

Part 1 General

1.1 GENERAL

- .1 Provide a fully functional facility:
 - .1 Systems, equipment and components meet user's functional requirements before date of 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".
- .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 Departmental Representative 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 BAS – Building Automation System.
 - .3 EMCS – Energy Monitoring and Control Systems.
 - .4 MSDS – Material Safety Data Sheets.
 - .5 O&M Manual – Operations & Maintenance Manual.

- .6 PI – Product Information.
- .7 PV – Performance Verification.
- .8 TAB – Testing, Adjusting and Balancing.
- .9 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.
- 1.2 REFINEMENT OF Cx PLAN
 - .1 During construction phase, Cx Manager will revise, refine and update Cx Plan to include:
 - .1 Changes resulting from Client program modifications.
 - .2 Approved design and construction changes.
 - .2 Engineer/Consultant to include testing parameters at full range of operating conditions and check responses of equipment and systems.
- 1.3 COMPOSITION, ROLES AND RESPONSIBILITIES OF Cx TEAM
 - .1 Project Manager to maintain overall responsibility for project and is sole point of contact between members of commissioning team.
 - .2 PWGSC O&M Commissioning Manager: ensures Cx activities area carried out to ensure delivery of a fully operational project including:
 - .1 Organizing Cx.
 - .2 Monitoring operations Cx activities.
 - .3 Witnessing of reported results.
 - .4 Witnessing TAB and other tests.
 - .5 Ensuring implementation of final Cx Plan.
 - .6 Review of Cx documentation from operational perspective.
 - .7 Review for performance, reliability, durability of operation, accessibility, maintainability, operational efficiency under conditions of operation.
 - .8 Protection of health, safety and comfort of occupants and O&M personnel.
 - .9 Monitoring of Cx activities, training, development of Cx documentation.
 - .10 Work closely with members of Cx Team.

- .3 Engineer/Consultant is responsible for:
 - .1 Monitoring operations Cx activities.
 - .2 Witnessing, certifying accuracy of reported results.
 - .3 Witnessing and certifying TAB and other tests.
 - .4 Ensuring implementation of final Cx Plan.
 - .5 Performing verification of performance of installed systems and equipment.
 - .6 Implementation of Training Plan.
- .4 Construction Team: contractor, sub-contractors, suppliers and support disciplines, is responsible for construction/ installation in accordance with contract documents, including:
 - .1 Testing.
 - .2 TAB.
 - .3 Performance of Cx activities.
 - .4 Delivery of training and Cx documentation.
 - .5 Assigning one person as point of contact with Consultant and PWGSC O&M Commissioning 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.

1.4 Cx PARTICIPANTS

- .1 Ensure that Cx participant:
 - .1 Could complete work within scheduled time frame.
 - .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 design values.
 - .2 Changes to heating or cooling loads beyond scope of EMCS.
 - .3 Changes to EMCS control strategies beyond level of training provided to O&M personnel.
 - .4 Redistribution of electrical services.
- .2 Provide names of participants to Cx Manager and details of instruments and procedures to be followed for Cx one month prior to starting date of Cx for review and approval.

1.5 EXTENT OF Cx

.1 Commission mechanical systems and associated equipment:

- .1 Plumbing systems:
 - .1 DCW Piping.
 - .2 DHW Piping.
 - .3 Hot Water Heater.
- .2 Exhaust systems:
 - .1 Fan Coil Unit.
- .3 Fire and life safety systems:
 - .1 Fire Stop Verification.
- .4 EMCS / BAS:
 - .1 Static Testing.
 - .2 Dynamic Operational Test.

.2 Commission electrical systems and equipment:

- .1 Low voltage below 750 V:
 - .1 Receptacle Verification.
 - .2 Load Balancing.
 - .3 Low voltage equipment.

.3 Other systems and equipment:

- .1 Motor Starters.

1.6 DELIVERABLES RELATING TO O&M PERSPECTIVES

- .1 General requirements:
 - .1 Compile documentation.
 - .2 Documentation to be computer-compatible format ready for inputting for data management.
- .2 Provide deliverables:
 - .1 Warranties.
 - .2 Operations & Maintenance Manual.
 - .3 Inventory of spare parts, special tools and maintenance materials.
 - .4 Computerized Maintenance Management System (CMMS) identification system used.
 - .5 WHMIS information.
 - .6 MSDS data sheets.
 - .7 Electrical Panel inventory containing detailed inventory of electrical circuitry for each panel board. Duplicate of inventory inside each panel.

1.7 DELIVERABLES RELATING TO THE Cx PROCESS

- .1 General:
 - .1 Start-up, testing and Cx requirements, 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.
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- .3 Deliverables: provide:
 - .1 Cx Specifications.
 - .2 Start-up, pre-Cx activities and documentation for systems, and equipment.
 - .3 Completed installation checklists (ICL).

