

PART 1 - GENERAL

- 1.1 SUMMARY .1 Section Includes:
.1 Description of overall structure of Cx Plan and roles and responsibilities of Cx team.
- 1.2 REFERENCES .1 American Water Works Association (AWWA)
.2 National Fire Protection Association (NFPA)
.1 NFPA-13-02, Installation of Sprinkler Systems Handbook.
.2 NFPA-14-02, Automatic Sprinkler Systems Handbook.
.3 NFPA-20-03, Standard for the Installation of Stationary Fire Pumps for Fire Protection.
.3 Public Works and Government Services Canada (PWGSC)
.1 PWGSC - Commissioning Guidelines CP.4 -3rd edition-03.
.4 Underwriters' Laboratories of Canada (ULC)
- 1.3 GENERAL .1 Provide a fully functional facility:
.1 Systems, equipment and components meet user's functional requirements before date of final acceptance, and operate consistently at peak efficiencies and within specified energy budgets under normal loads.
.2 Facility user and O&M personnel have been fully trained in aspects of installed systems.
.3 Optimized life cycle costs.
.4 Complete documentation relating to installed equipment and systems.
.2 Term "Cx" in this section means "Commissioning".
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1.3 GENERAL
(Cont'd)

- .3 Use this Cx Plan as master planning document for Cx:
 - .1 Outlines organization, scheduling, allocation of resources, documentation, pertaining to implementation of Cx.
 - .2 Communicates responsibilities of team members involved in Cx Scheduling, documentation requirements, and verification procedures.
 - .3 Sets out deliverables relating to O&M, process and administration of Cx.
 - .4 Describes process of verification of how built works meet Owner 's design requirements.
 - .5 Produces a complete functional system prior to issuance of Certificate of Occupancy.
 - .6 Management tool that sets out scope, standards, roles and responsibilities, expectations, deliverables, and provides:
 - .1 Overview of Cx.
 - .2 General description of elements that make up Cx Plan.
 - .3 Process and methodology for successful Cx.
- .4 Acronyms:
 - .1 Cx - Commissioning.
 - .2 BMM - Building Management Manual.
 - .3 EMCS - Energy Monitoring and Control Systems.
 - .4 MSDS - Material Safety Data Sheets.
 - .5 PI - Product Information.
 - .6 PV - Performance Verification.
 - .7 TAB - Testing, Adjusting and Balancing.
 - .8 WHMIS - Workplace Hazardous Materials Information System.
- .5 Commissioning terms used in this Section:
 - .1 Bumping: short term start-up to prove ability to start and prove correct rotation.
 - .2 Deferred Cx - Cx activities delayed for reasons beyond Contractor's control due to lack of occupancy, weather conditions, need for heating/cooling loads.

