

1 General

1.1 WORK COVERED BY THE CONTRACT DOCUMENTS

- .1 Work of this Contract includes, but is not limited to, the replacement of the existing constant or 2-position laboratory air valves with new variable air volume air valves, the installation of additional new variable air volume air valves and the upgrade of the existing energy management and control system throughout the laboratory spaces. Refer to the project design specifications and drawings for complete scope of work requirements.
- .2 The Contractor will be responsible for the commissioning and functional performance testing of all systems replaced, upgraded and installed as part of this project. Refer to the project design specifications and drawings, as well as the preliminary commissioning plan, for complete scope of work requirements.
 - .1 Central system and AHU's will be reprogrammed and retuned at intervals to prevent oscillations and to meet the new sequence of operations. Reprogramming of these system is to be by Delta Controls factory trained representative.
- .3 The contractor shall provide a pre-construction TAB report for all supply diffusers, exhaust grilles, canopy hoods, fume hoods and speciality exhaust systems (i.e. extraction arms, snorkels, equipment specific, modified fume hoods / canopy hoods), within the impacted laboratory spaces in both occupied and unoccupied modes. The TAB report shall be provided at least two (2) weeks prior to any construction work beginning on-site.
- .4 The contractor shall be responsible for the re-certification and verification testing for all laboratory fume hoods post retrofit. This shall be provided through a 3rd party independent testing authority (i.e. Con-Test shall be an acceptable testing agency).
- .5 The laboratory building, as well as laboratory spaces, outside of the immediate construction area are expected to remain fully operational throughout the construction. The Contractor will be responsible for providing a sufficient workforce such that a single laboratory space can be fully completed within a five (5) day period. The Departmental Representative will arrange a schedule to allow the project to proceed on a rotational basis through the building.
 - .1 The existing Laboratory exhaust and supply central air handling and exhaust systems under control of Delta Control, including variable frequency drive and system static pressure set points shall be re-commissioned as part of this project.
- .6 Where tie-ins to the existing fume exhaust system are required, this work will be coordinated with the Departmental Representative and completed after-hours or on the weekends. The fume exhaust system shall not be shut-down while the building is occupied. The Contractor shall be responsible for coordinating with, and following any safe-work procedures provided by, the Departmental Representative for these shutdowns.
 - .1 All new building automation system control points, including all alarms, monitoring / BACnet integration points and system sequences of

operation, including associated points shall be commissioned though the graphics of the existing enteliWEB OWS.

- .7 The Contractor will be responsible for the tie-ins to the existing fume exhaust system as shown within the design plans. The Contractor shall provide a detailed, site-specific safety plan regarding the work required for these tie-ins and shall provide all required testing and cleaning required to mitigate risks identified within the Contractor's safety plan.
- .8 The project Work is located at the Bedford Institute of Oceanography (BIO) Ellis Laboratory Building in Dartmouth, NS.
- .9 The Work includes Mechanical, Electrical and Controls, whom will be engaged by this Contractor. The Work also includes retrofits to existing equipment, whom will also be engaged by this Contractor.
 - .1 Update of the existing enteliWEB Front End to reflect all changes to the HVAC upgrades to the Ellis Building. This shall include integration of all required inputs and outputs, enteliWEB licence requirements, all updates to event management and alarm routing, object trending, and updates to existing graphics. To re-calibrate and re-tune the control objects on the central equipment, including all air handlers and exhaust fans, to work with the new air valves and HVAC system to ensure temperature and humidity setting, and prevent equipment oscillation and control problems.
- .8 The Bedford Institute of Oceanography (BIO) will provide site security services for this project. The Department Representative will coordinate the application for Contractor security checks. Contractors will be escorted while security checks are being processed. None of the above requirements will be the Contractor's responsibility.

1.2 CONTRACT METHOD

- .1 Construct Work under single stipulated price contract.

1.3 WORK BY OTHERS

- .1 Co-operate with other Contractors in carrying out their respective works and carry out instructions from Departmental Representative.
- .2 Co-ordinate work with that of other Contractors. If any part of work under this Contract depends for its proper execution or result upon work of another Contractor, report promptly to Departmental Representative, in writing, any defects which may interfere with proper execution of Work.

1.4 WORK SEQUENCE

- .1 Construct Work in a single phase. Co-ordinate with the Departmental Representative in terms of shut-down(s), parking and other policies in force on the job site during construction.
- .2 Minimize disruption and disturbance.
- .3 All Contractor work to be done during regular Construction working hours (ie: Monday to Friday from 0700 to 1700 hours), except were specifically identified within the scope of work summary.

- .4 Coordinate work with the Departmental Representative for off-hours Work during the evenings, early morning hours, on the weekends (ie: Saturday and/or Sunday) and/or during Holidays.
- .5 Co-ordinate Progress Schedule and co-ordinate with Departmental Representative Occupancy during construction.
- .6 Maintain fire access/control.
- .7 Clean job-site daily. Be responsible for all construction related debris. Construction related materials are not permitted to blow away into the Halifax Harbour. Secure all work and maintain a safe job-site.

1.5 CONTRACTOR USE OF PREMISES

- .1 Limit use of premises for Work, for storage and for access, to allow:
 - .1 Departmental Representative occupancy.
 - .2 Work by other Contractors.
- .2 Co-ordinate use of premises under direction of Departmental Representative.
- .3 Obtain and pay for use of additional storage or work areas needed for operations under this Contract.
- .4 Remove or alter existing work to prevent injury or damage to portions of existing work which remain.
- .5 Repair or replace portions of existing work which have been altered during construction operations or adjoining work, as directed by Departmental Representative.
- .6 At completion of operations condition of existing work shall be the same which existed before new work started.

1.6 DEPARTMENTAL REPRESENTATIVE CO-OPERATION

- .1 Co-operate with the Departmental Representative w.r.t. Work scheduling and operations to minimize conflict and to facilitate the Departmental Representative's usage of the Jetty.

1.7 ALTERATIONS, ADDITIONS AND/OR REPAIRS

- .1 Execute work with least possible interference or disturbance to the Jetty operations. Co-ordinate the Work with the Departmental Representative to facilitate execution of the Work.
- .2 Accept liability for damage, safety of equipment and over-loading of existing equipment.

1.8 EXISTING SERVICES

- .1 Notify the Departmental Representative of intended interruption of services and obtain required permission prior to interruption.
- .2 Where Work involves breaking into or connecting to existing services, give Departmental Representative 48 hours advanced notice for necessary interruption of mechanical and/or electrical service throughout the course of the Work. Minimize duration of interruptions. Carry out Work at times as directed by the Department Representative with minimum disturbance to operations.

- .3 Maintain accessibility to the Jetty at all times.
- .4 Establish location and extent of service lines in area of work before starting Work. Notify Departmental Representative of findings.
- .5 Submit schedule to and obtain approval from the Departmental Representative for any shut-down or closure of active service or facility including water, power, controls and/or communications services. Adhere to approved schedule and provide notice to affected parties.
- .6 Where unknown services are encountered, immediately advise the Department Representative. Confirm findings in writing.
- .7 Protect, relocate or maintain the remaining existing active services. When inactive services are encountered, cap off in manner approved by the Departmental Representative.
- .8 Record locations of maintained, re-routed and abandoned service lines.

1.9 DOCUMENTS REQUIRED

- .1 Maintain at job site, one (1) copy each document as follows:
 - .1 Contract Drawings.
 - .2 Specifications.
 - .3 Addenda.
 - .4 Reviewed Shop Drawings.
 - .5 List of Outstanding Shop Drawings.
 - .6 Change Orders.
 - .7 Other Modifications to Contract.
 - .8 Field Test Reports.
 - .9 Copy of Approved Work Schedule.
 - .10 Health and Safety Plan and Other Safety Related Documents.
 - .11 Other documents as specified.

2 Products

2.1 NOT USED

- .1 Not used.

3 Execution

3.1 NOT USED

- .1 Not used.

END OF SECTION

1 General

1.1 ACCESS AND EGRESS

- .1 Maintain "access to" and "egress from" work areas, including relevant equipment rooms, as directed by the Department Representative and in accordance with relevant Municipal, Provincial, Federal and/or other regulations.

1.2 USE OF SITE AND FACILITIES

- .1 Execute work with least possible interference or disturbance to normal use of premises. Make arrangements with Departmental Representative to facilitate work as stated.
- .2 Maintain existing access to and from for authorized personnel and vehicle access.
- .3 The Contractor shall be escorted by a Commissionaire (at no cost/charge to the Contractor) during that period when the security checks are being processed. The Department Representative will coordinate the security clearance application form process.
- .4 The Department Representative will provide security staff at all times, at no cost/charge to the Contractor.
- .5 Departmental Representative will assign sanitary facilities for use by Contractor's personnel. Keep facilities clean.
- .6 Accept liability for damage, safety of equipment and overloading of existing equipment.
- .7 Closures: protect work temporarily until permanent enclosures are completed.
- .8 Parking spaces are very limited on-site. Parking of Contractor vehicles will be limited to operational vehicles only. Coordinate the number of vehicles permitted with the Department Representative.

1.3 ALTERATIONS, ADDITIONS OR REPAIRS TO EXISTING BUILDING

- .1 Execute work with least possible interference or disturbance to Jetty operations, occupants, public and normal use of premises. Coordinate the Work with the Departmental Representative to facilitate execution of the Work.

1.4 EXISTING SERVICES

- .1 Notify the Departmental Representative of intended interruption of services and obtain required permission prior to the interruption.
- .2 Where Work involves breaking into or connecting to existing services, give the Departmental Representative 48 hours of notice for necessary interruption of Mechanical and/or Electrical service throughout course of work. Keep duration of interruptions to a minimum. Connections into the existing fume exhaust system shall be completed after-hours or on the weekends. The exhaust system shall not be shut down when the building is occupied.
- .3 Construct barriers in accordance with Section 01 56 00 Temporary Barriers and Enclosures.

1.5 SPECIAL REQUIREMENTS

- .1 Carry out noise generating Work: Monday to Friday from 0700 to 1700 hours. Coordinate Work and noise working restrictions on Saturdays, Sundays and/or Holidays.
- .2 Ensure Contractor's personnel employed on site become familiar with and obey regulations including safety, fire, traffic and security regulations.
- .3 Keep within limits of work and avenues of ingress and egress.

2 Products

2.1 NOT USED

- .1 Not used.

3 Execution

3.1 NOT USED

- .1 Not used.

END OF SECTION

1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 45 00 Quality Control.
- .2 Section 01 78 00 Closeout Submittals.

1.2 ADMINISTRATIVE

- .1 Submit to the Departmental Representative submittals listed for review. Submit promptly and in orderly sequence to not cause delay in Work. Failure to submit in ample time is not considered sufficient reason for extension of Contract Time and no claim for extension by reason of such default will be allowed.
- .2 Do not proceed with Work affected by submittal until review is complete.
- .3 Present shop drawings, product data, samples and mock-ups in SI Metric units.
- .4 Where items or information is not produced in SI Metric units, converted values are acceptable.
- .5 The Contractor shall review submittals prior to submission to the Departmental Representative. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and co-ordinated with requirements of Work and Contract Documents. Submittals not stamped, signed, dated and identified as being "project specific" will be returned without being examined and shall be considered "Rejected".
- .6 Notify Departmental Representative, in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.
- .7 Verify field measurements and affected adjacent Work are co-ordinated.
- .8 Contractor's responsibility for errors and omissions in the submittals is not relieved by the Departmental Representative's review of the submittals.
- .9 Contractor's responsibility for deviations in the submittals from requirements of Contract Documents is not relieved by the Departmental Representative review.
- .10 Keep one reviewed copy of each submittal on site at all times.

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 The term "shop drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures, and other data which are to be provided by Contractor to illustrate details of a portion of Work.
- .2 Shop drawings shall be stamped and signed by a qualified Professional Engineer registered or licensed to practice in the Province of Nova Scotia, Canada.
- .3 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of Work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been co-ordinated, regardless of Section under which adjacent items will be supplied and installed. Indicate cross references to design drawings and specifications.

- .4 Allow fifteen (15) calendar days for the Departmental Representative's review of each submission.
- .5 Adjustments and/or corrections made on the shop drawings by the Departmental Representative are not intended to change the Contract Price. If adjustments affect the value of the Work, state such in writing to the Departmental Representative prior to proceeding with the Work.
- .6 Make changes to the shop drawings as the Departmental Representative may require, consistent with the Contract Documents. When re-submitting, notify the Departmental Representative in writing of revisions other than those requested.
- .7 Accompany submissions with transmittal letter, in duplicate, containing:
 - .1 Date.
 - .2 Project title and number.
 - .3 Contractor's name and address.
 - .4 Identification and quantity of each shop drawing, product data and sample.
 - .5 Other pertinent data.
- .8 Submissions include:
 - .1 Date and revision dates.
 - .2 Project title and number.
 - .3 Name and address of:
 - .1 Subcontractor.
 - .2 Supplier.
 - .3 Manufacturer.
 - .4 Contractor's stamp, signed by Contractor's authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents.
 - .5 Cross reference to particular details of contract drawings and specifications section number for which shop drawing submission addresses.
 - .6 Details of appropriate portions of Work as applicable:
 - .1 Fabrication.
 - .2 Layout, showing dimensions, including identified field dimensions, and clearances.
 - .3 Setting or erection details.
 - .4 Capacities.
 - .5 Performance characteristics.
 - .6 Standards.
 - .7 Operating weight.
 - .8 Wiring diagrams.
 - .9 Single line and schematic diagrams.
 - .10 Relationship to adjacent work.
- .9 After the Departmental Representative's review, distribute copies.

- .10 Submit a PDF electronic copy of all shop drawings for each requirement requested in specification Sections and as Departmental Representative may reasonably request.
- .11 Submit a PDF electronic copy of product data sheets or brochures for requirements requested in specification Sections and as requested by Departmental Representative where shop drawings will not be prepared due to standardized manufacture of product.
- .12 Submit electronic copy of test reports for requirements requested in specification Sections and as requested by Departmental Representative.
 - .1 Report signed by authorized official of testing laboratory that material, product or system identical to material, product or system to be provided has been tested in accord with specified requirements.
 - .2 Testing must have been within three (3) years of the date of contract award for this project.
- .13 Submit electronic copy of certificates for requirements requested in specification Sections and as requested by the Departmental Representative.
 - .1 Statements printed on manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material attesting that product, system or material meets specification requirements.
 - .2 Certificates must be dated after award of project contract complete with project name.
- .14 Submit a PDF electronic copy of the manufacturer's instructions for requirements requested in specification Sections and as requested by the Departmental Representative.
 - .1 Pre-printed material describing installation of product, system or material, including special notices and Material Safety Data Sheets concerning impedances, hazards and safety precautions.
- .15 Submit a PDF electronic copy of the Manufacturer's Field Reports for requirements requested in specification Sections and as requested by the Departmental Representative.
- .16 Documentation of the testing and verification actions taken by the manufacturer's representative to confirm compliance with the manufacturer's standards or instructions.
- .17 Submit a PDF electronic copy of all Operation and Maintenance Data for requirements requested in specification Sections and as requested by the Departmental Representative.
- .18 Delete information not applicable to project.
- .19 Supplement standard information to provide details applicable to this project.
- .20 If upon review by the Departmental Representative, no errors or omissions are discovered or if only minor corrections are made, copies will be returned and fabrication and installation of Work may proceed. If shop drawings are rejected, noted copy will be returned and re-submission of corrected shop drawings, through same procedure indicated above, must be performed before fabrication and installation of the Work may proceed.

- .21 The review of shop drawings by Departmental Representative is for sole purpose of ascertaining conformance with general concept.
 - .1 This review shall not mean that Departmental Representatives approves detail design inherent in shop drawings, responsibility for which shall remain with the Contractor submitting same, and such review shall not relieve Contractor of responsibility for errors or omissions in shop drawings or of responsibility for meeting requirements of construction and Contract Documents.
 - .2 Without restricting generality of foregoing, the Contractor is responsible for dimensions to be confirmed and correlated at job site, for information that pertains solely to fabrication processes or to techniques of construction and installation and for co-ordination of the Work of sub-trades.

