

SECTION 01 91 00 COMMISSIONING

PART 1 - GENERAL

1.1 SUMMARY

- A. Perform and document commissioning. This Section supplements but does not supersede specific testing requirements found elsewhere in the Contract Documents. The equipment and systems included in the commissioning work scope are described in detail in tables included in the following specification sections:

1. Section XX XX XX Commissioning of Building Envelope
2. Section XX XX XX Commissioning of Equipment
3. Section 22 08 00 Commissioning of Plumbing
4. Section 23 08 00 Commissioning of HVAC
5. Section 25 08 00 Commissioning of DDC/EMS System
6. Section 26 08 00 Commissioning of Electrical Systems
7. Section 28 08 00 Commissioning of Electronic Safety and Security
8. Section 33 08 00 Commissioning of Utilities

B. General Responsibilities

1. Provide all materials, labor and documentation to execute the commissioning activities as described in the Contract Documents.
2. Provide a Quality Assurance Manager.
3. Coordinate the commissioning work and ensure that commissioning responsibilities of all trades are executed according to the Contract Documents.
4. Include commissioning activities in the contract schedule.
5. Attend commissioning meetings.

1.2 RELATED WORK AND DOCUMENTS

- A. Section 01 33 23 - Shop Drawings, Product Data and Samples
- B. Section 01 79 00 - Demonstration and Training
- C. Division XX Title
- D. Division XX Title
- E. Division 22 Plumbing
- F. Division 23 Heating, Ventilating, and Air Conditioning (HVAC)
- G. Division 25 Integrated Automation
- H. Division 26 Electrical
- I. Division 28 Electronic Safety and Security
- J. Division 33 Utilities

1.3 ABBREVIATIONS & DEFINITIONS

- A. ASHRAE: American Society of Heating, Refrigerating, and Air Conditioning Engineers.
- B. Commissioning (Cx): The process of verifying and documenting that all equipment and systems are correctly installed and perform interactively according to the requirements of the Contract Documents.
- C. Commissioning Team: The group of individuals who collaborate to ensure the facility is commissioned including Contractor and University's Representative.
- D. Commissioning Plan: The plan that outlines the process, procedures, deliverables, and specific goals of commissioning. It also defines the roles of the parties participating in commissioning the project during construction.
- E. Cx Action Item: An issue identified during the verification process that must be resolved prior to acceptance of completed Installation/Start-up Verification (ISV) and Functional Performance Test (FPT) checklists.

- F. Deficiency: A condition in installation, operation or performance of equipment and systems that is not in conformance with the Contract Documents.
 - G. Equipment Functional Performance Tests (EFPT): Tests designed to demonstrate that the operation of equipment and system components meet design intent and project requirements under operating conditions. These tests are documented on the FPT Checklist. These tests may be performed by testing agencies described in the Contract Documents.
 - H. Functional Performance Test (FPT) Checklist: The checklist used to document the successful operation and performance of equipment and systems. This checklist includes the Equipment Functional Performance Tests, the Operational Tests and the System Functional Performance Tests.
 - I. Installation/Start-up Verification (ISV) Checklist: The checklist used to document the successful installation and start-up of equipment. This checklist includes requirements for verifying the proper installation and start-up of equipment and systems and preparations required for continuous operation.
 - J. Operational Test (OT): Tests designed to validate satisfactory system performance over a period of time under normal operating conditions, satisfactory recovery of systems from failure conditions (such as a power outage), and the correct response of systems to emergency conditions (such as encountered during Fire Alarm conditions). In general, the operational tests consist largely of trend data collected prior to the System Functional Performance Tests (SFPT). This data is an historical record of the system operational performance. These tests are documented on the FPT Checklist.
 - K. Quality Assurance Manager (QAM): Person employed by the Contractor to manage, coordinate, and supervise the installation, start-up and testing of systems and equipment, the Contractor's quality assurance program, and the commissioning process of the project. The QAM qualifications and responsibilities are described in this section.
 - L. Sequence of Operations (SOO): Narrative describing the modes of operation and control sequences for equipment and systems.
 - M. Start-up Test: The process whereby the Contractor executes the equipment manufacturer recommended start-up and check out procedures, completes the start-up checklists, energizes the device or equipment, and documents it is in proper working order.
 - N. System: A system includes all items of equipment, devices and appurtenances connected in such a manner that their operation or function complements, protects or controls the operation or function of the others.
 - O. System Functional Performance Tests (SFPT): Tests designed to demonstrate the satisfactory operation of equipment as a complete system under operating conditions. This shall include a detailed verification of the Sequence of Operations. Testing of some systems may require the proper functioning of other systems (i.e., the testing of proper performance of air handlers shall require the proper operation of chilled water and hot water systems, and thus these water systems must be tested before the air handlers, and they must be in satisfactory operation during the air handler testing. These tests are documented on the FPT Checklist.
 - P. TAB: Testing, Adjusting, and Balancing.
 - Q. Trending: Monitoring and recording the history of performance and parameters using the Emergency Management System (EMS) or devices like data loggers. Trending is used to prove successful operation of systems over a period of time, and is a prerequisite for a system's Functional Performance Test.
- 1.4 COORDINATION
- A. Commissioning Meetings
 - 1. Cx Kickoff Meeting