- 1.4 DEVELOPMENT OF 100% CX PLAN
- .1 Cx Plan to be 95% completed before added into Project Specifications.
 - .2 Cx Plan to be 100% completed within [8]weeks of award of contract to take into account:
 - .1 Approved shop drawings and product data.
 - .2 Approved changes to contract.
 - .3 Contractor's project schedule.
 - .4 Cx schedule.
 - .5 Contractor's, sub-contractor's, suppliers' requirements.
 - .6 Project construction team's and Cx team's requirements.
 - .3 Submit completed Cx Plan to Departmental Representative and obtain written approval.
- 1.5 REFINEMENT OF CX PLAN
- .1 During construction phase, revise, refine and update Cx Plan to include:
 - .1 Changes resulting from Client program modifications.
 - .2 Approved design and construction changes.
 - .2 Revise, refine and update every 3 months during construction phase. At each revision, indicate revision number and date.
 - .3 Submit each revised Cx Plan to Departmental Representative for review and obtain written approval.
 - .4 Include testing parameters at full range of operating conditions and check responses of equipment and systems.
- 1.6 COMPOSITION, ROLES AND RESPONSIBILITIES OF CX TEAM
- .1 Departmental Representative to maintain overall responsibility for project and is sole point of contact between members of commissioning team.
 - .2 Project Manager will select Cx Team consisting of members to represent the following disciplines:
 - .1 Architectural.
 - .2 Mechanical.
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- 1.6 COMPOSITION, ROLES AND RESPONSIBILITIES OF CX TEAM (Cont'd)
- .2 (Cont'd)
 - .3 Electrical.
 - .3 General Contractor is to provide its own Cx Agent.
 - .4 Project Manager will select Cx Team consisting of following members:
 - .1 PWGSC Design Quality Review Team: during construction, will conduct periodic site reviews to observe general progress.
 - .2 PWGSC 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 Monitoring of Cx activities, training, development of Cx documentation.
 - .4 Work closely with members of Cx Team.
 - .3 Departmental Representative is responsible for:
 - .1 Monitoring operations Cx activities.
 - .2 Witnessing, certifying accuracy of reported results.
 - .3 Witnessing and certifying TAB and other tests.
 - .4 Developing BMM.
 - .5 Ensuring implementation of final Cx Plan.
 - .6 Performing verification of performance of installed systems and equipment.
 - .7 Implementation of Training Plan.
 - .4 Construction Team: Contractor, sub-contractors, suppliers and support disciplines, as responsible for construction/installation in accordance with contract documents, including:
 - .1 Testing.
 - .2 TAB.
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- 1.6 COMPOSITION, .4 (Cont'd)
ROLES AND .4 Construction Team: (Cont'd)
RESPONSIBILITIES OF .3 Organization and Performance of Cx
CX TEAM activities.
(Cont'd) .4 Delivery of training and Cx
documentation.
.5 Assigning one person as point of
contact with Departmental Representative
and PWGSC Cx Manager for administrative
and coordination purposes.
.5 Contractor's Cx agent implements
specified Cx activities including:
.1 Demonstrations.
.2 Training.
.3 Testing.
.4 Preparation, submission of test
reports.
.6 Facility Manager: represents lead role
in Operation Phase and onwards and is
responsible for:
.1 Receiving facility.
.2 Day-To-Day operation and
maintenance of facility.
- 1.7 CX PARTICIPANTS .1 Employ the following Cx participants to
verify performance of equipment and systems:
.1 Installation contractor/subcontractor:
.1 Equipment and systems except as
noted.
.2 Equipment manufacturer: equipment specified
to be installed and started by manufacturer.
.1 To include performance verification.
.3 Specialist subcontractor: equipment and
systems supplied and installed by specialist
subcontractor.
.4 Specialist Cx agency:
.1 Possessing specialist qualifications and
installations providing environments essential
to Client's program but are outside scope or