- .4 Complete 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.
 - .9 Tests of all equipment and systems identified in Section 01 91 31 – 1.6 to be witnessed by:
 - .1 Cx Manager
 - .2 Engineer / Consultant
 - .10 Training Plans.
 - .11 Cx Reports.
 - .12 Prescribed activities during warranty period.
 - .4 Engineer/Consultant and Cx Manager to witness and certify tests and reports of results provided to by Contractor.
- 1.8 PRE-Cx ACTIVITIES AND RELATED DOCUMENTATION
- .1 Items listed in this Cx Plan include the following:
 - .1 Pre-Start-Up Inspection: by Cx Manager and Engineer / Consultant prior to permission to start up and rectification of deficiencies to Cx Manager and Engineer / Consultant satisfaction.
 - .2 Cx Agent to use approved check lists.
 - .3 Cx Manager and Engineer / Consultant will monitor some of these pre-start-up inspections.
 - .4 Include completed documentation with Cx report.
 - .5 Conduct pre-start-up tests: conduct pressure, static, flushing and cleaning during construction as specified in technical sections. To be witnessed and certified by Cx Manager and Engineer / Consultant and does not form part of Cx specifications.
 - .6 Cx Manager and Engineer / Consultant will monitor some of these inspections and tests.
 - .7 Include completed documentation in Cx report.
 - .2 Pre-Cx activities – Mechanical:
 - .1 As required.

- .3 Pre-Cx activities – Electrical:
 - .1 As required.
- 1.9 START-UP
 - .1 Start up components, equipment and systems.
 - .2 Performance Verification (PV):
 - .1 Approved Cx Agent to perform.
 - .1 Repeat when necessary until results are acceptable to Engineer/Consultant and Cx Manager.
 - .2 Use procedures modified generic procedures to suite project requirements.
 - .3 Cx Manager to witness and certify reported results using approved PI and PV forms.
 - .4 Cx Manager and Engineer/Consultant to approve completed PV reports.
 - .5 Cx Manager and Engineer/Consultant reserves right to verify up to 30% 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.
- 1.10 Cx ACTIVITIES AND RELATED DOCUMENTATION
 - .1 Perform Cx by specified Cx Agent as using procedures developed by Cx Manager and Engineer/Consultant.
 - .2 Cx Manager and Engineer/Consultant to monitor Cx activities.
 - .3 Upon satisfactory completion, Cx agent performing tests to prepare Cx Report using approved PV forms.
 - .4 Engineers/Consultant and Cx Manager to witness and certify tests and reports of results.
 - .5 Cx Manager and Engineer/Consultant reserves right to verify a percentage of reported results at no cost to contract.
- 1.11 Cx OF INTEGRATED SYSTEMS AND RELATED DOCUMENTATION
 - .1 Cx to be performed by specified Cx specialist, using procedures developed by Cx Manager and Engineer/Consultant.
 - .2 Tests to be witnessed by Cx Manager and Engineer/Consultant and documented on approved report forms.
 - .3 Upon satisfactory completion, Cx Agent to prepare Cx Report, to be certified by Cx Manager and Engineer/Consultant.
 - .4 Cx Manager and Engineer/Consultant reserves right to verify percentage of reported

results.

.5 Integrated system to include:

.1 As required.

.6 Identification:

.1 In later stages of Cx, before hand-over and acceptance Contractor and Cx Manager to cooperate to complete inventory data sheets and provide assistance in full implementation of CMMS identification system of components, equipment, sub-systems, systems.

1.12 INSTALLATION CHECK LISTS (ICL)

.1 Refer to Project Specification Appendix

1.13 PERFORMANCE VERIFICATION (PV) REPORT

.1 Refer to Project Specification Appendix.

1.14 DELIVERABLES RELATING TO ADMINISTRATION OF Cx

.1 General:

.1 Complete Cx of occupancy, weather and seasonal-sensitive equipment and systems in these areas before building is occupied.

1.15 Cx SCHEDULES

.1 Contractor to prepare detailed Cx Schedule and submit to Cx Manager 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 Submission of list of instrumentation with relevant certificates.

.2 Notification of intention to start TAB: 14 days before start of TAB.

.3 TAB: after successful start-up, correction of deficiencies and verification of normal and safe operation.

.4 Notification of intention to start Cx: 14 days before start of Cx.

.5 Notification of intention to start Cx of integrated systems: after Cx of related systems is completed 14 days before start of integrated system Cx.

.6 Identification of deferred Cx.

.7 Implementation of training plans.

.8 Cx reports: immediately upon successful completion of Cx.

.2 Detailed training schedule to demonstrate no conflicts with testing, completion

of project and hand-over.

.3 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.

1.16 Cx REPORTS

.1 Include completed and certified PV reports in properly formatted Cx Reports.

.2 Before reports are accepted, reported results to be subject to verification by Cx Manager and Engineer/Consultant.

1.17 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.

1.18 TESTS TO BE PERFORMED BY OWNER/USER

.1 As required.

1.19 TRAINING PLANS

.1 See Section 01 91 41

1.20 FINAL SETTINGS

.1 Upon completion of Cx to satisfaction of Cx Manager and Engineer/Consultant lock control devices in their final positions, indelibly mark settings marked and include in Cx reports.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION