

**Part 1            General**

**1.1                SECTION INCLUDES**

- .1        This section deals with commissioning activities to occur during the construction stage and the early period of facility occupancy stage.
- .2        Section includes:
  - .1        Commissioning activities to be performed by the Contractor who is assigned membership on a Commissioning Team as part of the contract requirements.
  - .2        Commissioning activities to be performed by other members of the Commissioning Team.
- .3        In general, Contractor's commissioning activities consists of performing specified tasks and functions to assist the Commissioning Agent, along with other members of the commissioning team who will commission various components and systems of the Facility.

**1.2                RELATED SECTIONS**

- .1        Section 01 78 00 – Closeout Submittals.
- .2        Section 01 79 00 – Demonstration and Training.

**1.3                BACKGROUND INFORMATION**

- .1        Historically in the past, the term commissioning has been used in reference to the process used to conduct testing, adjusting and balancing of the heating, ventilation and air conditioning (HVAC) systems of a building.
- .2        Commissioning (or the commissioning process), as understood by DEPARTMENTAL REPRESENTATIVE, is a planned program of activities conducted in concert with other activities performed during each stage of project delivery.
  - .1        The commissioning process identifies issues during the Planning and Design stages which are addressed during the Construction and Occupancy Stages of a Facility to ensure that the built facility is constructed and proven to operate satisfactorily under all weather, environmental and occupancy conditions to meet operational and user requirements.
  - .2        Commissioning activities during the Construction stage incorporates a third party verification process and a transfer of critical operational knowledge to Facility personnel.

**1.4                COMMISSIONING OBJECTIVES**

- .1        A Commissioning Plan has been prepared by the Design Engineer, on behalf of DEPARTMENTAL REPRESENTATIVE, which identifies, among other issues, specific commissioning activities to be carried out by the commissioning team during the Construction and Occupancy Stages of the project.

- .2 The commissioning activities have the following objectives:
  - .1 Collect data on equipment and systems being supplied and document their installation;
  - .2 Conduct checks and tests on fully installed building components, equipment, systems and integrated systems to:
    - .1 Verify whether they operate in accordance with requirements of Contract Documents;
    - .2 Verify performance against design criteria and user requirements and measure peak capacities;
  - .3 Prepare a Building Management Manual (BMM) which contains operations and maintenance data, as-built record documents, commissioning reports, training data and other critical information for future use by Facility operational staff;
  - .4 Ensure transfer of knowledge on the operations, maintenance and management of the Facility to Tenant and Operational personnel by means of appropriate training.
- .3 Work to achieve the above objectives requires a collaborative effort from all members of the commissioning team.
  - .1 Contractor's commissioning activities and responsibilities are described in Clause 1.8 below.
- .4 Commissioning activities performed by the Commissioning Agent and the Design Engineer does not replace checks, tests, adjustments, balancing and other performance verification procedures to be carried out by the Contractor as an integral part of performing the Work of this contract as specified in other sections of the Specifications.

## **1.5 SYSTEMS TO BE COMMISSIONED**

- .1 The following systems and controls, complete with associated equipment and components, will be commissioned by the Commissioning Agent and requires related commissioning activities to be performed by Contractor as specified herein and in section(s):
  - .1 Specification Section 23 21 23 – Hydronic Pumps.
  - .2 Specification Section 23 52 00 – Heating Boilers.
  - .3 Specification Section 25 01 11 – EMCS: Start-up, Verification and Commissioning.

## **1.6 DEFINITIONS**

- .1 For the purpose of this contract, the various terms listed below, as they relate directly or indirectly to the commissioning process, shall be deemed to have the following meaning.
- .2 Commissioning Process: a planned program of tasks, activities and procedures carried out systematically during the Construction and Occupancy Stages in accordance with the commissioning objectives, specified in clause 1.4.2 above, to:
  - .1 Verify whether the fully installed equipment, systems and integrated systems operate in accordance with contract documents and Basis of Design (BOD);