expertise of Cx specialists on this project.
.5 Ensure that Cx participants:
.1 Could complete work within scheduled
time frame.
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- 1.7 CX PARTICIPANTS .5 Ensure that Cx participants:(Cont'd)
(Cont'd)
- .2 Available for emergency and troubleshooting service during first year of occupancy by user for adjustments and modifications outside responsibility of O&M personnel, including:
 - .1 Modify ventilation rates to meet changes in off-gassing.
 - .2 Changes to heating or cooling loads beyond scope of Control System.
 - .3 Changes to Control System control strategies beyond level of training provided to O&M personnel.
 - .4 Redistribution of electrical services.
 - .5 Modifications of fire alarm systems.
 - .6 Modifications to voice communications systems.
 - .6 Provide names of participants to Departmental Representative and details of instruments and procedures to be followed for Cx 3 months prior to starting date of Cx for review and approval.
- 1.8 EXTENT OF CX .1 The following list is not necessarily all - inclusive and may change during the Cx process.
- .1 Cx Architectural Systems:
 - .1 Exterior systems:
 - .1 Landscaping.
 - .2 Raised floor systems.
 - .3 Accessibility and operational safety:
 - .1 Accessible parking, access to building entrance.
 - .4 Vertical transportation systems:
 - .1 Passenger elevators.
 - .5 Equipment:
 - .1 Kitchen equipment installed under contract.
 - .6 Doors, windows, related hardware:
 - .1 Special doors as identified herein:
 - .2 Door and window hardware.
 - .3 Door sidelight and window glazing.
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- 1.8 EXTENT OF CX .1 (Cont'd)
- (Cont'd)
- .1 Cx Architectural Systems: (Cont'd)
 - .7 Roofing and flashing.
 - .2 Commission mechanical systems and associated equipment:
 - .1 Plumbing systems:
 - .1 Domestic CWS, HWS and HWR (HW RECIRC).
 - .2 Regular sanitary waste systems.
 - .3 Fixtures and trim.
 - .4 DHW Tank.
 - .5 Storm water systems.
 - .6 Sump pump for elevator sump .
 - .7 DHWR Pump.
 - .2 HVAC and exhaust systems:
 - .1 HVAC systems - VRF, FC's HRV's and Heating.
 - .2 General exhaust systems.
 - .3 Exhaust systems and related systems.
 - .4 Heat recovery systems- HRV's.
 - .3 Fire and life safety systems:
 - .1 Wet pipe sprinkler systems.
 - .2 Dry pipe sprinkler systems.
 - .3 Fire extinguishers.
 - .4 Noise and vibration control systems for mechanical systems.
 - .1 HVAC Equipment.
 - .2 Pumps.
 - .5 Seismic restraint and control measures.
 - .6 IAQ environmental control systems:
 - .1 Indoor conditions in areas listed herein:
 - .1 All areas supplied with AC, ventilation and heating.
 - .2 Indoor air quality (IAQ):
 - .1 Filters supplied with mechanical HVAC equipment.
 - .3 Environmental control systems in areas listed herein:
 - .7 Building Control System:
 - .1 Mechanical components such as HVAC equipment, pumps, temperature control, etc. are connected and controlled.
 - .8 Energy metering systems for hot and cold water.
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- 1.8 EXTENT OF CX (Cont'd) .3 Commission electrical systems and equipment:
- .1 Low voltage below 750 V:
 - .1 Low voltage equipment.
 - .2 Low voltage distribution systems.
 - .3 Voice communications systems.
 - .4 Audio/visual systems.
 - .5 Electronic data and communications information systems.
 - .2 Emergency power generation systems:
 - .1 Generators.
 - .2 Fuel systems.
 - .3 Transfer switchgear and controllers.
 - .3 Lighting systems:
 - .1 Lighting equipment.
 - .2 Distribution systems.
 - .3 Emergency lighting systems, including battery packs.
 - .4 Fire exit emergency signage.
 - .4 Fire alarm systems, equipment:
 - .1 Annunciators.
 - .2 Control panels.
 - .3 Fire alarm battery banks.
 - .4 Devices.
 - .5 External monitoring.
 - .5 Other systems and equipment:
 - .1 Access security and safety systems as follows:
 - .1 Door operating system.
 - .2 Card access.
 - .2 Lightning protection systems.

- 1.9 DELIVERABLES RELATING TO O&M PERSPECTIVES .1 General requirements:
- .1 Compile English documentation.
 - .2 Documentation to be computer-compatible format ready for inputting for data management.
- .2 Provide deliverables:
- .1 Warranties.
 - .2 Project record documentation.
 - .3 Inventory of spare parts, special tools and maintenance materials.
 - .4 Maintenance Management System (MMS) identification system used.
 - .5 WHMIS information.
 - .6 MSDS data sheets.
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1.9 DELIVERABLES .2 Provide deliverables:(Cont'd)
RELATING TO O&M .7 Electrical Panel inventory containing
PERSPECTIVES detailed inventory of electrical circuitry for
(Cont'd) each panel board. Duplicate of inventory
inside each panel.

1.10 DELIVERABLES .1 General:
RELATING TO THE CX .1 Start-up, testing and Cx requirements,
PROCESS conditions for acceptance and specifications
form part of relevant technical sections of
these specifications.

.2 Definitions:
.1 Cx as used in this section includes:
.1 Cx of components, equipment,
systems, subsystems, and integrated
systems.
.2 Factory inspections and performance
verification tests.

.3 Deliverables: provide:
.1 Cx Specifications.
.2 Startup, pre-Cx activities and
documentation for systems, and equipment.
.3 Completed installation checklists (ICL).
.4 Completed product information (PI)
report forms.
.5 Completed performance verification (PV)
report forms.
.6 Results of Performance Verification
Tests and Inspections.
.7 Description of Cx activities and
documentation.
.8 Description of Cx of integrated systems
and documentation.

.4 Departmental Representative to witness and
certify tests and reports of results provided.

1.11 PRE-CX .1 Items listed in this Cx Plan include the
ACTIVITIES AND following:
RELATED .1 Pre-Start-Up inspections: prior to
DOCUMENTATION permission to start up and rectification of
deficiencies to Departmental Representative's
satisfaction.

- 1.11 PRE-CX ACTIVITIES AND RELATED DOCUMENTATION
(Cont'd)
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- .1 (Cont'd)
- .2 Departmental Representative to use approved check lists.
 - .3 Departmental Representative will monitor some or all of these pre-start-up inspections.
 - .4 Include completed documentation with Cx report.
 - .5 Conduct pre-start-up tests: conduct pressure, static, flushing, cleaning, and "bumping" during construction as specified in technical sections. To be witnessed and certified by Departmental Representative and does not form part of Cx specifications.
 - .6 Departmental Representative will monitor some or all of these inspections and tests.
 - .7 Include completed documentation in Cx report.
- .2 Pre-Cx activities - ARCHITECTURAL:
- .1 Exterior walls: conduct thermographic surveys to ensure appropriate level of tightness after exterior envelope has been completed. Permanent HVAC systems are able to provide appropriate negative or positive pressure, a temperature of at 20 degrees C can be maintained between inside and outside and wind speed is less than 10 kph.
 - .2 Raised floor systems: verify freedom for air movement through-out.
 - .3 Vertical transportation:
 - .1 Passenger elevator: provide acceptance of elevator installation by including Government Services Elevator License. Include all testing and commentary forms.
 - .4 Equipment:
 - .1 Kitchen equipment: verify operation.
 - .5 Doors, windows, related hardware:
 - .1 Overhead doors: verify operation.
 - .2 Door and window hardware: verify operation.
- .3 Pre-Cx activities - MECHANICAL:
- .1 Plumbing systems:
 - .1 "Bump" each item of equipment in its "stand-alone" mode.
 - .2 Complete pre-start-up checks and complete relevant documentation.
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1.11 PRE-CX
ACTIVITIES AND
RELATED
DOCUMENTATION
(Cont'd)

- .3 Pre-Cx activities - MECHANICAL:(Cont'd)
 - .1 Plumbing systems:(Cont'd)
 - .3 After equipment has been started, test related systems in conjunction with control systems on a system-by-system basis.
 - .2 HVAC equipment and systems:
 - .1 "Bump" each item of equipment in its "stand-alone" mode.
 - .2 At this time, complete pre-start-up checks and complete relevant documentation.
 - .3 After equipment has been started, test related systems in conjunction with control systems on a system-by-system basis.
 - .4 Perform TAB on systems. TAB reports to be approved by Departmental Representative.
 - .3 Building Control System:
 - .1 Control System trending to be available as supporting documentation for performance verification.
 - .2 Perform point-by-point testing in parallel with start-up.
 - .3 Carry out point-by-point verification.
 - .4 Demonstrate performance of systems, to be witnessed by Departmental Representative prior to start of 30 day Final Acceptance Test period.
 - .5 Perform final Cx and operational tests during demonstration period and 30 day test period.
 - .6 Only additional testing after foregoing have been successfully completed to be "Off-Season Tests".
- .4 Pre-Cx activities - ELECTRICAL:
 - .1 Low voltage distribution systems under 750 V:
 - .1 Requires independent testing agency to perform pre- energization and post-energization tests.
 - .2 Megger test all feeders.
 - .2 Emergency power generation systems
 - .1 Transfer switches: test by simulating loss of power. Verify