1.4 SAMPLES

- .1 Submit for review samples in duplicate, as requested in respective Specification Sections. Label samples with origin and intended use.
- .2 Deliver samples pre-paid to the Departmental Representative Project Manager's office or other address as directed by Departmental Representative's. Do not drop off samples at construction site, except for special circumstances previously approved by the Departmental Representative.
- .3 Notify the Departmental Representative in writing, at time of submission of deviations in samples from requirements of the Contract Documents.
- .4 Where colour, pattern or texture is criterion, submit full range of samples.
- .5 Adjustments made on samples by the Departmental Representative are not intended to change the Contract Price. If adjustments affect the value of Work, state such in writing to Departmental Representative prior to proceeding with the Work.
- .6 Make changes in samples which Departmental Representative may require, consistent with the Contract Documents.
- .7 Reviewed and accepted samples will become standard of workmanship and material against which installed Work will be verified.

1.5 MOCK-UPS

- .1 Erect mock-ups in accordance with 01 45 00 Quality Control.

1.6 CERTIFICATES AND TRANSCRIPTS

- .1 Immediately after award of Contract, submit copies of permits, notices, compliance certificates received by Regulatory Agencies having jurisdiction and as applicable to the Work.
- .2 Submission of above documents to be in accordance with Submittal – General Requirements procedures specified in this section.

2 Products

2.1 NOT USED

.1 Not Used.

3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

1 General

1.1 SECTION INCLUDES

- .1 Procedures to isolate and lockout electrical facility or other equipment from energy source.
- .2 **Contractors who are not entirely familiar with all aspects of lock-out procedures and/or do not have any written procedures in place may be given the "PWGSC - Electrical Safety Requirements Manual" dated Sept. 1995 (prepared by the Atlantic Region A/E Services Electrical Engineering Unit) as a reference tool, modelled from the Canada Labour Code, to assist in interpreting the various codes and safety standards for ensuring electrical safety on PWGSC projects and to help in developing and implementing lock-out procedures. It should be emphasized to the Contractor that the manual shall be used for reference purposes only and that he is ultimately responsible for becoming familiar with all applicable safety regulations and developing procedures appropriate to the project circumstances.**

1.2 RELATED WORK

- .1 Section 01 35 30 Health and Safety Requirements.
- .2 Section 01 35 35 Fire Safety Requirements

1.3 REFERENCES

- .1 CSA C22.1-2015 Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations.
- .2 CSA C22.3 No. 1-M87 (R2001) Overhead Systems.
- .3 CSA C22.3 No. 7-94 (R2005) Underground Systems.
- .4 COSH, Canada Occupational Health and Safety Regulations made under Part II of the Canada Labour Code.

1.4 DEFINITIONS

- .1 **Electrical Facility:** means any system, equipment, device, apparatus, wiring, conductor, assembly or part thereof that is used for the generation, transformation, transmission, distribution, storage, control, measurement or utilization of electrical energy, and that has an amperage and voltage that is dangerous to persons.
- .2 **Guarantee of Isolation:** means a guarantee by a competent person in control or in charge that a particular facility or equipment is isolated.

- .3 De-energize: in the electrical sense, that a piece of equipment is isolated and grounded, e.g. if the equipment is not grounded, it cannot be considered de-energized (DEAD).
- .4 Guarded: means that an equipment or facility is covered, shielded, fenced, enclosed, inaccessible by location, or otherwise protected in a manner that, to the extent that is reasonably practicable, will prevent or reduce danger to any person who might touch or go near such item.
- .5 Isolate: means that an electrical facility, mechanical equipment or machinery is separated or disconnected from every source of electrical, mechanical, hydraulic, pneumatic or other kind of energy that is capable of making it dangerous.
- .6 Live/alive: means that an electrical facility produces, contains, stores or is electrically connected to a source of alternating or direct current of an amperage and voltage that is dangerous or contains any hydraulic, pneumatic or other kind of energy that is capable of making the facility dangerous to persons.

1.5 COMPLIANCE

- .1 Perform lockouts in compliance with:
 - .1 Canadian Electrical Code
 - .2 Federal and Provincial Occupational Health and Safety Acts and Regulations as specified in section 01 35 30.
 - .3 Regulations and code of practice as applicable to mechanical equipment or other machinery being de-energized.
 - .4 Procedures specified herein.
- .2 In event of conflict between any provisions of above authorities the most stringent provision will apply. Should a dispute arise in determining the most stringent requirement, Departmental Representative will advise on the course of action to be followed.

1.6 SUBMITTALS

- .1 Submit copy of proposed Lockout Procedures and sample form of lockout permit and lockout tags for review.
- .2 Submit documentation within 14 calendar days of contract award. Do not proceed with work until submittal has been reviewed by Departmental Representative.
- .3 Submit above documents in accordance with the submittal - general requirements specified in section 01 33 00.
- .4 Resubmit Lockout Procedures with noted revisions as may result from Departmental Representative's review.

1.7 ISOLATION OF EXISTING SERVICES

- .1 Obtain Departmental Representative's written authorization prior to conducting work on an existing active, energized service or facility required as part of the work and before proceeding with lockout of such services or facility.
- .2 To obtain authorization, submit to Departmental Representative following documentation:
 - .1 Written Request for Isolation of the service or facility and;
 - .2 Copy of Contractor's Lockout Procedures.
- .3 Make a Request for Isolation for each event, unless directed otherwise by Departmental Representative, and as follows:
 - .1 Fill-out standard forms in current use at the Facility when so directed by Departmental Representative or;
 - .2 Where no form exist at Facility, make request in writing identifying:
 - .1 Identification of system or equipment to be isolated, including its' location;
 - .2 Time duration, indicating Start time & date and Completion time & date when isolation will be in effect.
 - .3 Voltage of service feed to system or equipment being isolated.
 - .4 Name of person making the request.
 - .3 Document to be in typewritten format.
- .4 Do not proceed until receipt of written notification from Departmental Representative granting the Isolation Request and authorizing to proceed with the isolation of designated equipment or facility. Departmental Representative may designate other individual at the Facility as the person authorized to grant the Isolation Request.
- .5 Conduct safe, orderly shutdown of equipment or facilities, de-energize and isolate power and other sources of energy and lockout items in accordance with requirement of clause 1.8 below.
- .6 Plan and schedule shut down of existing services in consultation with the Departmental Representative and the Facility Manager. Minimize impact and downtime of facility operations.
- .7 Determine in advance, as much as possible, in cooperation with the Departmental Representative, the type and frequency of situations which will require a Request for Isolation. Follow Departmental Representative's directives in this regard.
- .8 Conduct hazard assessment as part of the planning process of isolating existing equipment and facilities. Hazard Assessments to conform with requirements of Health and Safety Section 01 35 30.

1.8 LOCKOUTS

- .1 Isolate and lockout electrical facilities, mechanical equipment and machinery from all potential energy sources prior to starting work on such items.
- .2 Develop and implement lockout procedures to be followed on site as an integral part of the Work.
- .3 Use energy isolation lockout devices specifically designed and appropriate for type of facility or equipment being locked out.
- .4 Use industry standard lockout tags.
- .5 Provide appropriate safety grounding and guards as required.
- .6 Prepare Lockout Procedures in writing. Describe safe work practices, work functions and sequence of activities to be followed on site to safely isolate all potential energy sources and lockout/tagout facilities and equipment.
- .7 Include within procedures a system of worker request and issuance of individual lockout permit by a person, employed by Contractor, designated to be "in-charge" and being responsible for:
 - .1 Controlling issuance of permits or tags to workers.
 - .2 Determining permit duration.
 - .3 Maintaining record of permits and tags issued.
 - .4 Submitting a Request for Isolation to Departmental Representative when required in accordance with Clause 1.7 above.
 - .5 Designating a Safety Watcher, when one is required based on type of work.
 - .6 Ensuring equipment or facility has been properly isolated, providing a Guarantee of Isolation to worker(s) prior to proceeding with work.
 - .7 Collecting and safekeeping lockout tags, returned by workers, as a record of the event.
- .8 Clearly establish, describe and allocate, within procedures, the responsibilities of:
 - .1 Workers.
 - .2 Designated person controlling issuance of lockout tags/permits.
 - .3 Safety Watcher.
 - .4 Subcontractors and General Contractor.
- .9 Procedures shall meet the requirements of Codes and Regulations specified in clause 1.5 above.
- .10 Generic procedures, if used, must be edited, supplemented with pertinent information and tailored to reflect specific project conditions. Clearly label as being the procedures applicable to this contract.
 - .1 Incorporate site specific rules and procedures established by Facility Manager and in force at site. Obtain such procedures through Departmental Representative.

- .11 Procedures to be in typewritten format.
- .12 Submit copy of Lockout Procedures to Departmental Representative, in accordance with submittal requirements of clause 1.6 herein, prior to commencement of work.

1.9 CONFORMANCE

- .1 Ensure that lockout procedures, as established for project on site, are stringently followed. Enforce use and compliance by all workers.
- .2 Brief all persons working on electrical facilities, mechanical and other equipment fed by an energy source on requirements of this section.
- .3 Failure to perform lockouts in accordance with regulatory requirements or follow procedures specified herein may result in the issuance of a Non-Compliance Notification at Departmental Representative's discretion with possible disciplinary measures.

1.10 DOCUMENTS ON SITE

- .1 Post Lockout Procedures on site in common location for viewing by workers.
- .2 Keep copies of Request for Isolation submitted to Departmental Representative and lockout permits or tags issued to workers during the course of work for full project duration.
- .3 Upon request, make such data available to Departmental Representative or to authorized safety representative for inspection.

2 Products

2.1 Not Used

- .1 Not used.

3 Execution

3.1 Not Used

- .1 Not used.

END OF SECTION

1 General

1.1 SECTION INCLUDES

- .1 Health and safety consideration required to ensure that Departmental Representative shows due diligence towards health and safety on construction sites, and meets the requirements laid out in Departmental Representative/RPB Departmental Policy DP 073 Occupational Health and Safety Construction.

1.2 RELATED SECTIONS

- .1 Section 01 33 00 Submittal Procedures.
- .2 Section 01 35 25 Special Procedures on Lockout Requirements.
- .3 Section 01 35 35 Fire Safety Requirements.

1.3 REFERENCES

- .1 Canada Labour Code, Part 2, Canada Occupational Safety and Health Regulations
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
 - .1 Material Safety Data Sheets (MSDS).
- .3 Province of Nova Scotia:
 - .1 Occupational Health and Safety Act, S.N.S. Updated 2013.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 Submittal Procedures.
- .2 Submit site-specific Health and Safety Plan: Within seven (7) days after date of Notice to Proceed and prior to commencement of Work. Health and Safety Plan must include:
 - .1 Results of site specific safety hazard assessment.
 - .2 Results of safety and health risk or hazard analysis for site tasks and operation.
- .3 Submit three (3) copies of the Contractor's authorized representative's work site health and safety inspection reports to the Departmental Representative weekly.
- .4 Submit copies of reports or directions issued by Federal, Provincial and Territorial health and safety inspectors.
- .5 Submit copies of incident and accident reports.
- .6 Submit WHMIS MSDS Material Safety Data Sheets.
- .7 Departmental Representative will review Contractor's site-specific Health and Safety Plan and provide comments to Contractor within seven (7) days after receipt of the plan. Revise plan as appropriate and resubmit plan to the Departmental Representative within seven (7) days after receipt of comments from the Departmental Representative.

- .8 Departmental Representative's review of the Contractor's final Health and Safety plan should not be construed as approval and does not reduce the Contractor's overall responsibility for construction Health and Safety.
- .9 Medical Surveillance: where prescribed by legislation, regulation or safety program, submit certification of medical surveillance for site personnel prior to commencement of Work, and submit additional certifications for any new site personnel to the Departmental Representative.
- .10 On-site Contingency and Emergency Response Plan: address standard operating procedures to be implemented during emergency situations.

1.5 FILING OF NOTICE

- .1 File Notice of Project with Provincial authorities prior to beginning of Work.

1.6 SAFETY ASSESSMENT

- .1 Perform site specific safety hazard assessment related to project.

1.7 MEETINGS

- .1 Schedule and administer Health and Safety meeting with the Departmental Representative prior to commencement of Work.

1.8 GENERAL REQUIREMENTS

- .1 Develop written site-specific Health and Safety Plan based on hazard assessment prior to beginning site Work and continue to implement, maintain, and enforce plan until final demobilization from site. Health and Safety Plan must address project specifications.
- .2 Departmental Representative may respond in writing, where deficiencies or concerns are noted and may request re-submission with correction of deficiencies or concerns.

1.9 RESPONSIBILITY

- .1 Be responsible for health and safety of persons on site, safety of property on site and for protection of persons adjacent to site and environment to extent that they may be affected by conduct of Work.
- .2 Comply with and enforce compliance by employees with safety requirements of Contract Documents, applicable federal, provincial, territorial and local statutes, regulations, and ordinances, and with the project/site-specific Health and Safety Plan.

1.10 COMPLIANCE REQUIREMENTS

- .1 Comply with Occupational Health and Safety Act, General Safety Regulation, N.S. Reg.
- .2 Comply with the Canada Labour Code and Canada's Occupational Safety and Health Regulations.

1.11 UN-FORSEEN HAZARDS

- .1 When unforeseen or peculiar safety-related factor, hazard, or condition occur during performance of Work, follow procedures in place for Employee's Right to

Refuse Work in accordance with Acts and Regulations of Province having jurisdiction and advise the Departmental Representative verbally and in writing.

1.12 HEALTH AND SAFETY CO-ORDINATOR

- .1 Employ and assign to Work, competent and authorized representative as Health and Safety Co-ordinator. Health and Safety Co-ordinator must:
 - .1 Have site-related working experience specific to activities associated with demolition and renovation of buildings.
 - .2 Have working knowledge of occupational safety and health regulations.
 - .3 Be responsible for completing Contractor's Health and Safety Training Sessions and ensuring that personnel not successfully completing required training are not permitted to enter site to perform Work.
 - .4 Be responsible for implementing, enforcing daily and monitoring the project/site-specific Contractor's Health and Safety Plan.
 - .5 Be on site during execution of Work and report directly to and be under direction of site supervisor.

1.13 POSTING OF DOCUMENTS

- .1 Ensure applicable items, articles, notices and orders are posted in conspicuous location on site in accordance with Acts and Regulations of Province having jurisdiction, and in consultation with the Departmental Representative.

1.14 CORRECTION OF NON-COMPLIANCE

- .1 Immediately address health and safety non-compliance issues identified by authority having jurisdiction or by the Departmental Representative.
- .2 Provide the Departmental Representative with written report of action taken to correct non-compliance of health and safety issues identified.
- .3 The Departmental Representative may stop Work if non-compliance of health and safety regulations is not corrected.

1.15 BLASTING

- .1 Blasting or other use of explosives is not permitted.

1.16 POWDER ACTUATED DEVICES

- .1 Use powder actuated devices only after receipt of written permission from Departmental Representative.

1.17 WORK STOPPAGE

- .1 Give precedence to safety and health of public and site personnel and protection of environment over cost and schedule considerations for Work.

2 Products

2.1 NOT USED

- .1 Not used.

3 Execution

3.1 NOT USED

.1 Not used.

END OF SECTION

1 General

1.1 FIRE DEPARTMENT BRIEFING

- .1 The Departmental Representative will co-ordinate arrangements for Contractor briefing on Fire Safety at a pre-work conference before Work is commenced.

1.2 REPORTING FIRES

- .1 Know location of nearest fire alarm box and telephone, including emergency phone number.
- .2 Report immediately fire incidents to Fire Department as follows:
 - .1 Activate nearest fire alarm box; or
 - .2 Telephone.
- .3 Person activating the fire alarm box will remain at the box to direct Fire Department personnel to the scene of fire.
- .4 When reporting fire by telephone, give exact location of the fire, on or near the Jetty.

1.3 INTERIOR AND EXTERIOR FIRE PROTECTION AND ALARM SYSTEMS

- .1 Fire protection and alarm system will not be:
 - .1 Obstructed;
 - .2 Shut-off, unless approved by the Departmental Representative; and
 - .3 Left inactive at end of working day or shift.
- .2 Fire hydrants, standpipes and hose systems will not be used for other than fire-fighting.
- .3 Costs incurred from the fire department and/or the facility Departmental Representative, resulting from negligently setting off false alarms will be charged back to the Contractor in the form of financial progress payment reductions and holdback assessments against the Contract.