- .2 Ensure that appropriate documentation is compiled to effectively train O& M staff and prepare a comprehensive Owner's Operation and Maintenance Manual (O&M).
- .3 Commission (i.e.: to commission a building component or system): tests and checks conducted by Commissioning Agent on all systems and integrated systems of Facility; carried out only after they are fully installed, functional and Contractor's Performance Verification responsibilities have been completed and approved.
  - .1 Contractor provides assistance during this process by operating equipment and systems, by troubleshooting and making adjustments as may be required.
  - .2 Systems are run under their full operation and under various modes to determine if they function correctly, consistently, at peak efficiency and interactively with each other as intended in accordance with Contract Documents and design criteria.
  - .3 During these checks, adjustments may be made enhancing performance to meet environmental or user requirements.
- .4 Commissioning Agent: a specifically appointed person, representing the Departmental Representative, responsible for the development of a Commissioning Plan and managing its implementation by overseeing and coordinating various activities and responsibilities to be performed by members of the Commissioning Team.
  - .1 In this project, an independent Commissioning Agent will be engaged by PSPC outside of this contract.
  - .2 Commissioning Agent plays a lead role in support to the Departmental Representative to ensure that the commissioning objectives are achieved.
- .5 Commissioning Manager: a PSPC departmental employee providing advice and guidance on commissioning requirements to the Commissioning Agent in support to the Departmental Representative.
- .6 Commissioning Plan: the document which describes the organization, scheduling, allocation of resources, required documentation, target dates, and team roles and responsibilities for verification that the built works meet Contract Document and design criteria requirements.
- .7 Contractor: means the General Contractor, however it also refers to any personnel from Subcontractors, including the controls and TAB specialists, suppliers and manufacturer's technical persons which Contractor employs to carry out his/her designated commissioning duties and activities.
- .8 Design Engineer: persons from the mechanical and electrical design disciplines of the engineering firm(s) which have been engaged by the Departmental Representative to prepare the final design and produce the contract documents. Design Engineer also has specifically identified commissioning activities for this project.

- .9 Basis of Design: All those factors included in the design of a Facility prescribed by the Owner's Project Requirements or as determined by Designer as necessary in order to meet all functional and user operational requirements
  
- .10 Pre-Functional/Start-up Verification: A written compilation of checks and inspections to be performed by Contractor during the pre-functional and start-up of a particular equipment or system component.
  - .1 Checklist sheets are produced which include the following data:
    - .1 Product manufacturer's installation instructions and recommended checks and;
    - .2 Special procedures as specified in relevant sections of Specifications;
    - .3 Other items considered good installation and engineering industry practices deemed appropriate for proper and efficient operation.
  - .2 Standard Installation/Start-Up Checklist sheets prepared by equipment manufacturer are acceptable for use. However, supplement with additional data representative of specific project conditions as deemed required by Commissioning Agent.
  - .3 Use Checklist sheets for all equipment installation. Document in writing on checklist the various checks made, deficiencies noted and corrective action taken.
  - .4 Installer to sign Checklist sheets upon completion, certifying that stated checks and inspections have been performed.
  - .5 Use of Installation/Start-Up Checklists shall not be considered part of the commissioning process but shall be stringently used for all equipment pre-start and start-up procedures.
  - .6 Return completed Installation/Start-Up Checklist sheets after use to Commissioning Agent for retention. Checklists are required by Commissioning Agent when Facility is commissioned and will be included in the O&M manual at completion of project.
  
- .11 Functional Performance Testing (FPT): Running dynamic tests and adjustments carried out by Contractor on equipment and systems, upon their installation, to ensure they operate correctly, efficiently and function independently and interactively with other systems as intended in accordance with contract documents and manufacturer's recommendations.
  - .1 Functional Performance Testing (FPT) shall not be considered part of the commissioning process. It is however considered an essential and integral part of Contractor's responsibilities in the equipment installation process which must be stringently conducted, successfully completed and approved by Departmental Representative before a piece of equipment or system is considered fully installed and functional.
  - .2 Facility components and systems will not be commissioned by Commissioning Agent until Functional Performance Testing (FPT) has been completed and approved.
  
- .12 Functional Performance Test Forms (FPTF): forms developed by Commissioning Agent for Contractor's use to record measured data and readings taken during functional testing and Performance Verification procedures.

- .13 Product Information (PI Data): a compilation of data gathered on a particular piece of equipment, typically produced by manufacturer, which includes nameplate information, installation/startup instructions, parts list, operating instructions, maintenance guidelines and other pertinent technical data and recommended checks that is necessary to prepare for start-up and functional testing and used during operation and maintenance of such equipment. This documentation is included in the O&M Manual at completion of work.

