

### **1.12 COMMISSIONING INVOLVEMENT**

1.12.1 Commissioning Authority shall direct, witness and validate as required; and Contractor and/or his Suppliers or retained Independent Third Party Agents shall perform the following:

1.12.1.1 Check and ensure installation of systems and equipment to ensure installations are completed and in a proper and safe state ready for functional performance testing;

1.12.1.2 Run and test the systems and equipment through their design parameters to verify their capabilities in performance, sequencing, safety protection and alarms annunciation;

1.12.1.3 Ensure deficiencies and defects found are rectified and the systems re-tested as required;

1.12.1.4 Arrange and provide demonstration and training of Owners’ personnel;

1.12.1.5 Review Operating and Maintenance Manuals for systems;

### **1.13 SYSTEMS TO BE COMMISSIONED**

1.13.1 Building envelope systems shall include but not limited to the systems outlined in specification 01 45 00 Quality Control.

### **1.14 TESTING EQUIPMENT**

1.14.1 Contractor and manufacturer shall provide all instrumentation and test equipment necessary to conduct the tests and validation specified during the commissioning process.

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Contractor shall submit a list of equipment to be used and copies of latest equipment calibration certificates to the Commissioning Authority and Consultant for approval.

### **1.15 EXTENT OF FUNCTIONAL PERFORMANCE TESTING**

1.15.1 The sampling rate to be determined by the owner and the third party testing agency.

### **1.16 DOCUMENTATION**

1.16.1 Contractor shall record test results and procedures on approved record forms and submit the forms together with copies of test certificates to the Consultant and Commissioning Authority for review and approval.

1.16.2 When results are validated, Commissioning Authority shall incorporate those records in his System Operation Manual. They shall also make entry of those test results into appropriate sections of the Operations and Maintenance Manual as reference for future system/equipment performance tests.

### **1.17 COMMISSIONING PROCESS**

1.17.1 Commissioning Authority is to perform and complete all work as specified in the "GENERAL" Section of this specification "Responsibilities of Commissioning Authority".

1.17.2 Contractors are to perform and complete all works as specified in the "GENERAL" Section of this specification "Responsibilities of Contractor". In general, it shall include test, and verification of performance of all components, equipment and systems; rectification of deficiencies; recording of test results for submission; demonstration, instruction and training of Owner's operating and maintenance personnel; follow-up during first year of operation for building service monitoring.

1.17.3 Equipment verification is to be performed by the Contractor who shall test and verify proper operation of all equipment and systems prior to start of commissioning and record all results from the test for each piece of equipment. Forms shall be included in the Operating and Maintenance Manual. Equipment data shall include, but is not limited to:

1.17.3.1 Manufacturer's name, address and telephone number;

1.17.3.2 Distributors' name, address and telephone number;

1.17.3.3 Make, model number and serial number;

1.17.3.4 Any other special characteristics.

### **1.18 TESTING FOR BUILDING ENVELOPE SYSTEMS**

1.18.1 To be completed as per our specification Section 01 45 00 Quality Control



### **1.19 OPERATION AND MAINTENANCE MANUAL**

1.19.1 Contractor shall prepare and submit the Operation and Maintenance Manual as outlined in specification 01 77 00 Contact Closeout Procedures and Submittals.

### **1.20 SYSTEMS OPERATING MANUAL**

1.20.1 Systems Operation Manual shall be prepared by Commissioning Authority using data collected by Contractor and test results.

1.20.2 The content and format of the SOM to be as per the university's document "Systems Operation Manual Creation Process and Expected Contents".

1.20.3 Commissioning Authority shall provide a copy of the Systems Description Manual to the University.

### **1.21 OPERATOR TRAINING AND INSTRUCTIONS**

1.21.1 Contractor and equipment manufacturers shall provide operator training for each system and piece of equipment.

1.21.2 The training and instruction shall be provided by qualified technicians and shall be conducted in a classroom setting at the equipment or system.

1.21.3 Training and instruction will begin when the Operating and Maintenance Manual has been approved and delivered to Owner.