1.4 FIRE EXTINGUISHERS

- .1 Supply fire extinguishers necessary to protect the work in progress and to protect the Contractor's physical assets/materials on-site.

1.5 BLOCKAGE OF ROADWAYS

- .1 Advise Departmental Representative of work that would impede fire apparatus response. This includes violation of minimum overhead clearance, erecting of barricades and/or obstructions.

1.6 SMOKING PRECAUTIONS

- .1 Observe and abide to the on-site smoking regulations.

1.7 RUBBISH AND WASTE MATERIALS

- .1 Keep rubbish and waste materials at minimum quantities.

- .2 Burning of rubbish is prohibited. Allowing materials to blow away and/or fall into the Halifax Harbour is not permitted.
- .3 Removal:
 - .1 Remove rubbish from work site at end of work day or shift or as directed.
- .4 Storage:
 - .1 Store oily waste in approved receptacles to ensure maximum cleanliness and safety.
 - .2 Deposit greasy or oily rags and materials subject to spontaneous combustion in approved receptacles and remove specified.

1.8 FLAMMABLE AND COMBUSTIBLE LIQUIDS

- .1 Handling, storage and use of flammable and combustible liquids governed by the current 2010 National Fire Code of Canada.
- .2 Keep flammable and combustible liquids such as gasoline, kerosene and naphtha for ready use in quantities not exceeding 45 litres provided they are stored in approved safety cans bearing Underwriters' Laboratory of Canada or Factory Mutual seal of approval. Storage of quantities of flammable and combustible liquids exceeding 45 litres for work purposes requires permission.
- .3 Transfer of flammable and combustible liquids is prohibited within buildings or jetties.
- .4 Transfer of flammable and combustible liquids will not be carried out in vicinity of open flames or any type of heat-producing devices.
- .5 Do not use flammable liquids having flash point below 38 degrees C such as naphtha or gasoline as solvents or cleaning agents.
- .6 Store flammable and combustible waste liquids, for disposal, in approved containers located in safe ventilated area. Keep quantities minimum and Fire Department is to be notified when disposal is required.

1.9 HAZARDOUS SUBSTANCES

- .1 Work entailing use of toxic or hazardous materials, chemicals and/or explosives, or otherwise creating hazard to life, safety or health, in accordance with National Fire Code of Canada.
- .2 Obtain from Departmental Representative a "Hot Work" permit for work involving welding, burning or use of blowtorches and salamanders, in buildings or facilities.
- .3 When Work is carried out in dangerous or hazardous areas involving use of heat, provide fire watchers equipped with sufficient fire extinguishers. Determination of dangerous or hazardous areas along with level of protection necessary for Fire Watch is at discretion of Departmental Representative. Contractors are responsible for providing fire watch service for work on scale established at pre-work conference.
- .4 Provide ventilation where flammable liquids, such as lacquers or urethanes are used, eliminate sources of ignition. Inform Departmental Representative prior to and at cessation of such work.

1.10 FIRE SAFETY AND HOT WORK REQUIREMENTS

- .1 Implement and follow fire safety measures during work. Comply with the following:
 - .1 National Fire Code, 2010.
 - .2 Fire Protection Standards PCC 301, Standard for Construction Operations and FCC 302, Standard for Welding and Cutting as issued by the Fire Protection Services of Human Resources Development Canada.
 - .3 Federal and Provincial Occupational Health and Safety Acts and Regulations as specified in Section 01 35 30 – Health and Safety Requirements.
- .2 In event of conflict between any provisions of above authorities, the most stringent provision will apply. Should a dispute arise in determining the most stringent requirement, the Departmental Representative will advise on the course of action to be followed.
- .3 Hot Work Requirements:
 - .1 Obtain the Departmental Representative's written Authorization to Proceed for the performance of Hot Work on site as may be required in the course of work.
 - .2 To obtain authorization submit to the Departmental Representative for review:
 - .1 Contractor's Hot Work Procedures to be followed on site in accordance with clause 1.12 below.
 - .2 Type of work and frequency of situations which will require Hot Work.
 - .3 Upon confirmation that effective fire safety measures will be implemented for hot work, Departmental Representative will grant authorization covering the entire construction project and duration of work. However, in some cases, depending upon the nature of phasing of work, the quantity of various trades needing to perform welding and cutting on site, or other deemed situation, the Departmental Representative might designate certain portions of the work as separate entities, each entity requiring individual written authorization to proceed. Follow the Departmental Representative's directives in this regard.
- .4 Do not perform and Hot Work until receipt of the Departmental Representative's written Authorization to Proceed.
- .5 In occupied areas of facility, co-ordinate performance of Hot Work with Facility Manager through the Departmental Representative. When directed perform Hot Work during non-operative hours facility is vacant of employees. Follow the Departmental Representative's directives in this regard.

1.11 CONFORMANCE

- .1 Ensure that Hot Work procedures, as established for project and agreed upon with Departmental Representative, are stringently followed. Enforce use and compliance by all workers.
- .2 Brief all workers and sub-contractors on Hot Work Procedures and Permit system.

- .3 Failure to comply with the established hot work procedures may result in disciplinary measures.

1.12 HOT WORK PROCEDURES

- .1 Develop Hot Work Procedures, to be followed when Hot Work is required as part of the work.
- .2 Describe safe work practices and sequence of activities to be followed on site by the Contractor and workers to minimize the potential occurrence of a fire resulting from Hot Work.
- .3 Hot Work Procedures to include:
 - .1 Requirement to perform hazard assessment of the site and immediate work area, based on type and extent of Hot Work required, in accordance with Hazard Assessment and Safety Plan requirements. Carry out hazard assessment for each hot work event.
 - .2 Use of a Hot Work Permit system, issued by authorized contractor, for each event when Hot Work is required, granting permission to carry out hot work.
 - .3 Provision of a designated persons to carry out a Fire Safety Watch for a minimum of thirty (30) minutes immediately upon completion of the hot work.
- .4 Procedures to comply with fire safety codes and standards specified herein and occupational health and safety regulations.
- .5 Generic procedures, if used, must be edited, supplemented with pertinent information and tailored to reflect specific project conditions. Clearly label as being the Hot Work Procedures applicable to this contract.
- .6 Include within procedures the step-by-step process on how to prepare and issue the Hot Work Permit.
- .7 Hot Work Procedures to be in typewritten format, listing step by step procedures and worker instructions, clearly establishing and allocating responsibilities of:
 - .1 Worker(s).
 - .2 Designated person authorized to issue the Hot Work Permit.
 - .3 Fire Safety Watcher.
 - .4 Sub-Contractors and the Prime Contractor.

1.13 HOT WORK PERMIT

- .1 Develop "Hot Work Permit" form in typewritten format.
- .2 Hot Work Permit to include, as a minimum, the following data:
 - .1 Project name and project number.
 - .2 Building name, address and specific floor, room or area where hot work will be performed.
 - .3 Date when permit issued.
 - .4 Description on type of hot work to be carried out.
 - .5 Special precautions required, including type of fire extinguisher needed.

- .6 Name and signature authorized person, designated by Contractor, to issue the permit.
- .7 Name of worker(s) clearly printed, to which the permit is being issued.
- .8 Time duration of permit (not to exceed 8 hours) indicating "Start" time and date and "Completion" time and date when Hot Work permit will be in effect.
- .9 Worker signature with date and time when hot work terminated.
- .10 Specified period of time requiring Safety Watch.
- .11 Name and signature of person designated as Fire Safety Watcher, complete with time and date when safety watch terminated, certifying that the surrounding area was under his continual watch and inspection for the minimum time period specified in Permit and commenced immediately upon the completion of Hot Work.
- .3 Industry standard forms shall only be used if all data specified above is included on form.
- .4 Each Hot Work Permit to be completed in full and signed as follows:
 - .1 Authorized person issuing Permit before Hot Work commences.
 - .2 Worker's upon completion of Hot Work.
 - .3 Fire Safety Watcher upon termination of safety watch.
 - .4 Returned to Contractor's site superintendent for safe keeping.

1.14 DOCUMENTS ON-SITE

- .1 Keep work permits and hazard assessment documentation on site for duration of work.
- .2 Upon request, make available to the Departmental Representative or to authorized safety representative for inspection.

2 Products

2.1 NOT USED

- .1 Not Used.

3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 33 00 Submittal Procedures.
- .2 Section 01 78 00 Closeout Submittals.

1.2 INSPECTION

- .1 Allow the Departmental Representative access to the Work. If part of the Work is in preparation at locations other than Place of Work, allow access to such Work whenever it is in progress.
- .2 Give timely notice requesting inspection if Work is designated for special tests, inspections or approvals by the Departmental Representative instructions, or law of Place of Work.
- .3 If Contractor covers or permits to be covered Work that has been designated for special tests, inspections or approvals before such is made, uncover such Work, have inspections or tests satisfactorily completed and make good such Work.
- .4 The Departmental Representative may order part of the Work to be examined if the Work is suspected to be not in accordance with Contract Documents. If, upon examination such work is found not in accordance with Contract Documents, correct such Work and pay cost of examination and correction.

1.3 INDEPENDENT INSPECTION AGENCIES

- .1 Independent Inspection/Testing Agencies may be engaged by the Departmental Representative for purpose of inspecting and/or testing portions of Work. Cost of such services will be borne by the Departmental Representative.
- .2 Provide equipment required for executing inspection and testing by appointed agencies.
- .3 Employment of inspection/testing agencies does not relax responsibility to perform Work in accordance with Contract Documents.
- .4 If defects are revealed during inspection and/or testing, appointed agency will request additional inspection and/or testing to ascertain full degree of defect. Correct defect and irregularities as advised by the Departmental Representative at no cost to the Departmental Representative. Pay costs for retesting and re-inspection.

1.4 ACCESS TO WORK

- .1 Allow inspection/testing agencies access to Work, off site manufacturing and fabrication plants.
- .2 Co-operate to provide reasonable facilities for such access.

1.5 PROCEDURES

- .1 Notify appropriate agency and the Departmental Representative in advance of requirement for tests, in order that attendance arrangements can be made.

- .2 Submit samples and/or materials required for testing, as specifically requested in specifications. Submit with reasonable promptness and in orderly sequence to not cause delays in Work.
- .3 Provide labour and facilities to obtain and handle samples and materials on site. Provide sufficient space to store and cure test samples.

1.6 REJECTED WORK

- .1 Remove defective Work, whether result of poor workmanship, use of defective products or damage and whether incorporated in Work or not, which has been rejected by the Departmental Representative as failing to conform to Contract Documents. Replace or re-execute in accordance with Contract Documents.
- .2 Make good other Contractor's work damaged by such removals or replacements promptly.

1.7 REPORTS

- .1 Submit one (1) copy of all inspection and test reports to the Departmental Representative.

1.8 TESTS AND MIX DESIGNS

- .1 Furnish test results and mix designs as requested.

1.9 MOCK-UPS

- .1 Prepare mock-ups for Work specifically requested in specifications. Include for Work of Sections required to provide mock-ups.
- .2 Construct in locations acceptable to the Departmental Representative.
- .3 Prepare mock-ups for the Departmental Representative's review with reasonable promptness and in orderly sequence, to not cause delays in Work.
- .4 Failure to prepare mock-ups in ample time is not considered sufficient reason for extension of Contract Time and no claim for extension by reason of such default will be allowed.
- .5 If requested, the Departmental Representative will assist in preparing schedule fixing dates for preparation.
- .6 Remove mock-up at conclusion of Work or when acceptable to the Departmental Representative.

1.10 MILL TESTS

- .1 Submit mill test certificates as required of specification Sections.

1.11 EQUIPMENT AND SYSTEMS

- .1 Submit Testing, Adjusting and Balancing (TAB) reports for all mechanical equipment and/or systems installed.
- .2 Submit point verification reports for all Controls components installed.

2 Products

2.1 NOT USED

.1 Not Used.

3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

1 General

1.1 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 Submittal Procedures.

1.2 INSTALLATION AND REMOVAL

- .1 Provide temporary utilities controls in order to execute work expeditiously.
- .2 Remove from site all such work after use.

1.3 TEMPORARY HEATING AND VENTILATION

- .1 Ventilating:
 - .1 Prevent accumulations of dust, fumes, mists, vapours or gases in areas occupied during construction.
 - .2 Provide local exhaust ventilation to prevent harmful accumulation of hazardous substances into atmosphere of occupied areas.
 - .3 Dispose of exhaust materials in manner that will not result in harmful exposure to persons.
 - .4 Ventilate storage spaces containing hazardous or volatile materials.
 - .5 Ventilate temporary sanitary facilities.
 - .6 Continue operation of ventilation and exhaust system for time after cessation of work process to assure removal of harmful contaminants.
- .2 Maintain strict supervision of operation of temporary heating and ventilating equipment to:
 - .1 Conform with applicable codes and standards.
 - .2 Enforce safe practices.
 - .3 Prevent abuse of services.
 - .4 Prevent damage to finishes.
 - .5 Vent direct-fired combustion units to outside.
- .3 Be responsible for damage to Work due to failure in providing adequate heat and protection during construction.

2 Products

2.1 NOT USED

- .1 Not Used.

3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

1 General

1.1 RELATED SECTIONS

- .1 Section 01 51 00 Temporary Utilities.

1.2 REFERENCES

- .1 Canadian General Standards Board (CGSB):
 - .1 CGSB 1.59-97, Alkyd Exterior Gloss Enamel.
 - .2 CAN/CGSB 1.189-00, Exterior Alkyd Primer for Wood.
- .2 Canadian Standards Association (CSA International):
 - .1 CSA-O121-M1978(R2003), Douglas Fir Plywood.

1.3 INSTALLATION AND REMOVAL

- .1 Provide temporary controls in order to execute Work expeditiously.
- .2 Remove from site all such work after use.

1.4 GUARD RAILS AND BARRICADES

- .1 Provide secure, rigid guard rails and barricades around open shafts/tunnels/manholes.
- .2 Provide as required by the governing Authorities Having Jurisdiction (AHJ).

1.5 DUST TIGHT SCREENS

- .1 Provide dust tight screens or insulated partitions to localize dust generating activities, and for protection of workers, finished areas of Work and the general public.
- .2 Maintain and relocate protection until such work is complete.

1.6 ACCESS TO SITE

- .1 Provide and maintain access roads, sidewalk crossings, ramps and construction runways as may be required for access to Work.

1.7 PUBLIC TRAFFIC FLOW

- .1 Provide and maintain competent signal flag operators, traffic signals, barricades and flares, lights, or lanterns as required to perform Work and protect public.

1.8 FIRE ROUTES

- .1 Maintain access to property including overhead clearances for use by emergency response vehicles.

1.9 PROTECTION FOR OFF-SITE AND PUBLIC PROPERTY

- .1 Protect surrounding private and public property from damage during performance of Work.
- .2 Be responsible for damage incurred.

1.10 PROTECTION OF EXISTING FINISHES

- .1 Provide protection for finished and partially finished finishes and equipment during performance of Work.
- .2 Provide necessary screens, covers, and hoardings.
- .3 Confirm with Departmental Representative locations and installation schedule three (3) days prior to installation.
- .4 Be responsible for damage incurred due to lack of or improper protection.

1.11 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 Construction/Demolition Waste Management and Disposal.

2 Products

2.1 NOT USED

- .1 Not Used.

3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

1 General

1.1 REFERENCES

- .1 Within text of each specifications section, reference may be made to reference standards.
- .2 Conform to these reference standards, in whole or in part as specifically requested in specifications.
- .3 If there is question as to whether products or systems are in conformance with applicable standards, the Departmental Representative reserves right to have such products or systems tested to prove or disprove conformance.
- .4 Cost for such testing will be born by the Departmental Representative in event of conformance with Contract Documents or by Contractor in event of non-conformance.

1.2 QUALITY

- .1 Products, materials, equipment and articles incorporated in Work shall be new, not damaged or defective, and of best quality for purpose intended. If requested, furnish evidence as to type, source and quality of products provided.
- .2 Procurement policy is to acquire, in cost effective manner, items containing highest percentage of recycled and recovered materials practicable consistent with maintaining satisfactory levels of competition. Make reasonable efforts to use recycled and recovered materials and in otherwise utilizing recycled and recovered materials in execution of work.
- .3 Defective products, whenever identified prior to completion of Work, will be rejected, regardless of previous inspections. Inspection does not relieve responsibility, but is precaution against oversight or error. Remove and replace defective products at own expense and be responsible for delays and expenses caused by rejection.
- .4 Should disputes arise as to quality or fitness of products, decision rests strictly with the Departmental Representative, based upon requirements of the Contract Documents.
- .5 Unless otherwise indicated in specifications, maintain uniformity of manufacture for any particular or like item throughout the project.
- .6 Permanent labels, trademarks and nameplates on products are not acceptable in prominent locations, except where required for operating instructions, or when located in mechanical or electrical rooms.

1.3 AVAILABILITY

- .1 Immediately upon signing Contract, review product delivery requirements and anticipate foreseeable supply delays for items. If delays in supply of products are foreseeable, notify the Departmental Representative of such, in order that substitutions or other remedial action may be authorized in ample time to prevent delay in performance of Work.
- .2 In the event of failure to notify the Departmental Representative at commencement of Work and should it subsequently appear that Work may be

delayed for such reason, the Departmental Representative reserves right to substitute more readily available products of similar character, at no increase in Contract Price or Contract Time.

1.4 STORAGE, HANDLING AND PROTECTION

- .1 Handle and store products in manner to prevent damage, adulteration, deterioration and soiling and in accordance with manufacturer's instructions when applicable.
- .2 Store packaged or bundled products in original and undamaged condition with manufacturer's seal and labels intact. Do not remove from packaging or bundling until required in Work.
- .3 Store products subject to damage from weather in weatherproof enclosures.
- .4 Store sheet materials, lumber on flat, solid supports and keep clear of ground. Slope to shed moisture.
- .5 Store and mix paints in heated and ventilated room. Remove oily rags and other combustible debris from site daily. Take every precaution necessary to prevent spontaneous combustion.
- .6 Remove and replace damaged products at own expense and to satisfaction of the Departmental Representative.
- .7 Touch-up damaged factory finished surfaces to the Departmental Representative's satisfaction. Use touch-up materials to match original. Do not paint over name plates.

1.5 TRANSPORTATION

- .1 Pay costs of transportation of products required in performance of the Work.

1.6 MANUFACTURER'S INSTRUCTIONS

- .1 Unless otherwise indicated in specifications, install or erect products in accordance with manufacturer's instructions. Do not rely on labels or enclosures provided with products. Obtain written instructions directly from manufacturers.
- .2 Notify the Departmental Representative in writing, of conflicts between specifications and manufacturer's instructions, so that the Departmental Representative will establish course of action.
- .3 Improper installation or erection of products, due to failure in complying with these requirements, authorizes the Departmental Representative to require removal and re-installation at no increase in Contract Price or Contract Time.

1.7 QUALITY OF WORK

- .1 Ensure Quality of Work is of highest standard, executed by workers experienced and skilled in respective duties for which they are employed. Immediately notify the Departmental Representative if required Work is such as to make it impractical to produce required results.
- .2 Do not employ anyone unskilled in their required duties. The Departmental Representative reserves the right to require dismissal from site, workers deemed incompetent or careless.

- .3 Decisions as to standard or fitness of Quality of Work in cases of dispute rest solely with the Departmental Representative, whose decision is final.

1.8 CO-ORDINATION

- .1 Ensure co-operation of workers in laying out Work. Maintain efficient and continuous supervision.
- .2 Be responsible for coordination and placement of openings, sleeves and accessories.

1.9 CONCEALMENT

- .1 In finished areas conceal pipes, ducts and wiring in floors, walls and ceilings, except where indicated otherwise.
- .2 Before installation, inform the Departmental Representative if there is interference. Install as directed by the Departmental Representative.

1.10 REMEDIAL WORK

- .1 Perform remedial work required to repair or replace parts or portions of Work identified as defective or unacceptable. Co-ordinate adjacent affected Work as required.
- .2 Perform remedial work by specialists familiar with materials affected. Perform in a manner to neither damage nor put at risk any portion of Work.

1.11 LOCATION OF FIXTURES

- .1 Consider location of fixtures, outlets, and mechanical and electrical items indicated as approximate.
- .2 Inform the Departmental Representative of conflicting installation. Install as directed.

1.12 FASTENINGS

- .1 Provide metal fastenings and accessories in same texture, colour and finish as adjacent materials, unless indicated otherwise.
- .2 Prevent electrolytic action between dissimilar metals and materials.
- .3 Use non-corrosive hot dip galvanized steel fasteners and anchors for securing exterior work, unless stainless steel or other material is specifically requested in affected specification Section.
- .4 Space anchors within individual load limit or shear capacity and ensure they provide positive permanent anchorage. Wood, or any other organic material plugs are not acceptable.
- .5 Keep exposed fastenings to a minimum, space evenly and install neatly.
- .6 Fastenings which cause spalling or cracking of material to which anchorage is made are not acceptable.

1.13 FASTENINGS - EQUIPMENT

- .1 Use fastenings of standard commercial sizes and patterns with material and finish suitable for service.

- .2 Use heavy hexagon heads, semi-finished unless otherwise specified
- .3 Bolts may not project more than one diameter beyond nuts.
- .4 Use plain type washers on equipment, sheet metal and soft gasket lock type washers where vibrations occur. Use resilient washers with stainless steel.

1.14 PROTECTION OF WORK IN PROGRESS

- .1 Prevent overloading of parts of building. Do not cut, drill or sleeve load bearing structural member, unless specifically indicated without written approval of the Departmental Representative.

1.15 EXISTING UTILITIES

- .1 When breaking into or connecting to existing services or utilities, execute Work at times directed by local governing authorities, with minimum of disturbance to the Work and the Jetty operations.
- .2 Protect, relocate or maintain existing active services. When services are encountered, cap off in manner approved by authority having jurisdiction. Stake and record location of capped service.

2 Products

2.1 NOT USED

- .1 Not Used.

3 Execution

3.1 NOT USED

- Not Used.

END OF SECTION

1 General

1.1 REFERENCES

- .1 Departmental Representative Standard Acquisition Clauses and Conditions
SACC-ID: R0202D, Title: General Conditions "C", In Effect as of: Oct. 8, 2014.

1.2 PROJECT CLEANLINESS

- .1 Maintain the work site and the existing manhole access points/entrances, etc. designated for use by construction work force in tidy condition, free from accumulation of waste products and debris. Clean areas on a daily basis.
- .2 Hourly, daily and/or nightly clean-up is required, which includes sweeping and/or vacuuming of dirt and debris.
- .3 Remove waste materials from site at daily regularly scheduled times or dispose of as directed by the Departmental Representative. Do not burn waste materials on-site, nor allow any materials to enter Halifax Harbour.
- .4 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- .5 Provide on-site containers for collection of waste materials and debris.
- .6 Use separate collection bins, clearly marked as to purpose for recycling. Refer also to Section 01 74 21 Construction/Demolition Waste Management and Disposal.
- .7 Clean interior areas prior to start of finishing work, and maintain areas free of dust and other contaminants during finishing operations.
- .8 Store volatile waste in covered metal containers, and remove from premises at end of each working day.
- .9 Provide adequate ventilation during use of volatile or noxious substances. Use of building ventilation systems is not permitted for this purpose.
- .10 Use only cleaning materials recommended by manufacturer of surface to be cleaned, and as recommended by cleaning material manufacturer.
- .11 Employ dust barriers, dividers, seal doors with tape and provide other means required, and as approved by the Departmental Representative.
- .12 Be responsible to immediately clean construction dust and dirt transferred by foot traffic, or by other means, into the pipe Tunnel.

1.3 FINAL CLEANING

- .1 When Work is Substantially Performed, remove surplus products, tools, construction machinery and equipment not required for performance of remaining Work.
- .2 Remove waste products and debris other than that caused by others, and leave Work clean and suitable for occupancy.
- .3 Prior to final review remove surplus products, tools, construction machinery and equipment.
- .4 Remove waste products and debris.

- .5 Remove waste materials from site at regularly scheduled times or dispose of as directed by the Departmental Representative. Do not burn waste materials on site.
- .6 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- .7 Clean all Mechanical, Electrical and Controls components installed. Replace broken, scratched or disfigured items.
- .8 Remove stains, spots, marks and dirt from Mechanical and/or Electrical and/or Controls.
- .9 Remove debris and surplus materials from jobsite.

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 Construction/Demolition Waste Management and Disposal.

2 Products

2.1 NOT USED

- .1 Not Used.

3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

1 General

1.1 WASTE MANAGEMENT GOALS

- .1 Prior to start of Work, conduct meeting with the Departmental Representative to review and discuss Departmental Representative waste management plan and goals.

Departmental Representative waste management goal: to divert eighty (80) percent of the total Project Waste from landfill sites. Provide the Departmental Representative documentation certifying that waste management, recycling, reuse of recyclable and reusable materials has been extensively practiced.

- .2 Accomplish maximum control of solid construction waste.
- .3 Preserve environment and prevent pollution and environment damage.

1.2 RELATED SECTIONS

- .1 Section 01 33 00 Submittal Procedures.

1.3 MATERIALS SOURCE SEPARATION PROGRAM (MSSP)

- .1 Prepare MSSP and have ready for use prior to project start-up.
- .2 Implement MSSP for waste generated on project in compliance with approved methods and as reviewed by the Departmental Representative.
- .3 Provide on-site facilities for collection, handling, and storage of anticipated quantities of reusable and recyclable materials.
- .4 Provide containers to deposit reusable and recyclable materials.
- .5 Locate containers in locations to facilitate deposit of materials without hindering daily operations.
- .6 Locate separated materials in areas which minimizes material damage.
- .7 Collect, handle, store on-site, and transport off-site, salvaged materials in separate condition.
 - .1 Transport to approved and authorized recycling facility to users of material for recycling.
- .8 Collect, handle, store on-site, and transport off-site, salvaged materials in combined condition.
 - .1 Ship materials to site operating under Certificate of Approval premises of Departmental Representative.
 - .2 Materials must be immediately separated into required categories for reuse or recycling.

1.4 STORAGE, HANDLING AND PROTECTION

- .1 Store materials to be reused, recycled and salvaged in locations as directed by Departmental Representative.
- .2 Unless specified otherwise, materials for removal become the Contractor's property.

- .3 Protect, stockpile, store, and catalogue salvaged items.
- .4 Separate non-salvageable materials from salvaged items. Transport and deliver non-salvageable items to licensed disposal facility.
- .5 Protect structural components not removed for demolition from movement or damage.
- .6 Support affected structures. If safety of the Tunnel is endangered, cease operations and immediately notify Departmental Representative.
- .7 Prevent contamination of materials to be salvaged and recycled and handle materials in accordance with requirements for acceptance by designated facilities.
 - .1 On-site source separation is recommended.
 - .2 Remove co-mingled materials to off-site processing facility for separation.
 - .3 Provide waybills for separated materials.

1.5 DISPOSAL OF WASTES

- .1 Do not bury or sub-merge rubbish or waste materials in the Tunnel, nor Halifax Harbour.
- .2 Do not dispose of waste, volatile materials, mineral spirits, oil or paint thinner into waterways, storm, or sanitary sewers.
- .3 Keep records of construction waste including:
 - .1 Number and size of bins.
 - .2 Waste type of each bin.
 - .3 Total tonnage generated.
 - .4 Tonnage reused or recycled.
 - .5 Reused or recycled waste destination.
- .4 Remove materials from deconstruction as deconstruction/disassembly work progresses.
- .5 Prepare project to verify destination and quantities on a material-by-material basis as identified in pre-demolition material audit.

1.6 USE OF SITE AND FACILITIES

- .1 Execute Work with least possible interference or disturbance to normal use of premises.
- .2 Maintain security measures established by the existing facility.

1.7 SCHEDULING

- .1 Co-ordinate Work with other activities at site to ensure timely and orderly progress of Work.

2 Products

2.1 NOT USED

- .1 Not Used.

3 Execution

3.1 APPLICATION

- .1 Handle waste materials not reused, salvaged, or recycled in accordance with appropriate regulations and codes.

3.2 CLEANING

- .1 Remove tools and waste materials on completion of work, and leave work area in clean and orderly condition.
- .2 Clean up work areas as work progresses.
- .3 Source separate materials to be reused/recycled into specified sort areas.

END OF SECTION

1 General

1.1 RELATED SECTIONS

- .1 Section 01 78 00 Closeout Submittals.

1.2 INSPECTION AND DECLARATION

- .1 Contractor's Inspection: Contractor and Sub-contractors: conduct inspection of work, identify deficiencies and defects, and repair as required to conform to Contract Documents.
 - .1 Notify the Departmental Representative in writing of satisfactory completion of Contractor's Inspection and that corrections have been made and deficiencies rectified.
 - .2 Request the Departmental Representative's Inspection.
- .2 Departmental Representative's Inspection: the Departmental Representative and the Contractor will perform inspection of work to identify obvious defects or deficiencies. Contractor to correct work accordingly.
- .3 Completion: submit written certificate that following have been performed:
 - .1 Work has been completed and inspected for compliance with Contract Documents.
 - .2 Defects have been corrected and deficiencies have been completed.
 - .3 Equipment and systems have been tested, adjusted and balanced and are fully operational.
 - .4 Certificates required by the various Authorities Having Jurisdiction (AHJ) have been submitted.
 - .5 Operation of systems have been demonstrated to the Departmental Representative.
 - .6 Work is complete and ready for final inspection.
- .4 Final Inspection: When items noted above are completed, request final inspection of work by the Departmental Representative. If Work is deemed incomplete by the Departmental Representative, complete outstanding items and request re-inspection.
- .5 Notwithstanding the General Conditions, the Contractor's attention is drawn to the fact that the Departmental Representative will not issue an Interim Certificate of completion until such time that Contractor performs following work and/or turns over to Departmental Representative specified documents.
 - .1 Project record "As-Built" documents.
 - .2 Final operations and maintenance manuals.
 - .3 Maintenance materials, parts and tools.
 - .4 Certificates of test and test results.
 - .5 Training complete with related manuals.
 - .6 Manufacturer's Guarantee Certificates.
 - .7 Commissioning and support documents.

1.3 CLEANING

- .1 In accordance with Section 01 74 11 Cleaning.
- .2 Remove waste and surplus materials, rubbish and construction facilities from the site in accordance with Section 01 74 21 Construction/Demolition Waste Management and Disposal.

2 Products

2.1 NOT USED

- .1 Not Used.

3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

1 General

1.1 RELATED SECTIONS

- .1 Section 01 33 00 Submittal Procedures.
- .2 Section 01 79 00 Demonstration and Training.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 Submittal Procedures.
- .2 Prepare instructions and data using personnel experienced in maintenance and operation of described products.
- .3 Copy will be returned with the Departmental Representative's comments.
- .4 Revise content of documents as required prior to final submittal.
- .5 Three (3) weeks prior to application for Interim Certificate of Completion of project, submit to the Departmental Representative, three (3) final hard copies of the Operating and Maintenance Manuals and one (1) electronic PDF copy on a flash drive, all in English.
- .6 Ensure spare parts, maintenance materials and special tools provided are new, undamaged or defective, and of same quality and manufacture as products provided in Work.
- .7 Furnish evidence, if requested, for type, source and quality of products provided.
- .8 Defective products will be rejected, regardless of previous inspections. Replace products at own expense.
- .9 Pay costs of transportation.

1.3 FORMAT

- .1 Organize data as instructional manual.
- .2 Binders: vinyl, hard covered, 3 'D' ring, loose leaf sized 215 x 280 mm paper, with spine and face pockets.
- .3 When multiple binders are used, correlate data into related consistent groupings.
 - .1 Identify contents of each binder on spine.
- .4 Cover: identify each binder with type or printed title 'Project Record Documents'; list title of project and identify subject matter of contents.
- .5 Arrange content by systems, process flow, under Section numbers and sequence of Table of Contents.
- .6 Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.
- .7 Text: manufacturer's printed data, or typewritten data.
- .8 Drawings: provide with reinforced punched binder tab.
 - .1 Bind in with text; fold larger drawings to size of text pages.
- .9 Provide 1:1 scaled CAD files in dwg format on CD.

1.4 CONTENTS - PROJECT RECORD DOCUMENTS

- .1 Table of Contents for Each Volume: provide full table of contents in each binder, clearly indicate which contents are in each binder.
- .2 Cover sheet containing:
 - .1 Date of submission.
 - .2 Project title, location and project number.
 - .3 Names, addresses and telephone numbers of Contractor and all Sub-Contractors.
 - .4 Schedule of products and systems, indexed to content of volume.
- .3 For each product or system:
 - .1 List names, addresses and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement parts.
- .4 Product Data: mark each sheet to identify specific products and component parts, and data applicable to installation; delete inapplicable information.
- .5 Drawings: supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.
- .6 Typewritten Text: as required to supplement product data.
 - .1 Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions specified in Section 01 45 00 - Quality Control.
- .7 Training: refer to Section 01 79 00 Demonstration and Training.

1.5 "AS -BUILT" DOCUMENTS

- .1 Maintain, at site for Departmental Representative one record copy of:
 - .1 Contract Drawings.
 - .2 Specifications.
 - .3 Addenda.
 - .4 Change Orders and other modifications to Contract.
 - .5 Reviewed shop drawings, product data, and samples.
 - .6 Field test records.
 - .7 Inspection certificates.
 - .8 Manufacturer's certificates.
- .2 Store record documents in field office, apart from documents used for construction.
 - .1 Provide files, racks, and secure storage.
- .3 Label record documents and file in accordance with Section number listings in List of Contents of this Project Manual.
 - .1 Label each document "PROJECT RECORD" in neat, large, printed letters.
- .4 Maintain record documents in clean, dry and legible condition.
 - .1 Do not use record documents for construction purposes.

- .5 Keep record documents and samples available for inspection by the Departmental Representative.

1.6 RECORDING INFORMATION ON PROJECT RECORD DOCUMENTS

- .1 Record information on set of drawings, and in copy of Project Manual, provided by the Departmental Representative.
- .2 Use felt tip marking pens, maintaining separate colours for each major system, for recording information.
- .3 Record information concurrently with construction progress.
 - .1 Do not conceal Work until required information is recorded.
- .4 Contract Drawings and shop drawings: mark each item to record actual construction, including:
 - .1 Measured locations of internal utilities and appurtenances, referenced to visible and accessible features of construction.
 - .2 Field changes of dimension and detail.
 - .3 Changes made by change orders.
 - .4 Details not on original Contract Drawings.
 - .5 References to related shop drawings and modifications.
- .5 Specifications: mark each item to record actual construction, including:
 - .1 Manufacturer, trade name, and catalogue number of each product actually installed, particularly optional items and substitute items.
 - .2 Changes made by Addenda and change orders.
- .6 Other Documents: maintain manufacturer's certifications, inspection certifications, field test records, required by individual specifications sections.

1.7 EQUIPMENT AND SYSTEMS

- .1 For each item of equipment and each system include description of unit or system, and component parts.
 - .1 Give function, normal operation characteristics and limiting conditions.
 - .2 Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts.
- .2 Panel board circuit directories: provide electrical service characteristics, controls, and communications.
- .3 Include installed colour coded wiring diagrams.
- .4 Operating Procedures: include start-up, break-in, and routine normal operating instructions and sequences.
 - .1 Include regulation, control, stopping, shut-down, and emergency instructions.
 - .2 Include summer, winter, and any special operating instructions.
- .5 Maintenance Requirements: include routine procedures and guide for trouble-shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
- .6 Provide servicing and lubrication schedule, and list of lubricants required.

- .7 Include manufacturer's printed operation and maintenance instructions.
- .8 Include sequence of operation by controls manufacturer.
- .9 Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- .10 Provide installed control diagrams by the Controls Contractor.
- .11 Provide Contractor's co-ordination drawings, with installed colour coded piping diagrams.
- .12 Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
- .13 Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
- .14 Include Testing, Adjusting and Balancing (TAB) reports.
- .15 Additional requirements: as specified in individual specification sections.

1.8 MATERIALS AND FINISHES

- .1 Building products, applied materials, and finishes: include product data, with catalogue number, size, composition, and colour and texture designations.
 - .1 Provide information for re-ordering custom manufactured products.
- .2 Instructions for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
- .3 Moisture-protection and weather-exposed products: include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
- .4 Additional requirements: as specified in individual specifications sections.

1.9 MAINTENANCE MATERIALS

- .1 Spare Parts:
 - .1 Provide spare parts, in quantities specified in individual specification sections.
 - .2 Provide items of same manufacture and quality as items in Work.
 - .3 Deliver to site, store in location as directed by the Departmental Representative.
 - .4 Receive and catalogue items. Prepare and submit inventory listing indicating the following:
 - .1 Part number.
 - .2 Identification of equipment or system for which parts are applicable
 - .3 Installation instruction as applicable.
 - .4 Name, address and telephone number of nearest supplier.
 - .5 Obtain receipt for delivered products and submit prior to final payment.
- .2 Extra Stock Materials:

- .1 Provide maintenance and extra materials, in quantities specified in individual specification sections.
- .2 Provide items of same manufacture and quality as items in Work.
- .3 Deliver to site. Store in location as directed by Department Representative.
- .4 Receive and catalogue items.
 - .1 Submit inventory listing to the Departmental Representative.
 - .2 Include approved listings in the Operations and Maintenance Manuals.
- .5 Obtain receipt for delivered products and submit prior to final payment.
- .3 Special Tools:
 - .1 Provide special tools, in quantities specified in individual specification section.
 - .2 Provide items with tags identifying their associated function and equipment.
 - .3 Provide instructions on intended use of tool.
 - .4 Deliver to site. Store in location as directed by the Departmental Representative.
 - .5 Receive and catalogue items.
 - .1 Submit inventory listing to the Departmental Representative.
 - .2 Include approved listings in the Operations and Maintenance Manuals.

1.10 DELIVERY, STORAGE AND HANDLING

- .1 Store spare parts, maintenance materials, and special tools in manner to prevent damage or deterioration.
- .2 Store in original and undamaged condition with manufacturer's seal and labels intact.
- .3 Clearly mark on each container or packaging as to content and quantity.
- .4 Store components subject to damage from weather in weather-proof enclosures.
- .5 Store paints and freezable materials in a heated and ventilated room.
- .6 Remove and replace damaged products during handling or delivery at own expense to satisfaction of the Departmental Representative.

1.11 WARRANTIES

- .1 Develop warranty management plan to contain information relevant to Warranties.
- .2 Submit warranty management plan, thirty (30) days before planned pre-warranty conference, to the Departmental Representative for approval.
- .3 Warranty management plan to include required actions and documents to assure that the Departmental Representative receives warranties to which it is entitled.
- .4 Provide plan in narrative form and contain sufficient detail to make it suitable for use by future maintenance and repair personnel.

- .5 Submit, warranty information made available during construction phase, to the Departmental Representative for approval prior to each monthly pay estimate.
- .6 Assemble approved information in binder, submit upon acceptance of work and organize binder as follows:
 - .1 Separate each warranty with index tab sheets keyed to Table of Contents listing.
 - .2 List the Sub-Contractor, the supplier, and the manufacturer with name, address and telephone number of responsible principal.
 - .3 Obtain warranties executed in duplicate by sub-contractors, suppliers, and manufacturers, within ten (10) days after completion of applicable item of work.
 - .4 Verify that documents are in proper form, contain full information, and are notarized.
 - .5 Co-execute submittals when required.
 - .6 Retain warranties until time specified for submittal.
- .7 Except for items put into use with the Departmental Representative's permission, leave date of beginning of time of warranty until Date of Substantial Performance is determined.
- .8 Conduct joint four (4) month and nine (9) month warranty inspection, measured from time of acceptance by the Departmental Representative.
- .9 Include information contained in warranty management plan as follows:
 - .1 Roles and responsibilities of personnel associated with warranty process, including points of contact and telephone numbers within the organizations of Contractors, Sub-Contractors, manufacturers or suppliers involved.
 - .2 Provide list for each warranted equipment, item, feature of construction or system indicating:
 - .1 Name of item.
 - .2 Model and serial numbers.
 - .3 Location where installed.
 - .4 Name and phone numbers of manufacturers or suppliers.
 - .5 Names, addresses and telephone numbers of sources of spare parts.
 - .6 Warranties and terms of warranty: include one-year overall warranty of construction. Indicate items that have extended warranties and show separate warranty expiration dates.
 - .7 Cross-reference to warranty certificates as applicable.
 - .8 Starting point and duration of warranty period.
Maintenance procedures required to continue warranty in force.
 - .9 Cross-Reference to specific pertinent Operation and Maintenance Manuals.
 - .10 Organization, names and phone numbers of persons to call for warranty service.
 - .11 Typical response time and repair time expected for various warranted equipment.

- .3 Procedure and status of tagging of equipment covered by extended warranties.
- .4 Post copies of instructions near selected pieces of equipment where operation is critical for warranty and/or safety reasons.
- .10 Respond in timely manner to oral or written notification of required construction warranty repair work.
- .11 Written verification to follow oral instructions.
 - .1 Failure to respond will be cause for the Departmental Representative to proceed with action against the Contractor.

1.12 WARRANTY TAGS

- .1 Tag, at time of installation, each warranted item. Provide durable, oil and water-resistant tag approved by Departmental Representative.
- .2 Attach tags with copper wire and spray with waterproof silicone coating.
- .3 Leave date of acceptance until project is accepted for occupancy.
- .4 Indicate following information on tag:
 - .1 Type of product/material.
 - .2 Model number.
 - .3 Serial number.
 - .4 Contract number.
 - .5 Warranty period.
 - .6 Inspector's signature.
 - .7 Construction Contractor.

2 Products

2.1 NOT USED

- .1 Not Used.

3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

1 General

1.1 ADMINISTRATIVE REQUIREMENTS

- .1 Demonstrate scheduled operation and maintenance of equipment and systems to the Departmental Representative prior to date of final inspection.
- .2 The Departmental Representative will provide list of personnel to receive instructions and will co-ordinate their attendance at agreed-upon times.
- .3 Prior to carrying out Demonstration and Training, ensure that equipment is fully operational, and that all testing, adjusting and balancing (TAB) has been carried out.
- .4 Provide copies of completed operation and maintenance manuals for use in demonstrations and instructions.
- .5 Preparation:
 - .1 Verify conditions for demonstration and instructions comply with requirements.
 - .2 Verify designated personnel are present.
- .6 Demonstration and Instructions:
 - .1 Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, and maintenance of each item of equipment.
 - .2 Instruct personnel in phases of operation and maintenance using operation and maintenance manuals as basis of instruction.
 - .3 Review contents of manual in detail to explain aspects of operation and maintenance.
 - .4 Prepare and insert additional data in operations and maintenance manuals when needed during instructions.
 - .5 Provide other specific training and instructions as specified in trade sections.
 - .6 Allow minimum four (4) hours on-site for instruction time.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 Submittal Procedures.
- .2 Submit schedule of time and date for demonstration of each item of equipment and each system a minimum of two weeks prior to designated dates, for the Departmental Representative's approval.
- .3 Submit reports within one week after completion of demonstration, that demonstration and instructions have been satisfactorily completed.
- .4 Give time and date of each demonstration, with list of persons present.

1.3 QUALITY ASSURANCE

- .1 Ensure that only personnel from own forces, sub-contractor or suppliers competent and fully knowledgeable in the particular material component, equipment or system installation are used to provide training and demonstrations.

- .2 When specified in individual Sections requiring manufacturer to provide authorized representative to demonstrate operation of equipment and systems:
 - .1 Instruct Departmental Representative.
 - .2 Provide a written report that demonstration and instructions have been completed.
- .3 Provide evidence to the Departmental Representative when deemed required of individual Trainer's knowledge and qualifications.

2 Products

2.1 NOT USED

- .1 Not Used.

3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 General requirements relating to Commissioning (Cx) of project's components and systems, specifying general requirements to performance verification (PV) of components, equipment, sub-systems, systems, and integrated systems.
 - .2 Commission all Mechanical and Electrical equipment and systems installed, including, but not limited to:
 - .1 Laboratory fume hood exhaust controllers, including sash monitors, occupancy sensor and fume hood exhaust air valves;
 - .2 Laboratory supply controllers, including reheat coil controls, room thermostats and room supply air valves;
 - .3 Laboratory general exhaust controllers, including room exhaust air valves;
 - .4 Laboratory room controllers, including room specific controls and integration with the existing energy management and control system;
 - .5 Laboratory exhaust and supply central air handling and exhaust systems, including variable frequency drive and system static pressure set-points;
 - .6 All new building automation system control points, including all alarms, monitoring / BACnet integration points and system sequences of operation, including associated points.
- .2 A draft commissioning plan has been provided with this specification section, the Contractor shall be responsible for reviewing the document and meeting all responsibilities as outlined within the document, in addition to those outlined within the design specifications and drawings.
- .3 Acronyms:
 - .1 BMM - Building Management Manual.
 - .2 Cx - Commissioning.
 - .3 EMCS - Energy Monitoring and Control Systems.
 - .4 O&M - Operation and Maintenance.
 - .5 PI - Product Information.
 - .6 PV - Performance Verification.
 - .7 TAB - Testing, Adjusting and Balancing.

1.2 REFERENCES

- .1 Public Works and Government Services Canada (PWGSC):
 - .1 Commissioning Manual (CP.1)-4th edition.
- .2 Underwriters' Laboratories of Canada (ULC).

1.3 GENERAL

- .1 Cx is a planned program of tests, procedures and checks carried out systematically on systems and integrated systems of the finished Project. Cx is performed after systems and integrated systems are completely installed, functional and Contractor's Performance Verification responsibilities have been completed and approved.
- .2 Objectives:
 - .1 Verify installed equipment, systems and integrated systems operate in accordance with contract documents and design criteria and intent.
 - .2 Ensure appropriate documentation is compiled into the BMM.
 - .3 Effectively train Operations and Maintenance (O&M) staff.
- .3 Contractor assists in Cx process, operating equipment and systems, troubleshooting and making adjustments as required.
 - .1 Systems to be operated at full capacity under various modes to determine if they function correctly and consistently at peak efficiency. Systems to be interactive with each other as intended in accordance with Contract Documents and design criteria.
 - .2 During these checks, adjustments to be made to enhance performance to meet environmental or user requirements.
- .4 Design Criteria: as per the Client's requirements or determined by the Designer to meet Project functional and operational requirements.
- .5 A draft commissioning plan has been provided with this specification section, the Contractor shall be responsible for reviewing the document and meeting all responsibilities as outlined within the document, in addition to those outlined within the design specifications and drawings.

1.4 COMMISSIONING OVERVIEW

- .1 The Departmental Representative to maintain overall responsibility for the project and is the sole point of contact between members of the Commissioning Team. The Departmental Representative's Cx Team will consist of the following:
 - .1 Departmental Representative's Design Quality Review Team: during construction, they will conduct periodic site reviews to observe general progress.
 - .2 Departmental Representative's Quality Assurance Commissioning Manager: ensures Cx activities are carried out to ensure delivery of a fully operational project including:
 - .1 Review of Cx documentation from operational perspective.
 - .2 Review for performance, reliability, durability of operation, accessibility, maintainability, operational efficiency under conditions of operation.
 - .3 Protection of health, safety and comfort of occupants and O&M personnel.
 - .4 Monitoring of Cx activities, training, development of Cx documentation.

- .5 Work closely with members of Cx Team.
 - .6 Organizing Cx.
 - .7 Monitoring operations Cx activities.
 - .8 Witnessing, certifying accuracy of reported results.
 - .9 Witnessing and certifying TAB and other tests.
 - .10 Developing the BMM.
 - .11 Ensuring implementation of the final Cx Plan.
 - .12 Performing verification of performance of installed systems and equipment.
 - .13 Implementation of the Training Plan.
- .2 The Contractor shall be responsible to commission all Mechanical and Electrical systems and/or equipment installed. The Contractor shall be responsible for all Sub-Contractors, Suppliers/Manufacturer's Representatives and/or support staff. The Contractor shall be responsible for:
- .1 Pressure Testing.
 - .2 TAB.
 - .3 Performance of Cx activities, including preparation, completion and submission of functional performance test forms.
 - .4 Start-up and Commissioning.
 - .5 Demonstration and Training.
 - .6 Cx documentation.
 - .7 Assigning one person as point of contact with Departmental Representative and DEPARTMENTAL REPRESENTATIVE Cx Manager for administrative and coordination purposes.
Demonstrations.
 - .8 Preparation, completion, submission of test reports.
- .3 Cx to be a line item in the Contractor's cost breakdown/schedule of values.
- .4 Cx activities supplement field quality and testing procedures described in relevant technical sections.
- .5 Cx is conducted in concert with activities performed during stage of project delivery. Cx identifies issues in Planning and Design stages which are addressed during Construction and Cx stages to ensure the Facility is proven to operate satisfactorily under weather, environmental and occupancy conditions to meet functional and operational requirements. Cx activities includes transfer of critical knowledge to facility operational personnel.
- .6 The Departmental Representative will issue an Interim Acceptance Certificate when:
- .1 Completed Cx documentation has been received, reviewed for suitability and approved by Departmental Representative.
 - .2 Equipment, components and systems have been commissioned.
 - .3 O&M training has been completed.

1.5 NON-CONFORMANCE TO PERFORMANCE VERIFICATION REQUIREMENTS

- .1 Should equipment, system components, and associated controls be incorrectly installed or malfunction during Cx, correct deficiencies, re-verify equipment and components within the non-functional system, including related systems as deemed required by the Departmental Representative, to ensure effective performance.
- .2 Costs for corrective work, additional tests, inspections, to determine acceptability and proper performance of such items to be borne by Contractor. Above costs to be in form of progress payment reductions or hold-back assessments.

1.6 PRE-CX REVIEW

- .1 Before Construction:
 - .1 Review contract documents, confirm by writing to the Departmental Representative.
 - .1 Adequacy of provisions for Cx.
 - .2 Aspects of design and installation pertinent to success of Cx.
- .2 During Construction:
 - .1 Co-ordinate provision, location and installation of provisions for Cx.
- .3 Before start of Cx:
 - .1 Ensure installation of related components, equipment, sub-systems, systems are complete.
 - .2 Fully understand Cx requirements and procedures.
 - .3 Have Cx documentation shelf-ready.
 - .4 Understand completely design criteria and intent and special features.
 - .5 Submit complete start-up documentation to Departmental Representative.
 - .6 Have Cx schedules up-to-date.
 - .7 Ensure systems have been cleaned thoroughly.
 - .8 Complete TAB procedures on systems, submit TAB reports to Departmental Representative for review and approval.
 - .9 Ensure "As-Built" system schematics are available.
- .4 Inform Departmental Representative in writing of discrepancies and deficiencies on finished works.

1.7 CONFLICTS

- .1 Report conflicts between requirements of this section and other sections to Departmental Representative before start-up and obtain clarification.
- .2 Failure to report conflict and obtain clarification will result in application of most stringent requirement.

1.8 SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 Submittal Procedures.

- .1 Submit no later than four (4) weeks after award of Contract:
 - .1 Name of Contractor's Cx agent.
 - .2 Draft Cx documentation.
 - .3 Preliminary Cx schedule.
- .2 Request in writing to Departmental Representative for changes to submittals and obtain written approval at least eight (8) weeks prior to start of Cx.
- .3 Submit proposed Cx procedures to Departmental Representative where not specified and obtain written approval at least eight (8) weeks prior to start of Cx.
- .4 Provide additional documentation relating to Cx process required by Departmental Representative.

1.9 COMMISSIONING DOCUMENTATION

- .1 The Departmental Representative shall review and approve all Cx documentation submitted.
- .2 Provide completed and approved Cx documentation to the Departmental Representative.

1.10 COMMISSIONING SCHEDULE

- .1 Provide detailed Cx schedule as part of construction schedule in accordance with Section 01 11 00 Summary of Work and Section 01 14 00 Work Restrictions.
- .2 Provide adequate time for Cx activities prescribed in technical sections and commissioning sections including:
 - .1 Approval of Cx reports.
 - .2 Verification of reported results.
 - .3 Repairs, retesting, re-commissioning, re-verification.
 - .4 Training.

1.11 COMMISSIONING MEETINGS

- .1 Convene Cx meetings following project meetings as specified herein.
- .2 Purpose: to resolve issues, monitor progress, identify deficiencies, relating to Cx.
- .3 Continue Cx meetings on regular basis until commissioning deliverables have been addressed.
- .4 At 60% construction completion stage, the Departmental Representative shall call a separate Cx scope meeting to review progress, discuss schedule of equipment start-up activities and prepare for Cx. Issues at meeting to include:
 - .1 Review duties and responsibilities of Contractor and subcontractors, addressing delays and potential problems.
 - .2 Determine the degree of involvement of trades and manufacturer's representatives in the commissioning process.

- .5 Thereafter Cx meetings to be held until project completion and as required during equipment start-up and functional testing period.
- .6 Meeting will be chaired by the Departmental Representative, who will record and distribute minutes.
- .7 Ensure the Sub-Contractors and relevant manufacturer representatives are present at 60% and subsequent Cx meetings and as required.

1.12 STARTING AND TESTING

- .1 Contractor assumes liabilities and costs for inspections, including disassembly and re-assembly after approval, starting, testing and adjusting, including supply of testing equipment.

1.13 WITNESSING OF STARTING AND TESTING

- .1 Provide fourteen (14) day notice prior to commencement.
- .2 Departmental Representative to witness of start-up and testing.
- .3 Contractor's Cx Agent to be present at tests performed and documented by sub-trades, suppliers and equipment manufacturers.

1.14 MANUFACTURER'S INVOLVEMENT

- .1 Factory testing: manufacturer to:
 - .1 Coordinate time and location of testing.
 - .2 Provide testing documentation for approval by the Departmental Representative.
 - .3 Arrange for Departmental Representative to witness tests.
 - .4 Obtain written approval of test results and documentation from the Departmental Representative before delivery to site.
- .2 Obtain manufacturers installation, start-up and operations instructions prior to start-up of components, equipment and systems and review with the Departmental Representative.
 - .1 Compare completed installation with manufacturer's published data, record discrepancies, and review with manufacturer.
 - .2 Modify procedures detrimental to equipment performance and review same with manufacturer before start-up.
- .3 Integrity of warranties:
 - .1 Use manufacturer's trained start-up personnel where specified elsewhere in other divisions or required to maintain integrity of warranty.
 - .2 Verify with manufacturer that testing as specified will not void warranties.

1.15 PROCEDURES

- .1 Verify that equipment and systems are complete, clean, and operating in normal and safe manner prior to conducting start-up, testing and Cx.

- .2 Conduct start-up and testing in following distinct phases:
 - .1 Included in delivery and installation:
 - .1 Verification of conformity to specification, approved shop drawings and completion of PI report forms.
 - .2 Visual inspection of quality of installation.
 - .2 Start-up: follow accepted start-up procedures.
 - .3 Operational testing: document equipment performance.
 - .4 System PV: include repetition of tests after correcting deficiencies.
 - .5 Post-substantial performance verification: to include fine-tuning.
- .3 Correct deficiencies and obtain approval from Departmental Representative after distinct phases have been completed and before commencing next phase.
- .4 Document require tests on approved PV forms.
- .5 Failure to follow accepted start-up procedures will result in re-evaluation of equipment by an independent testing agency selected by the Departmental Representative. If results reveal that equipment start-up was not in accordance with requirements, and resulted in damage to equipment, implement following:
 - .1 Minor equipment/systems: implement corrective measures approved by the Departmental Representative.
 - .2 Major equipment/systems: if evaluation report concludes that damage is minor, implement corrective measures approved by the Departmental Representative.
 - .3 If evaluation report concludes that major damage has occurred, the Departmental Representative shall reject equipment.
 - .1 Rejected equipment to be remove from site and replace with new.
 - .2 Subject new equipment/systems to specified start-up procedures.

1.16 START-UP DOCUMENTATION

- .1 Assemble start-up documentation and submit to the Departmental Representative for approval before commencement of commissioning.
- .2 Start-up documentation to include:
 - .1 Factory and on-site test certificates for specified equipment.
 - .2 Pre-start-up inspection reports.
 - .3 Signed installation/start-up check lists.
 - .4 Start-up reports,
 - .5 Step-by-step description of complete start-up procedures, to permit the Departmental Representative to repeat start-up at any time.

1.17 OPERATION AND MAINTENANCE OF EQUIPMENT AND SYSTEMS

- .1 After start-up, operate and maintain equipment and systems as directed by equipment/system manufacturer.
- .2 With assistance of manufacturer, develop written maintenance program and submit to the Departmental Representative for approval before implementation.

- .3 Operate and maintain systems for length of time required for commissioning to be completed.
- .4 After completion of commissioning, operate and maintain systems until issuance of certificate of interim acceptance.

1.18 TEST RESULTS

- .1 If start-up, testing and/or PV produce unacceptable results, repair, replace or repeat specified starting and/or PV procedures until acceptable results are achieved.
- .2 Provide manpower and materials, assume costs for re-commissioning.

1.19 START OF COMMISSIONING

- .1 Notify the Departmental Representative at least twenty-one (21) days prior to start of Cx.
- .2 Start Cx after elements of building affecting start-up and performance verification of systems have been completed.

1.20 INSTRUMENTS / EQUIPMENT

- .1 Submit to the Departmental Representative for review and approval:
 - .1 Complete list of instruments proposed to be used.
 - .2 Listed data including, serial number, current calibration certificate, calibration date, calibration expiry date and calibration accuracy.
- .2 Provide the following equipment as required:
 - .1 2-way radios.
 - .2 Ladders.
 - .3 Equipment as required to complete work.

1.21 COMMISSIONING PERFORMANCE VERIFICATION

- .1 Carry out Cx:
 - .1 Under actual (preferable) and/or accepted simulated operating conditions, over entire operating range, in all modes.
 - .2 On independent systems and interacting systems.
- .2 Cx procedures to be repeatable and reported results are to be verifiable.
- .3 Follow equipment manufacturer's operating instructions.
- .4 EMCS trending to be available as supporting documentation for performance verification.

1.22 WITNESSING COMMISSIONING

- .1 The Departmental Representative shall witness activities and verify results.

1.23 AUTHORITIES HAVING JURISDICTION (AHJ)

- .1 Where specified start-up, testing or commissioning procedures duplicate verification requirements of authority having jurisdiction, arrange for authority to witness procedures so as to avoid duplication of tests and to facilitate expedient acceptance of facility.
- .2 Obtain certificates of approval, acceptance and compliance with rules and regulation of authority having jurisdiction.
- .3 Provide copies to the Departmental Representative within five (5) days of test and with Cx report.

1.24 COMMISSIONING CONSTRAINTS

- .1 It is necessary to complete Cx of occupancy, weather, and seasonal sensitive equipment and systems before issuance of the Interim Certificate, using, if necessary, simulated thermal loads.

1.25 EXTRAPOLATION OF RESULTS

- .1 Where Cx of weather, occupancy, or seasonal-sensitive equipment or systems cannot be conducted under near-rated or near-design conditions, extrapolate part-load results to design conditions when approved by the Departmental Representative in accordance with equipment manufacturer's instructions, using manufacturer's data, with manufacturer's assistance and using approved formulae.

1.26 EXTENT OF VERIFICATION

- .1 Provide manpower and instrumentation to verify up to 30% of reported results, unless specified otherwise in other sections.
- .2 Number and location to be at discretion of the Departmental Representative.
- .3 Conduct tests repeated during verification under same conditions as original tests, using same test equipment, instrumentation.
- .4 Review and repeat commissioning of systems if inconsistencies found in more than 20% of reported results.
- .5 Perform additional commissioning until results are acceptable to the Departmental Representative.

1.27 REPEAT VERIFICATIONS

- .1 Assume costs incurred by the Departmental Representative for third and subsequent verifications where:
 - .1 Verification of reported results fail to receive the Departmental Representative's approval.
 - .2 Repetition of second verification again fails to receive approval.
 - .3 The Departmental Representative deems Contractor's request for second verification was premature.

1.28 SUNDRY CHECKS AND ADJUSTMENTS

- .1 Make adjustments and changes which become apparent as Cx proceeds.
- .2 Perform static and operational checks as applicable and as required.

1.29 DEFICIENCIES, FAULTS, DEFECTS

- .1 Correct deficiencies found during start-up and Cx to satisfaction of Departmental Representative. Provide 'signed off' copy of Cx deficiency list upon request.
- .2 Report problems, faults or defects affecting Cx to the Departmental Representative in writing. Stop Cx until problems are rectified. Proceed with written approval from the Departmental Representative.

1.30 COMPLETION OF COMMISSIONING

- .1 Upon completion of Cx leave systems in normal operating mode.
- .2 Except for warranty and seasonal verification activities specified in Cx specifications, complete Cx prior to issuance of Interim Certificate of Completion.
- .3 Cx to be considered complete when contract Cx deliverables have been submitted and accepted by the Departmental Representative.

1.31 ACTIVITIES UPON COMPLETION OF COMMISSIONING

- .1 When changes are made to baseline components or system settings established during Cx process, provide updated Cx form for affected item.

1.32 MAINTENANCE MATERIALS, SPARE PARTS, SPECIAL TOOLS

- .1 Supply, deliver, and document maintenance materials, spare parts, and special tools as specified in contract.

1.33 OCCUPANCY

- .1 Cooperate fully with the Departmental Representative during stages of acceptance and occupancy of facility.

1.34 INSTALLED INSTRUMENTATION

- .1 Use instruments installed under Contract for TAB and PV if:
 - .1 Accuracy complies with these specifications.
 - .2 Calibration certificates have been deposited with the Departmental Representative.
- .2 Calibrated EMCS sensors may be used to obtain performance data provided that sensor calibration has been completed and accepted.

1.35 PERFORMANCE VERIFICATION TOLERANCES

- .1 Application tolerances:

- .1 Specified range of acceptable deviations of measured values from specified values or specified design criteria to be within +/- 10% of specified values, except for special areas.
- .2 Instrument accuracy tolerances:
 - .1 To be of higher order of magnitude than equipment or system being tested.
- .3 Measurement tolerances during verification:
 - .1 Unless otherwise specified actual values to be within +/- 2% of recorded values.

1.36 DEPARTMENTAL REPRESENTATIVE'S PERFORMANCE TESTING

- .1 Performance testing of equipment or system by the Departmental Representative will not relieve Contractor from compliance with specified start-up and testing procedures.

2 Products

2.1 NOT USED

- .1 Not Used.

3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION



Public Works and
Government Services
Canada

COMMISSIONING PLAN ELLIS BUILDING HVAC UPGRADES



JULY 24, 2020

TABLE OF CONTENTS

Table of Contents	2
Introduction	2
Commissioning Goals	2
Commissioning Principles and Objectives	2
Determine Project Performance Requirements	2
Plan the Commissioning Process	2
Document Compliance and Acceptance	2
Building Description and Design intent	2
Owner's Project Requirements	2
Basis of Design	2
Project Commissioning Specifications	2
Building Commissioning	2
Commissioning Process Benefits	2
Commissioning Plan	2
Commissioning Program Overview and Process Activities	2
Commissioning Team	2
Communication Protocol, Coordination, Meetings and/or Management	2
Commissioning Team and Member Responsibilities	2
Commissioning Authority	2
Building Owner or Owner's Representative	2
Building Manager and Facility Staff	2
Contractor and Manufacturer Representatives	2
Design Professional	2
Commissioning Process	2
Installation Verification and Functional Performance Testing	2
Training Program Evaluation	2
Operation & Maintenance Manual Evaluation	2



INTRODUCTION

F.C. O'Neill, Scriven & Associates Limited (ONSA) was engaged by Public Works and Government Services Canada (PWGSC) to provide the mechanical and electrical engineering design and contract administration services for converting the existing laboratory ventilation and control systems at the Ellis laboratory building to a variable air volume laboratory control system.

Commissioning Goals

Commissioning is often misinterpreted to focus solely on the functional performance testing during the end of the construction phase. Commissioning is a collaborative process for planning, delivering and operating buildings that function as intended by the design and as expected by the owner. Commissioning is the process of ensuring that systems are designed, installed, functionally tested and capable of being operated and maintained to perform. Commissioning begins with planning and includes design, construction, start-up, acceptance and training and can be applied throughout the life of the building. Accordingly, the goals of commissioning are to:

- ✓ Define and document the Owner's Project Requirements clearly and update through the process;
- ✓ Verify and document compliance;
- ✓ Establish and document commissioning process tasks;
- ✓ Deliver buildings and construction projects that meet the Owner's Project Requirements; and
- ✓ Verify that operation and maintenance personnel and occupants are properly trained.