## **1.7 COMMISSIONING TEAM**

- .1 A commissioning team will be assembled to carryout various functions needed to effectively commission the Facility. Contractor shall be part of this team with duties and responsibilities as specified in this section and in other sections of the Specifications.
- .2 Members of the Commissioning Team are as follows:
  - .1 Commissioning Agent.
  - .2 Design Engineer.
  - .3 Contractor.
  - .4 Departmental Representative (PSPC Project Manager).
  - .5 PSPC Cx Manager.
  - .6 PSPC departmental personnel providing advice and project quality control to Departmental representative when required.
  - .7 Facility's operation and maintenance personnel staff as identified by Departmental Representative.
- .3 Effective commissioning requires coordination between members of the commissioning team. Cooperate with other team members in fulfilling assigned duties and as follows:
  - .1 Communicate commissioning objectives, to subcontractors, suppliers and manufacturers.
  - .2 Coordinate activities between subcontractors and trades as needed to carryout Contractor's assigned commissioning activities.
  - .3 Ensure attendance of subcontractors and required specialist at commissioning meetings and during the commissioning process.

## **1.8 CONTRACTOR'S COMMISSIONING ACTIVITIES**

- .1 General:
  - .1 Organize and arrange for the services of subcontractors, their specialists and manufacturer's technical representatives to perform Contractor's commissioning activities.
  - .2 Ensure that personnel forming part of the Commissioning Team are qualified and knowledgeable of installed equipment and systems and with design intent.
  - .3 Develop in conjunction with the Commissioning Agent a commissioning schedule as specified in clause 1.11.
  - .4 Notify Departmental Representative in writing when Facility is ready for be commissioned. Give 14 calendar day notice.
  - .5 Commissioning will only commence once that full documentation has been received and installed equipment and systems have undergone successful performance verification.

- .6 Note that Certificate of Substantial Performance will only be issued when:
  - .1 All commissioning documentation has been received and found suitable by Departmental Representative;
  - .2 Designated equipment and systems have been commissioned and;
  - .3 Training has been completed.
- .7 Performance faults:
  - .1 Equipment and systems found not operating correctly or not performing as intended during commissioning shall be re-verified by checking 100% of all equipment and components of the un-functional system, including related controls as required to rectify the deficiencies and ensure correct performance.
  - .2 Costs to conduct additional tests and inspections, as deemed required by Departmental Representative, to determine acceptability and proper performance of such item to be paid for by Contractor.
- .2 Prior to Facility being commissioned:
  - .1 Submit commissioning documentation as specified in clause 1.13 below.
  - .2 Submit the Pre-Functional/Start-up sheets to Commissioning Agent for review prior to conducting the pre-start and start-up of any piece of equipment. Incorporate additional start-up instructions onto checklist as determined by the Commissioning Agent's review.
  - .3 Conduct the pre-start and start-up of all equipment by following and filling out the approved Pre-Functional/Start-up.
  - .4 Conduct Functional Performance Testing, on all installed equipment and systems. Use and fill out the FPT Report Sheets provided.
  - .5 Upon completion of Pre-Functional and Functional Performance Testing process, submit signed copy of Checklist and FPT sheets to Commissioning Agent as affidavit that required checks and tests were successfully conducted.
  - .6 Record performance measurements and data reading on FPT sheets and return to Commissioning Agent for compilation.
  - .7 Give Departmental Representative and Commissioning Agent a minimum of 5 days' notice for start-up and performance verification of equipment and systems which must be witnessed by Commissioning Agent as determined by Commissioning Agent beforehand on FPT sheets.
  - .8 Provide missing information and data as identified by Commissioning Agent and Departmental Representative during documentation review.
  - .9 Submit above noted documentation before Commissioning will proceed.
  - .10 Address deficiencies in Work identified during FPT of equipment and systems. Conduct additional FPT thereafter.
  - .11 Arrange for special tools and devices, identified at commissioning meeting(s), as deemed required to assist with commissioning.
  - .12 Provide access ladders, two way radios and other equipment required by Team when facility will be commissioned.
- .3 When Facility is being commissioned:
  - .1 Provide qualified tradespersons to be present at site to assist Commissioning Agent for the time period and commissioning activity specified.