- 1.11 PRE-CX ACTIVITIES AND RELATED DOCUMENTATION (Cont'd)
- .4 Pre-Cx activities - ELECTRICAL: (Cont'd)
 - .2 (Cont'd)
 - .1 Transfer switches: (Cont'd) availability of power at equipment requiring same.
 - .1 Simulate automatic, by-pass and manual transfer.
 - .3 Lighting systems: battery units.
 - .1 Emergency lighting systems:
 - .1 Tests to include verification of lighting duration.
 - .4 Fire alarm systems: test after other safety and security systems are completed. Testing to include a complete verification in accordance with ULC requirements. Departmental Representative has witnessed and certified report, demonstrate devices and zones to Departmental Representative.
 - .5 Low voltage systems: these include:
 - .1 Clock, communications, low voltage lighting control systems and data communications systems.
 - .6 Security, surveillance systems: to include verification by Departmental Representative.
 - .7 Lightning protection systems.

1.12 START-UP

 - .1 Start up components, equipment and systems.
 - .2 Equipment manufacturer, supplier, installing specialist sub-contractor, as appropriate, to start-up, under Contractor's direction, following equipment, systems:
 - .1 VRF System.
 - .2 Building Control System (VRF Manufacturer).
 - .3 Wet and Dry Sprinkler Systems.
 - .3 Departmental Representative to monitor all of these start-up activities.
 - .1 Rectify start-up deficiencies to satisfaction of Departmental Representative.
 - .4 Performance Verification (PV):
 - .1 Approved Cx Agent to perform.
 - .1 Repeat when necessary until results are acceptable to Departmental Representative.

- 1.12 START-UP
(Cont'd)
- .4 Performance Verification (PV):(Cont'd)
 - .2 Use procedures modified generic procedures to suit project requirements.
 - .3 Departmental Representative to witness and certify reported results using approved PI and PV forms.
 - .4 Departmental Representative to approve completed PV reports and provide to Departmental Representative.
 - .5 Departmental Representative will verify up to 50% of reported results at random.
 - .6 Failure of randomly selected item shall result in rejection of PV report or report of system startup and testing.

- 1.13 CX ACTIVITIES
AND RELATED
DOCUMENTATION
- .1 Departmental Representative to monitor Cx activities.
 - .2 Upon satisfactory completion, Cx agency performing tests to prepare Cx Report using approved PV forms.
 - .3 Departmental Representative to witness and certify reported results of Cx activities.
 - .4 Departmental Representative reserves right to verify a percentage of reported results at no cost to contract.

- 1.14 CX OF
INTEGRATED SYSTEMS
AND RELATED
DOCUMENTATION
- .1 Cx to be performed by specified Cx specialist, using procedures developed by Cx Representative and approved by Departmental Representative.
 - .2 Tests to be witnessed by Departmental Representative and documented on approved report forms.
 - .3 Upon satisfactory completion, Cx specialist to prepare Cx Report, to be certified by Departmental Representative.
 - .4 Departmental Representative reserves right to verify percentage of reported results.
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- 1.14 CX OF INTEGRATED SYSTEMS AND RELATED DOCUMENTATION
(Cont'd)
- .5 Integrated systems to include:
 - .1 HVAC and associated systems forming part of integrated HVAC Systems.
 - .2 Indoor air quality.
 - .3 Environmental space conditions.
 - .4 Fire alarm systems.
 - .5 Voice communications systems.
 - .6 Emergency power generator.
 - .7 Transfer switch and controllers.
 - .8 Emergency lighting systems.
 - .6 Identification:
 - .1 In later stages of Cx, before hand-over and acceptance Departmental Representative, and Cx Manager to co-operate to complete inventory data sheets and provide assistance to PWGSC in full implementation of MMS identification system of components, equipment, sub-systems, systems.
- 1.15 INSTALLATION CHECK LISTS (ICL)
- .1 Refer to Section 01 91 33 - Commissioning (Cx) Forms: Installation Check Lists and Product Information (PI) / Performance Verification (PV) Forms.
- 1.16 PRODUCT INFORMATION (PI) REPORT FORMS
- .1 Refer to Section 01 91 33 - Commissioning (Cx) Forms: Installation Check Lists and Product Information (PI) / Performance Verification (PV) Forms.
- 1.17 PERFORMANCE VERIFICATION (PV) REPORT
- .1 Refer to Section 01 91 33 - Commissioning (Cx) Forms: Installation Check Lists and Product Information (PI) / Performance Verification (PV) Forms.
- 1.18 DELIVERABLES RELATING TO ADMINISTRATION OF CX
- .1 General:
 - .1 Because of risk assessment, complete Cx of occupancy, weather and seasonal-sensitive equipment and systems in these areas before building is occupied.
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- 1.19 CX SCHEDULES .1 Prepare detailed Cx Schedule and submit to Departmental Representative for review and approval same time as project Construction Schedule. Include:
- .1 Milestones, testing, documentation, training and Cx activities of components, equipment, subsystems, systems and integrated systems, including:
 - .1 Design criteria, design intents.
 - .2 Pre-TAB review.
 - .3 Cx agents' credentials.
 - .4 Cx procedures.
 - .5 Cx Report format.
 - .6 Submission of list of instrumentation with relevant certificates: 21 days before start of Cx.
 - .7 Notification of intention to start TAB: 21 days before start of TAB.
 - .8 TAB: after successful start-up, correction of deficiencies and verification of normal and safe operation.
 - .9 Notification of intention to start Cx: 14 days before start of Cx.
 - .10 Notification of intention to start Cx of integrated systems: after Cx of related systems is completed [14]days before start of integrated system Cx.
 - .11 Identification of deferred Cx.
 - .12 Implementation of training plans.
 - .13 Cx reports: immediately upon successful completion of Cx.
 - .14 Emergency evacuation exercises: after 80% occupancy.
 - .2 Detailed training schedule to demonstrate no conflicts with testing, completion of project and hand-over to Property Manager.
 - .3 6 months in Cx schedule for verification of performance in all seasons and wear conditions.
- .2 After approval, incorporate Cx Schedule into Construction Schedule.
- .3 Consultant, Contractor, Contractor's Cx agent, and Departmental Representative will monitor progress of Cx against this schedule.
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- 1.20 CX REPORTS .1 Submit reports of tests, witnessed and certified by Departmental Representative who will verify reported results.
- .2 Include completed and certified PV reports in properly formatted Cx Reports.
- .3 Before reports are accepted, reported results to be subject to verification by Departmental Representative.
- 1.21 ACTIVITIES DURING WARRANTY PERIOD .1 Cx activities must be completed before issuance of Interim Certificate, it is anticipated that certain Cx activities may be necessary during Warranty Period, including:
- .1 Fine tuning of HVAC systems.
- .2 Adjustment of ventilation rates to promote good indoor air quality and reduce deleterious effects of VOCs generated by off-gassing from construction materials and furnishings.
- .3 Full-scale emergency evacuation exercises.
- 1.22 TESTS TO BE PERFORMED BY OWNER/USER .1 None are anticipated on this project.
- 1.23 TRAINING PLANS .1 Refer to Section 01 91 41 - Commissioning (Cx) - Training.
- 1.24 FINAL SETTINGS .1 Upon completion of Cx to satisfaction of Departmental Representative lock control devices in their final positions, indelibly mark settings marked and include in Cx Reports.
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1.25 PAYMENTS FOR .1 To be included in base bid.
CX

PART 2 - PRODUCTS

2.1 NOT USED .1 Not Used.

PART 3 - EXECUTION

3.1 NOT USED .1 Not Used.