New building commissioning is an intensive quality assurance process that begins during the concept design of a new building and continues through the detailed design, the construction, the start-up, the occupancy and the first year of operation of the building. The commissioning process ensures that the new building operates as initially intended, meeting the Owner's Project Requirements and that building staff are prepared to operate and maintain its systems and equipment. The intent of the commissioning process is to verify and ensure that the fundamental building elements and systems are designed, installed and calibrated to operate as intended.

This commissioning report provides the necessary documentation for both the initial commissioning plan as well as the final commissioning report. As a result, this report will be continuously updated throughout the commissioning process as well as the progress of the project as new information is received and as the project moves through the various development stages towards completion.



COMMISSIONING PRINCIPLES AND OBJECTIVES

Regardless of the extent of the building systems commissioning determined to be appropriate for a particular project and the approach utilized, there are three overarching principles in the commissioning process that begin during the project concept development and continue through occupancy and operation of the building.

Determine Project Performance Requirements

Every project goes through pre-design and design stages that establish the Owner's Project Requirements as well as the goals, scope and design solutions for a proposed project. Proposed designs and constructed work can only be evaluated against objective criteria and measures that are well-documented in project requirement documents. Project development is a learning process where building performance decisions are refined to successive levels of detail over the course of a project's life cycle.

Plan the Commissioning Process

Commissioning involves the process of planning team member roles and responsibilities as well as tasks for all project phases and activities, including review and acceptance procedures, documentation requirements, development and approval of commissioning plans, commissioning schedules as well as testing and inspection plans. Planning the commissioning process includes identification of special testing needs for unique equipment and systems as well as measures that will assure adequate operation and maintenance training.

Document Compliance and Acceptance

Commissioning serves as the historical record of an owner's expectations for project performance throughout the project delivery process. The purpose of commissioning documentation is to record the key delivery team decisions throughout the planning and delivery process. Commissioning documents the establishment of standards of performance for building systems and verifies that designed and constructed work meets those standards.

BUILDING DESCRIPTION AND DESIGN INTENT

The Ellis laboratory building at the Bedford Institute of Oceanography is a 5-storey laboratory building built in 2006 housing 42 laboratories with 31 fume hoods and is approximately 77,500 square feet. Recent additions to the laboratory fume hood exhaust system have increased the required capacity of the exhaust system, jeopardizing the ability of two (2) of the three (3) existing exhaust fans to handle the load. If all three (3) of the exhaust fans are required to run at peak flow demand, there will be no redundancy within the system if there is a fan failure. Furthermore, laboratories throughout the building are over-ventilated during periods of low-use and during unoccupied periods, offering opportunities to reduce energy consumption throughout the building by implementing energy efficiency and conservation measures.

Owner's Project Requirements

The Owner's Project Requirements provide details regarding the owner's expectations of how the facility will be used and operated. The document provides a description of the Building's physical and functional characteristics as well as performance and acceptance criteria. It is an essential document because it will serve as a baseline for decision making throughout the rest of the design and construction process and be used by the Commissioning Authority to evaluate the project's development.

The primary role of the Commissioning Authority during the Building concept design is to help the owner and the project team document the Owner's Project Requirements. The development of the document was a team effort and involved the owner, design professionals and the Commissioning Authority. The document states the owner's goals and objectives for the Building as well as defines performance and acceptance criteria for each item listed within the document. The Owner's Project Requirements will be reviewed by the Commissioning Authority and assessed for clarity and completeness prior to the approval of contractor submittals of any equipment and/or systems to be commissioned.

Where this project is within an existing facility, the Owner's Project Requirements are focused solely to aspects, or objectives, of the renovation scope of work. Please see below for a summary of the Owner's Project Requirements:

The Ellis laboratory building at the Bedford Institute of Oceanography is a 5-storey laboratory building built in 2006 housing 42 laboratories with 31 fume hoods and is approximately 77,500 square feet. Recent additions to the laboratory fume hood exhaust system have increased the required capacity of the exhaust system, jeopardizing the ability of two (2) of the three (3) existing exhaust fans to handle the load. If all three (3) of the exhaust fans are required to run at peak flow demand, there will be no redundancy within the system if there is a fan failure. Furthermore, laboratories throughout the building are over-ventilated during periods of low-use and during unoccupied periods.

Since not all laboratory users within a building are typically operating at 100% of the required exhaust airflow through their hoods at the same time, by converting the building to a variable air volume laboratory control system the building system's will take advantage of diversity within the system

thereby improving system redundancy and safety, energy efficiency as well as serviceability. The goals of this project are limited to improving the building's laboratory exhaust and ventilation system energy efficiency by reducing ventilations rates and increasing system redundancy by reducing peak requirements by converting the existing laboratory ventilation and control systems throughout the building to a variable air volume laboratory control system. The project is not intended to modify or upgrade existing heating, ventilation or air conditioning systems, laboratory service systems or other building services, unless directly required in the effort to convert the existing system to a variable air volume system.

Basis of Design

The Basis of Design is a document developed by the design professionals based on the goals and objectives outlined within the Owner's Project Requirements. The document provides design specifics, such as local climatic conditions, occupancy levels, space conditions required, process and efficiency requirements, to achieve the Owner's Project Requirements. In addition, it documents concept design decisions on systems and types of products selected.

Applicable regulatory requirements, standards and guidelines to be followed are also summarized within the Basis of Design document. It will also include narrative descriptions as well as lists of individual items that the design was based on. The Basis of Design is also a continually evolving document that will be reviewed by the Commissioning Authority and updated by the design professionals throughout the design phase of the project. The Basis of Design includes the concepts and features the design professionals intend to incorporate into the design to meet the Owner's Project Requirements. The document includes:

- ✓ Objectives and purpose of each system and how the objectives will be met;
- ✓ Indoor and/or outdoor design conditions;
- ✓ Occupancy, usage and schedule assumptions;
- ✓ Zoning descriptions;
- ✓ Ventilation requirements;
- ✓ Envelope requirements;
- ✓ Equipment sizing and criteria;
- ✓ Basic sequence of operation
- ✓ Energy and water efficiency strategies;
- ✓ Design intent for efficiency measures; and
- ✓ Reference to pertinent local, provincial and/or federal compliance documents.

Similar to the Owner's Project Requirements above, where the project is within an existing facility, the Basis of Design focused solely to aspects, or objectives, of the renovation. Please see below for a summary of the Basis of Design:

As discussed above, since not all laboratory users within a building are typically operating at 100% of the required exhaust airflow through their hoods at the same time, by converting the building to a

variable air volume laboratory control system the building system's will take advantage of diversity within the system thereby improving system redundancy and safety, energy efficiency as well as serviceability. To accomplish this, the intention is to replace the existing constant or 2-position air valves with new variable volume air valves to reduce the airflows to 8 ACHs during occupied periods and to 5 ACHs during unoccupied periods, supplementing the conversions with new systems as required, and upgrading the existing Energy Management and Control Systems throughout the building to improve controllability, monitoring and alarming of the systems throughout the building.

There are a variety of standards and guidelines which suggest ventilation air change rates (ACHs) for laboratory facilities. The US Occupational Safety and Health Administration (OSHA) suggests 4 to 12 ACHs. The US National Research Council (NRC) suggests 6 to 12 ACHs. The American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) identifies 6 to 12 ACHs. The National Fire Protection Association (NFPA) recommends at least 8 ACHs. The National Institutes of Health (NIH) proposes a minimum 6 ACHs. The Canadian Food Inspection Agency (CFIA) identifies a minimum 10 ACHs. Typically, ONSA has designed laboratory facilities to have a minimum ventilation rate of 10 ACHs during occupied periods. To conserve energy, the ventilation rate is reduced to 5 ACHs during unoccupied hours.

The design concept report provided with the Request for Proposals (RFP) for the Project recommended the permanent reduction of ventilation rates throughout the Ellis laboratory building to 8 ACHs. ONSA noted that, while this may be correct for most laboratory spaces, there may be laboratory spaces that require a higher air change rates and there may be laboratory spaces where a lower air change rate may be acceptable. For example, a laboratory with little or no chemical usage may operate safely with an exhaust air change rate of 6 ACHs, however, a chemistry laboratory space may require 12 ACHs, or greater, in order to operate safely. Without completing a lab-by-lab assessment with an internal safety committed, it would be difficult to determine with confidence. ONSA recommended proceeding with a design that does not limit the spaces to only ever being able to achieve a maximum of 8 ACHs but rather enables the spaces to revert to the air change rate intended within the original building design. Further discussion will be had at the time of commissioning, and through the initial year of operation, to determine the appropriate setting for each laboratory and will need to establish a balance between the building's requirements and energy conservation and efficiency.

Laboratory facility ventilation rates are established by the greater requirement of (a) the space exhaust air change rate, (b) the air conditioning requirements for thermal comfort of occupants within the space, (c) the fume hood or equipment exhaust rate requirements, and/or (d) the outdoor air ventilation rates for the occupants within the space. As discussed above, the required space exhaust air change rate can vary significant depending upon the standard or guideline, it's important to consider the usage of the laboratory space when deciding and often the laboratory facility's health and safety personnel are involved in the discussion.

The air change rate requirements within laboratories is a topic of much debate, with many codes and standards providing various directions, see comments provided above. Many of them require the air

change rates within a laboratory to be 6-12 air changes per hour, unless a means of actively sensing the air quality within an individual laboratory is provided. In many cases, due to specialized exhaust requirements, the air changes rates can exceed 20 air changes per hour in individual laboratories. Based on the design concept report provided with the Request for Proposals (RFP), the proposed renovation for the Ellis laboratory building would maintain a minimum of laboratory ventilation rates at 8 air changes per hour during occupied hours and 5 air changes per hour during unoccupied hours.

Project Commissioning Specifications

The project's commissioning specifications define the contractors' commissioning-related responsibilities, including equipment installation and start-up, documentation and functional performance testing. As discussed in the section, Commissioning Team and Member Responsibilities, it is the design professionals' responsibility to develop the detailed commissioning specification requirements, however, the Commissioning Authority will have input into the language used and will review the requirements prior to the specifications being released. The commissioning specifications provide details relating to the:

- ✓ Contractors' expected communication and interface with the Commissioning Authority's construction oversight and testing procedures;
- ✓ Appropriate staff training requirements, especially when installing contractors and/or manufacturers' representatives were required to participate;
- ✓ Special equipment and/or instrumentation required to obtain measurements during performance testing; and
- ✓ Responsibility for compiling equipment installation verification, start-up reports and functional performance testing reports, developing operation and maintenance manuals and the deadline for their delivery to the commissioning authority.

BUILDING COMMISSIONING

The buildings designed and built today are sophisticated structures designed with the aid of sophisticated computer aided drafting software. In recent years, there has been a growing interest in the design and construction of sustainable buildings, resulting in greater emphasis on building commissioning. Buildings, if not properly commissioned, can be plagued by complaints and operational issues. Studies have been completed that demonstrate building commissioning can save building owners and property managers five (5) to twenty (20) percent in annual operating and maintenance costs.

A 1994 study of sixty (60) commercial buildings found that more than fifty (50) percent of the buildings surveyed suffered from temperature control problems, while forty (40) percent had problems with heating, ventilation and air conditioning equipment and thirty-three (33) percent had sensors that did not function properly. Furthermore, fifteen (15) percent of the buildings were actually missing specified equipment. A recent study also reported that twenty (20) to thirty (30) percent of commercial buildings suffer from indoor air quality problems. Uncomfortable building occupants will lead to increased complaints, resulting in increased expenses and hassles for the building owner. Building commissioning helps to prevent these problems. It has been reported that commissioning can reduce indoor environmental complaints by up to thirty-five (35) percent.

All forms of building commissioning share the same goals: to produce a building that meets the unique needs of its owner and occupants, operates as efficiently as possible, provides a safe, comfortable work environment and is operated and maintained by a well-trained staff or service contractor.

The commissioning process is a team effort, led by the Commissioning Authority who verifies the building meets the Owner's Project Requirements at each stage of the commissioning process. Since each building project is unique, the Commissioning Authority adapts the process to meet the project's specific goals. The Commissioning Authority should be an individual that is not involved in the design or construction of the building. However, there are projects where it may not be possible for the Commissioning Authority to be independent of the design or construction of the building, such as with the design and construction of smaller buildings (i.e. less than 50,000 square feet).

Commissioning Process Benefits

Commissioning benefits are far-reaching. Each of the participants in the design and construction process will benefit from commissioning and so will the building's owner, staff and future occupants. One study of six (6) new construction projects found that commissioning reduced change orders by eighty-seven (87) percent as well as contractor call-backs by ninety (90) percent, reducing the total construction cost by an estimated four (4) percent to nine (9) percent. Some of the benefits of commissioning have been briefly outlined below (the following list is not meant to be comprehensive summary or a guarantee of the benefits).

Cost Savings:

When commissioning starts during the design phase of a new construction project, the result is significant cost savings. Errors caught on paper, rather than

on the job site, are much less expensive to fix. Because commissioning identifies and helps resolve potential problems, it reduces costly change orders and contractor call-backs. This in turn helps to keep the project on schedule and on budget.

Improved Coordination: Commissioning improves communication between all team members. Without clear and frequent communication, there is little chance the new building will meet the Owner's Project Requirements. Throughout the project, commissioning tracks and resolves issues, focusing communication on passing problems. During commissioning meetings, participants are encouraged to consider one another's perspectives while maintaining a consistent focus on the owner's expectations for building performance. This improves the ability of the project team to identify the best long-term solutions for problems like oversized and inefficiently functioning systems, installation of the wrong equipment and incorrect programming of the sequences of operation.

Energy Savings: More and more building owners want to reduce energy use in their facility. Building commissioning ensures that the building's systems and equipment, as well as any special energy efficiency features, are installed and work correctly.

Fewer Deficiencies: During the last few months before turnover, the project team often focuses its attention on the systems and equipment most critical to obtain permits and readying the building for occupancy. At this stage it is easy to overlook incomplete or deficient systems, but problems that remain after turnover do not go away without attention.

Improved Environment: The quality of a building's indoor environment affects the health, comfort and productivity of its occupants. The consequences of poor indoor environmental quality range from mildly inconvenient to very serious. Temperature and lighting can cause an uncomfortable work environment that hinders learning and lowers an organization's efficiency and productivity. In more severe cases, poor air quality can cause headaches, fatigue or severe allergic reactions.

COMMISSIONING PLAN

The commissioning plan is an evolving document and will be continually shaped throughout the commissioning process as well as reviewed at major milestones throughout the project. For example, the plan below outlines specific commissioning-related activities to be completed during the pre-design phase, however, certain specific commissioning-related activities to be completed during the construction phase may not yet be determined at this point in the project. the commissioning plan will be updated to reflect the required commissioning-related activities as they are determined.

Generally speaking, the commissioning plan provides an outline of the project's commissioning activities, schedule, documentation requirements and the roles and responsibilities of the commissioning team. The specifics of the commissioning plan include:

- ✓ Building information and contact information;
- ✓ Project goals;
- ✓ An overview of the commissioning process, including the scope of commissioning;
- ✓ Building and system descriptions, including a list of components and systems to be commissioned;
- ✓ Commissioning process schedule;
- ✓ A List of team members, their responsibilities and expected deliverables;
- ✓ Description of communication, reporting and management protocols;
- ✓ Detailed description of testing procedures;
- ✓ Detailed description of monitoring procedures; and
- ✓ Recommended training activities.

Commissioning Program Overview and Process Activities

The commissioning process began during the pre-design phase of the project and will be carried through the construction phase and into the occupancy and operations phase. The table provided below provides a high-level overview of the commissioning activities outlined in the commissioning plan and to be completed during each phase of the building project, including the building concept design, the detailed design, the construction, the occupancy and the operation.