- .2 Assist in commissioning mechanical and electrical systems specified and as follows:
    - .1 Operate designated building component, mechanical/electrical equipment and system under all modes of operation and conduct checks and tests as directed by Commissioning Agent.
    - .2 Check and verify that building component, equipment, systems and integrated systems, including their controls, are functioning and responding correctly and interactively with each other.
    - .3 Test systems independently and then in unison with other related systems.
    - .4 Conduct all Commissioning checks and tests in presence of and witnessed by Commissioning Agent and Departmental Representative.
    - .5 Assist Design Engineer and other members of the commissioning team who will also be present to commission Facility.
  - .3 Specific procedures used to commission Facility will be provided by Commissioning Agent which includes:
    - .1 Sequential order of building component and system to be tested.
    - .2 Running systems under various anticipated modes and demands (example: high and low cooling or heating loads, duplicating outside temperature conditions, fire alarm and power failure conditions etc.).
    - .3 Running building controls through all sequences of operation to verify and confirm that equipment and systems are responding as designed and intended.
    - .4 Operating designated equipment at peak capacities, recording output data against design criteria.
  - .4 Run component or systems as long as necessary to effectively commission all items as deemed required by Commissioning Agent and Departmental Representative.
  - .5 Monitor equipment and system responses.
  - .6 Record test results, measurements and other data on commissioning forms provided by Commissioning Agent.
  - .7 Assist in analyzing results. Identify system deficiencies and components not responding as intended.
  - .8 Correct deficiencies and system non-conformance issues. Adjust, calibrate or fine tune system components as required. Debug system software as may be required.
  - .9 Retest systems when directed to confirm compliance.
- .4 Upon completion of Facility Commissioning:
    - .1 Provide training to maintenance & operational personnel as specified in clause 1.12 below.
    - .2 Turn over any filled-in checks sheets or reports resulting from commissioning.

## **1.9 COMMISSIONING ACTIVITIES OF OTHER TEAM MEMBERS**

- .1 Commissioning Agent:
  - .1 Represents the Departmental Representative during the commissioning process.
  - .2 Coordinates activities of the commissioning team members to ensure that commissioning activities are carried out properly and in a timely manner.

- .3 Prepares commissioning schedule in concert with Contractor.
- .4 Chairs commissioning meetings.
- .5 Works with Contractor, subcontractors, equipment suppliers, Design Departmental Representative resources, DEPARTMENTAL REPRESENTATIVE and Tenant Representatives to resolve technical problems which may arise during the process.
- .6 Witnesses Contractor's Pre-Functional/Start-up and Functional Performance Testing procedures for certain equipment and systems specified when deemed required due to their critical nature and function in the Facility.
- .7 Verifies that Static, Start-up and Functional Forms are used and stringently followed by Contractor.
- .8 Assists Contractor in coordination of training activities for facility staff.
- .9 Submits final commissioning report to Departmental Representative.
- .2 Design Engineer:
  - .1 Prepares in concert with Commissioning Agent the Commissioning Plan.
  - .2 Reviews Contractor's Static, Start-up and Functional Forms for completeness, incorporating supplement data not addressed on Forms. Provides to Contractor Forms for products which manufacturer does not provide installation and start-up instructions.
  - .3 Develops Functional Performance Test Forms for use by Contractor to record actual data and measurements against design data criteria.
  - .4 Includes, on Functional Performance Test Forms, design data and anticipated performance values for equipment and systems to undergo verification.
  - .5 Compiles commissioning documentation submitted by Contractor. Prepares final O&M Manuals.
  - .6 Assists Commissioning Agent in witnessing Functional Performance Testing.
  - .7 Approves type and method of calibration for instruments used by Contractor to conduct Functional Performance Testing tests.
  - .8 Assists Commissioning Agent in reviewing and analyzing tests results.
  - .9 Participate in the training sessions provided by Contractor to tenant O&M staff by giving introductory information on design philosophy, design intent and systems designs,
  - .10 Assist in the resolution of issues relating to commissioning.
- .3 Departmental Representative:
  - .1 Participates with other team members to ensure that systems as installed meet the operational and functional requirements.
  - .2 Periodically attends commissioning meetings as required.
  - .3 Attends final commissioning activities.
  - .4 Assists in resolving technical problems by providing additional details on operational requirements.
- .4 Facility Operations and Maintenance Staff:
  - .1 Participates in the commissioning process to obtain early introduction to the facility systems and to provide early operator feedback.

- .2 Prime interest is in the familiarization and training of appropriate maintenance staff.
- .3 Staff may attend certain critical equipment start-up and functional performance verification activities and provide comments and practical suggestions on issues which may arise during actual operation, maintenance and repair of the equipment and systems.
- .4 Attends commissioning meetings periodically, depending on issues being discussed.
- .5 Identifies the appropriate staff which must receive the O&M training.