1.21.4 Owner Training Pre-requisites:

1.21.4.1 O&M manual(s) been reviewed and approved by the architect.

1.21.4.2 For the system/assembly that training will occur on:

1.21.4.2.1 Envelope has been 100% completed, with no remaining deficiencies, or items on the Commissioning Issues Log.

1.21.4.3 Two weeks in advance of the scheduled training date, the following to be submitted to the owner for review:

1.21.4.3.1 An Agenda

1.21.4.3.2 A Trainor's bio

1.21.4.3.3 Training materials specific to the Agenda have been provided in electronic form for review and approval.

1.21.4.4 The owner reserves the right to reject the Trainor, or modify the agenda, if either are found to be unacceptable.

1.21.5 Each session shall be structured to cover:

1.21.5.1 The Operating and Maintenance Manual;

1.21.5.2 Operating procedures;

1.21.5.3 Maintenance procedures;

1.21.5.4 Trouble-shooting procedures;

1.21.5.5 Manufacturer's or service representative's name, address and phone number.

1.21.6 Contractor shall prepare a detailed training and instruction plan. This plan shall include the outline of all sessions and identification of the training presenters.

1.21.7 Submit the plan including a copy of training manual for Commissioning Authority's review and approval.

1.21.8 Provide course documentation for up to 6 people.

1.21.9 The sessions shall be co-ordinated by the Contractor.

1.21.10 Training and instruction shall be provided for the following systems wherever applicable:

SYSTEM	MINIMUM TRAINING DURATION
Architectural Design Summary	2 hours
Roofing	1 hour per type
Cladding Systems	1 hour per type
Entrance Systems	1 hour per type
Glazing Systems	1 hour per type
"Other" Systems	1 hour per type

1.21.11 Training and instruction requirement for the building envelope system shall include a walk-through of building by Contractor. During the walk-through the Contractor shall:

1.21.11.1 Identify system and equipment;

1.21.11.2 Identify maintenance requirements;

1.21.11.3 Identify functional aspects;

1.21.11.4 Identify access requirements;

1.21.12 When each session has been completed, training attendance lists are to be provided to the Commissioning Authority for review and sign-off related to completion.

## **1.22 SYSTEMS DEMONSTRATION AND TURNOVER**

1.22.1 System demonstration and turnover to the Owner shall occur when:

1.22.1.1 The installation is complete;

1.22.1.2 Acceptance tests conducted by the Consultant have been successfully completed;

1.22.1.3 Commissioning Authority system testing has been successfully completed;

1.22.1.4 Training and instruction has been completed;

1.22.1.5 Operating and Maintenance Manual has been accepted;

1.22.1.6 Shop drawings have been updated;

1.22.1.7 As-built drawings have been completed.

1.22.2 Systems demonstration shall be conducted by Contractor and manufacturers. The demonstration shall cover all operation and maintenance requirements and a physical demonstration of equipment installation and operation.

## **1.23 TESTING FORMS**

1.23.1 Contractor and manufacturers shall provide information required to complete building envelope systems testing for this Project.

1.23.2 Testing forms shall be submitted to the Commissioning Authority for review.

1.23.3 Building envelope testing and verification forms to be completed as required

## **1.24 EQUIPMENT AND SYSTEM WARRANTIES**

1.24.1 Equipment and system warranties shall be as defined in Division 1.

1.24.2 Contractor shall re-visit the building during the warranty period with Consultant, Commissioning Authority and Owner. During these visits the performance of the system shall be reviewed. These visits shall occur:

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1.24.2.1 Once during the first month of building operation;

1.24.2.2 Once during the sixth month of building operation (in a season opposite to turn-over – Summer or Winter);

1.24.3 The Owner shall organize these visits.

1.24.4 At these meetings Owner, Consultants and Commissioning Authority shall review the performance of the systems. If the performance is satisfactory then no further action need to be taken. If unsatisfactory then Contractor will be instructed to correct deficiencies, at his cost, to the satisfaction of Consultant.

**END OF SECTION**