Project Phase	Commissioning Activity Description
Concept Design Phase	Commissioning Authority Selected
	Commissioning Team Formed
	Owner's Project Requirements and Basis of Design Developed
	Commissioning Plan Developed
Design Phase	Design Drawings and Specifications Reviewed
	Commissioning Plan Updated

Project Phase	Commissioning Activity Description
	Commissioning Specifications Developed
	Verification Checklists, Functional Tests, Systems Manual and Training Requirements Developed and Planned
	Develop Design Phase Issues Logs
	Owner's Project Requirements and Basis of Design Reviewed
Construction Phase	Contractor Submittals and Coordination Drawings Reviewed
	Functional Performance Testing, Diagnostic Monitoring and Verification Check Lists Prepared (finalized based on contractor submittals)
	Verification Checklists Completed
	Functional Testing, Diagnostic Monitoring and Verification Checks Performed
	Issues Track and Rectified
	Training of Owner's Staff Verified and Reviewed
	Commissioning Report and Systems Manual Developed
	O&M Manuals Reviewed
	Owner's Project Requirements and Basis of Design Reviewed
	Commissioning Plan Updated
Occupancy and Operations Phase	As-Built Sequence of Operations Finalized
	Outstanding Commissioning Issues Resolved
	Occupant Concerns Reviewed and Resolved
	Final Issues Log Prepared
	Final Commissioning Report Prepared

The information shown in the table above is meant to provide a summary of the phases and relevant activities outlined in the commissioning plan and completed during the commissioning process, additional details regarding the successful completion of the activity and supporting documentation have been provided within the remaining sections of the report and appendices.

Commissioning Team

Roles and responsibilities will be outlined at a commissioning scoping meeting, which will occur early in the project and which all team members will be required to attend. At this meeting, the owner and the Commissioning Authority will describe each team member's responsibilities, as well as the commissioning

scope, process and schedule. Furthermore, the commissioning plan will clearly define and document the responsibilities of each team member.

It is important to note that neither the commissioning team nor the Commissioning Authority manages the design and construction process. Team members will be informed that they are not authorized to direct work, nor accept a building or system. Rather, their purpose is to facilitate communication, resolve issues and document performance.

The commissioning team includes the Commissioning Authority, the building owner (and the owner's representative), the building manager (and facility staff), the contractors (and manufacturers' representatives) and the design professionals. For further details regarding the roles and responsibilities of the various team members please see the section titled, Commissioning Team and Member Responsibilities.

Communication Protocol, Coordination, Meetings and/or Management

Throughout the commissioning process, it is the intent of the meetings and commissioning plan to create and maintain a cooperative and mutually-beneficial working environment between the owner, the design professionals, the contractors and the Commissioning Authority. As the Commissioning Authority was engaged by the owner, to provide commissioning service, all reports and correspondence related to commissioning will be directed to include the Commissioning Authority. All of the parties involved in commissioning will be directed to coordinate their activities with the Commissioning Authority and, where required, provide the necessary equipment to enable the Commissioning Authority to fulfill the required commissioning activities.



COMMISSIONING TEAM AND MEMBER RESPONSIBILITIES

The commissioning team will work together to identify and resolve problems early in the design and construction process, following them through to their eventual resolution and ensuring that the delivered building meets the owner's requirements and expectations. Clearly defined and documented responsibilities for each team member are vital to the success of the commissioning project.

Commissioning Authority

Name: David G. Inglis, P.Eng.
Company: F.C. O'Neill, Scriven & Associates Limited
Phone: (902) 429-0701 x 247
E-mail: davei@onsa.ca

The Commissioning Authority is responsible for delivering the commissioning requirements for the building. The Commissioning Authority leads the commissioning process and planning as well as schedules and coordinates the commissioning activities.

During the design phase, the Commissioning Authority works with the project team to ensure that the owner's requirements and expectations for building operations are adequately documented in the Owner's Project Requirements and submits peer review comments on the design submissions, including the Basis of Design, design drawings and design specifications.

During the construction phase, the Commissioning Authority visits the job site frequently, documents concerns and issues, witnesses' system start-up and functional testing of systems and/or components as well as verifies that all of the necessary documentation and training has been completed. Specific responsibilities of the commissioning authority include, but are not limited to:

- ✓ Organizes and leads the commissioning team;
- ✓ Ensures that the owner's expectations are adequately documented in the Owner's Project Requirements;
- ✓ Peer reviews design submittals and shop drawings;
- ✓ Assists in documenting the commissioning requirements to be included in the design specifications;
- ✓ Prepares and updates the commissioning plan;
- ✓ Develops and maintains review documents and issue logs;
- ✓ Observes construction;
- ✓ Observes and documents functional performance testing;
- ✓ Reviews operation and maintenance documentation to ensure complete and applicable;
- ✓ Attends staff training sessions and verifies training was acceptable; and
- ✓ Prepares and submits final commissioning report.

Building Owner or Owner's Representative



Name: Amy Boutilier, P.Eng.
Company: Public Works & Government Services Canada
Phone: (902) 401-8963
E-mail: amy.boutilier@pwgsc.gc.ca

The owner's and/or the owner's representative's primary responsibilities are to support the commissioning team and to clearly communicate expectations about how the building is to operate. These expectations will be documented and serve as the foundation for the commissioning process as well as the design and construction phases of the project. Specific responsibilities of the owner and/or the owner's representative include, but are not limited to:

- ✓ Clearly communicate expectations and goals for the project;
- ✓ Assign staff to represent interests during the commissioning process;
- ✓ Work with the commissioning authority to determine the scope and goals of the commissioning process;
- ✓ Review and comment on reports submitted by the Commissioning Authority;
- ✓ Approve start-up and functional performance test completion; and
- ✓ Include future building staff in the process.

Building Manager and Facility Staff

Name: Jeff Hilchey
Company: Department of Fisheries and Oceans Canada
Phone: (902) 292-6543
E-mail: jeff.hilchey@dfo-mpo.gc.ca

By participating in the commissioning process, the building manager and/or the facility staff gain an understanding of the building's systems, the inter-system interactions as well as of the original design intent in advance of turnover and occupancy. Training will also be provided by the contractors for the building manager and/or the facility staff regarding the installed equipment and control strategies. Specific responsibilities of the building manager and/or facility staff include, but are not limited to:

- ✓ Review designs for maintainability;
- ✓ Participate in periodic site walkthroughs;
- ✓ Observe functional performance testing; and
- ✓ Participate in training sessions.

Contractor and Manufacturer Representatives

Name: T.B.D.
Company: T.B.D.
Phone: T.B.D.

E-mail: T.B.D.

The contractor and/or the manufacturer representatives construct the facility. They provide, install, start and test the building's systems and components. Their commissioning responsibilities are limited to what appear in the project design specifications.

It is the responsibility of the contractor and/or the manufacturer representatives to ensure that the completed building systems operate as intended in the design. Their specific tasks include working with the Commissioning Authority to conduct functional performance tests on the systems they install, helping to resolve any deficiencies and providing documentation on system start-ups. They are also responsible for providing system operation and maintenance documentation as well as training building staff. Specific responsibilities of the contractor and/or the manufacturer representatives include, but are not limited to:

- ✓ Supply the Commissioning Authority with all of the requested shop drawings and respond to requests for information;
- ✓ Review functional performance tests developed by the Commissioning Authority;
- ✓ Assist the Commissioning Authority during the functional performance tests;
- ✓ Work with the commissioning team to remedy deficiencies;
- ✓ Prepare operation and maintenance manuals;
- ✓ Provide documentation for the system manuals; and
- ✓ Develop and conduct training for building staff.

Design Professional

Name: David G. Inglis, P.Eng.
Company: F.C. O'Neill, Scriven & Associates Limited
Phone: (902) 429-0701 x 247
E-mail: davei@onsa.ca

The design professionals include the mechanical design engineer and electrical design engineer. The design professionals develop plans and specifications for the building that met the owner's needs and expectations. Their role in commissioning is to work with the Commissioning Authority to document the owner's expectations for building operations in the owner's project requirement document, prepare their respective bases of design and work with the commissioning team to resolve issues that arise during the design and construction phases. Specific responsibilities of the design professionals include, but are not limited to:

- ✓ Complete and issue municipal and/or provincial Design Compliance Letters of Undertaking and Project Completion Forms;
- ✓ Review shop drawings;
- ✓ Review Commissioning Authority's commissioning activities;
- ✓ Review the Authorities Having Jurisdiction inspection reports;
- ✓ Conduct periodic site reviews and prepare site review reports;
- ✓ Supervise and/or witness tests conducted on-site;



- ✓ Review Contemplated Change Orders, Change Directives and Site Instructions;
- ✓ Attend project site meetings;
- ✓ Prepare deficiency reports and confirmed deficient work completed;
- ✓ Review operation and maintenance manuals;
- ✓ Review manufacturer installation verification, start-up and material test reports;
- ✓ Review testing, adjusting and balancing report;
- ✓ Review warranty letters; and
- ✓ Review As-Built and/or Record drawings.

COMMISSIONING PROCESS

As discussed above, the commissioning process begins during the pre-design phase of the project and carries through the construction phase and into the occupancy and operations phase. The table below provides a high-level overview of the commissioning activities outlined in the commissioning plan.

Project Phase	Commissioning Activity Description	Date
Concept Design Phase	Commissioning Authority Selected	-
	Commissioning Team Formed	-
	Owner's Project Requirements and Basis of Design Developed	-
	Commissioning Plan Developed	-
Design Phase	Design Drawings and Specifications Reviewed	-
	Commissioning Plan Updated	-
	Commissioning Specifications Developed	-
	Verification Checklists, Functional Tests, Systems Manual and Training Requirements Developed and Planned	-
	Develop Design Phase Issues Logs	-
	Owner's Project Requirements and Basis of Design Reviewed	-
Construction Phase	Contractor Submittals and Coordination Drawings Reviewed	-
	Verification Checklists Completed	-
	Functional Testing, Diagnostic Monitoring and Verification Checks Performed	-
	Issues Track and Rectified	-
	Training of Owner's Staff Verified and Reviewed	-
	Commissioning Report and Systems Manual Developed	-
	O&M Manuals Reviewed	-
	Owner's Project Requirements and Basis of Design Reviewed	-
	Commissioning Plan Updated	-

Project Phase	Commissioning Activity Description	Date
Occupancy and Operations Phase	Seasonal / Deferred Testing Performed	-
	Near Warranty-End Review Performed	-
	As-Built Sequence of Operations Finalized	-
	Outstanding Commissioning Issues Resolved	-
	Occupant Concerns Reviewed and Resolved	-
	Final Issues Log Prepared	-
	Final Commissioning Report Prepared	-

Installation Verification and Functional Performance Testing

As discussed above, the Commissioning Authority is responsible for the verification of the installation and performance of the commissioned systems. Commissioning is conducted to verify that the performance of the commissioned systems (as installed) meet the Owner's Project Requirements, Basis of Design and contract documents. Commissioning process activities will be completed for the following systems, including:

- ✓ Laboratory fume hood exhaust controllers, including sash monitors, occupancy sensor and fume hood exhaust air valves;
- ✓ Laboratory supply controllers, including reheat coil controls, room thermostats, room occupancy sensors and room supply air valves;
- ✓ Laboratory general exhaust controllers, including room occupancy sensors and room exhaust air valves;
- ✓ Laboratory room controllers, including room specific controls and integration with the existing energy management and control system;
- ✓ Laboratory exhaust and supply central air handling and exhaust systems, including variable frequency drive and system static pressure set-points;

The verification of the installation and performance of the commissioned systems includes three steps for each system to be commissioned: the installation inspection, the performance testing and a comparison of the results with the Owner's Project Requirements.

Installation Inspection: Sometimes referred to as pre-functional inspections, installation inspections will be developed and conducted as a systemic set of procedures intended to identify whether individual system components were installed correctly. This process will occur during the start-up of individual units of equipment and involve the use of pre-functional checklists as well as start-up forms to ensure the consistency of the inspections and document the process. The installation inspections will be completed by the appropriate contractor at the time of installation and be verified

by the Commissioning Authority as well as design professionals. The installation inspections provide quality control and ensure that relatively minor issues will be discovered and corrected prior to system performance testing.

Performance Testing: Referred to as functional performance testing, performance testing occurs once all of the system components have been installed, energized, programmed, balanced and made otherwise ready for operation under part-load and full-load conditions. Testing will include each process in the sequence of operations under central and packaged equipment control, including the start-up, shut-down, capacity modulation, emergency and failure modes, alarms and interlocks to other equipment.

The Commissioning Authority is responsible for the development of the system performance testing procedures. The procedures used will rely on a wide range of methods to simulate and evaluate that the system being tested performed as expected (as per the Owner's Project Requirements, Basis of Design and Contract Documents) in all modes of operation.

Systems performance testing will be completed by the appropriate contractor and verified by the Commissioning Authority, as outlined in the commissioning specifications and the commissioning plan. The performance testing will reveal problems with the performance of the commissioned systems that require follow-up and coordination amongst the contractors to replace and/or repair.

Evaluation of Results: The evaluation of the results is the final step, at each point during the process of installation inspections and systems performance testing, the Commissioning Authority evaluates whether the installed systems met the criteria for the project as set forth in the Owner's Project Requirements and the Basis of Design.

Training Program Evaluation

Operation and maintenance documentation and training are vital to the long term operational health of the facility. Thorough training provided by the contractor will provide the staff with the information they need to operate and maintain the facility. The Commissioning Authority will work with the owner's representative and building staff to ensure that the training agenda meet the specifications in the contract documents as well as the Owner's Project Requirements. The requirements for the training will be outlined in the specifications and the Commissioning Authority will verify that they are carried out as intended.

The contractor and manufacturers' representatives will conduct the training for the owner's representative and facility staff. The training program will consist of:

- ✓ Description of systems and/or equipment and the warranties;

- ✓ Operating instructions and procedures, including seasonal changeover and manual/automatic control;
- ✓ Emergency instructions and procedures;
- ✓ Operation and adjustment of dampers, valves and controls;
- ✓ Adjustment instructions, including information for maintain operational parameters;
- ✓ Requirements and schedules for maintenance on all sensitive equipment;
- ✓ Common problems, their causes and corrective actions;
- ✓ Indoor air quality, health, visual comfort, acoustic comfort and safety issues;
- ✓ Recommendations for special tools and spare parts inventory;
- ✓ Hands-on operation of equipment and systems;
- ✓ Review of operation and maintenance manuals and location on-site;
- ✓ Building walk-through;
- ✓ Review of related Owner's Project Requirement documents;
- ✓ Energy management control system operation and programming;
- ✓ Control sequences and strategies;
- ✓ Thermostat programming;
- ✓ Relevant commissioning reports and documents;
- ✓ Sound energy management practices; and
- ✓ Exotic or special equipment.

Operation & Maintenance Manual Evaluation

Operation and maintenance manuals contain essential information about building equipment that will be used for years to come. The final version of the operation and maintenance manuals will be a well-organized, detailed and delivered in time for staff training. In order for the facility staff to use the operation and maintenance manuals effectively, the information they contain must be well-organized. An index or table of contents improves the usability, and when created early in the project, it will also serve as a checklist to ensure all of the required contents have been received. It is typically more helpful to organize the manuals by system, rather than specification number. The information in the operation and maintenance manuals will be detailed enough to help building staff operate, maintain and troubleshoot equipment.

The contractors will be responsible to produce the operation and maintenance manuals, as outlined in the specifications. Furthermore, the specifications will include the level of detail, the layout and organization requirements, all items required in the manuals and their due date. The Commissioning Authority's scope of work will also include reviewing the draft and final operation and maintenance manuals to ensure that they meet the specifications as well as the owner's requirements. The operation and maintenance manuals will include:

- ✓ Installing contractor contact information;
- ✓ Supplier's and/or manufacturer's contact information;
- ✓ Product data, including tag number, manufacturer, model number, serial number as well as all options identified;
- ✓ Test data and performance curves;

- ✓ Installation instructions;
- ✓ Operation requirements;
- ✓ Preventative maintenance requirements;
- ✓ Parts lists, including replacement parts, special tools and local sources;
- ✓ Troubleshooting procedures specific to the equipment design and application;
- ✓ Equipment submittals;
- ✓ Design documents;
- ✓ Control strategies;
- ✓ Sequences of operations;
- ✓ Copies of commissioning test reports;
- ✓ Copy of testing, adjusting and balancing report;
- ✓ Warranty information;
- ✓ Single line schematic of control drawings; and
- ✓ Field wiring diagrams for line voltage and controls connections.