### **1.10 COMMISSIONING MEETINGS**

- .1 General briefing on commissioning will be conducted at first project construction meeting at commencement of work.
  - .1 Issues discussed will include scope and extent of commissioning and clarify responsibilities of commissioning team members.
  - .2 All team members must attend, including subcontractors of equipment and systems to be commissioned.
- .2 Include commissioning as one agenda item at each construction meeting held and chaired by Contractor during construction. Give subject due consideration for each material and equipment supplied and for all matters of Work.
- .3 At the 60% construction completion stage, as determined by Departmental Representative, a separate commissioning scope meeting will be called by Departmental Representative to review progress of work, discuss schedule of equipment start-up activities and prepare for upcoming commissioning. Issues at meeting will include:
  - .1 Review duties and responsibilities of Contractor and subcontractors, addressing delays and potential problems.
  - .2 Determine the degree of involvement of each trade and manufacturer's representatives in the commissioning process.
- .4 Separate commissioning meetings will be held from the 60% construction stage to project completion. Meetings are tentatively scheduled to be held on a bi-monthly basis but may be more frequent during the equipment start-up and functional testing period.
- .5 Whenever possible meetings will be held immediately following the construction meetings.
- .6 Meeting will be chaired by Contractor who will record and distribute minutes.
- .7 Ensure that all subcontractors and relevant manufacturer representatives are present at the 60% commissioning scope meeting and at other meetings as deemed required.

### **1.11 COMMISSIONING SCHEDULE**

- .1 Address commissioning activities within the construction work schedule. Clearly identify allocated time period for commissioning and training activities.

- .2 Provide a separate independent commissioning schedule at the 60% construction stage in order that specific issues and individual details of commissioning can be reviewed, discussed and dealt with from that period onward to project completion. Submit monthly updates thereafter,
- .3 Develop commissioning schedule in conjunction with Commissioning Agent. Indicate allocated time period and anticipated dates for:
  - .1 Submission of commissioning documentation, including O&M Manuals.
  - .2 Equipment and system start-up and performance verification, making them ready to be commissioned.
  - .3 Allocated period to commission designated building components and systems.
  - .4 Training period.
  - .5 Work during Warranty period.
- .4 Submit schedule to Departmental Representative for review.

## **1.12 TRAINING**

- .1 Commence process of familiarizing Tenant and O&M personnel in the early stages of work on purpose and operation of various equipment and systems. Continue process throughout the entire construction duration.
  - .1 Provide informal briefings during occasional site visits, at planned commissioning meetings and during the final commissioning site activities.
- .2 Conduct formal demonstration and training sessions, only after all identified systems have been commissioned by Commissioning Agent and Departmental Representative has given approval to proceed with the training process.
- .3 Carryout training in accordance with requirements of section 01 79 00.
- .4 Submit written agenda of training session(s) 4 weeks beforehand for review by Commissioning Agent and Departmental Representative.
- .5 Coordinate content with Commissioning Agent. Design Engineer will provide introductory presentation giving general outline of each system design and intended function.
- .6 Submit training manuals for review 2 weeks prior to actual training.
- .7 Ensure required tools and O&M Manuals are on site for training and system demonstration.
- .8 As a minimum, the training sessions to cover the following information:
  - .1 Introduction.
  - .2 Description of the system with factory personnel being involved at appropriate times.
  - .3 Instructions on start-up procedures including seasonal procedures, system check-lists and emergency procedures.

- .4 Operational procedures, including occupancy considerations, seasonal change-over, manual and automatic operations and emergency modes.
  - .5 Instruction on system shutdowns, including checklists.
  - .6 Instructions on all aspects of system maintenance, including routine servicing, lubrication, overhaul and factory servicing.
  - .7 Information concerning the scope of warranties and their use.
  - .8 A description of spare parts in stock and their service.
  - .9 A description of normal tools required for servicing the systems/equipment.
- .10 Submit typewritten record of training sessions given and list of attendees. Use forms of format approved by Departmental Representative.

### **1.13 COMMISSIONING DOCUMENTATION**

- .1 Submit the following documentation for use during commissioning and for incorporation thereafter into a Commissioning Manual:
- .1 Operations and Maintenance Manuals, Project Record Documents and other data as specified in Section 01 78 00. Data to include:
    - .1 Equipment Product Information (PI Data) complete with:
      - .1 Nameplate info.
      - .2 Installation instructions.
      - .3 Operating procedures and
      - .4 Maintenance guidelines.
    - .2 Reviewed shop drawings.
    - .3 As-built record drawings and Specifications.
  - .2 Completed Static Verification and Start-up Forms sheets used.
  - .3 Functional Performance Verifications checks and tests procedures and completed forms used.
  - .4 Copy of any Static and Functional Test and Reports conducted.
  - .5 TAB report and other reports as specified in various trade sections.
- .2 Above documentation is required by Commissioning Agent to commission Facility. Submit data minimum 3 weeks before commencement of commissioning.
- .3 Documentation to include detailed information and number of copies as specified for maintenance manuals of section 01 78 00.
- .4 Commissioning Agent and Design Engineer will compile above documentation and produce a Commissioning Report for operation/maintenance staff and tenant use.

END OF SECTION