- a. The QAM shall schedule, plan and conduct a commissioning kickoff meeting with the entire commissioning team in attendance within [60] days of the commencement of construction.
 - b. The objectives of the meeting are to review the commissioning work scope, to clarify team member roles and responsibilities, and to plan the commissioning activities for the entire duration of the project.
 - c. The QAM shall prepare and distribute meeting minutes to all participants.
2. Scheduled Cx Coordination Meetings
- a. The QAM shall plan and conduct regular Cx coordination meetings as construction progresses.
 - b. These meetings shall be included in the project schedule and shall occur at the following intervals:
 - 1) [Every 60 days] between the initial kickoff meeting and the beginning of the ISV portion of the work;
 - 2) [Every 14 days] during the ISV portion of the work;
 - 3) [Every 7 days] during the FPT portion of the work.
 - c. The objective of these meetings is to facilitate coordination of the work of all trades and resolve deficiencies.

1.5 SUBMITTALS

- A. Documentation supporting QAM qualifications as required in the Quality Assurance article.
- B. Installation/Start-up Verification (ISV) Checklists
 1. Specific ISV checklists have been included in the sections listed in the Summary article.
 2. Customize and submit ISV checklists for review and acceptance prior to beginning of installation verification and start-up. Manufacturer's installation and start-up instructions shall be included with each ISV checklist. Customized ISV Checklists that incorporate all University review comments shall be submitted by Contractor [60] days prior to the beginning of equipment startup.
 3. If the project includes equipment for which checklists have not been included in the Specifications, Contractor shall develop these checklists using the supplied checklists as models of scope and detail. The sections listed in the Summary article indicate which checklists shall be developed by the Contractor.
- C. Functional Performance Test Checklists
 1. Specific FPT checklists have been included in the sections listed in the Summary article.
 2. Functional Performance Test (FPT) Checklists include Equipment Functional Performance Tests (EFPT), Operational Tests (OT) and System Functional Performance Tests (SFPT).
 3. The Contractor shall customize and submit FPT checklists for review and acceptance prior to beginning of tests. The customizing work shall address characteristics and requirements of equipment actually provided. Contractor shall require all subcontractors and vendors to review FPT procedures to ensure feasibility, safety and equipment protection. Provide necessary alarm limits to be used during the tests. Damage caused to equipment during tests performed in accordance with the approved procedures shall be the responsibility of the Contractor. Customized FPT Checklists that incorporate all University review comments shall be submitted by the Contractor [60] days prior to the beginning of equipment startup.
 4. If the project includes equipment for which checklists have not been included in the specifications, Contractor shall develop these checklists using the supplied checklists as models of scope and detail.
- D. Commissioning Schedule
 1. Submit a schedule for commissioning activities and provide specific information on the date and duration of individual tests. Any temporary systems or installations that are required to allow start-up and testing shall also be included in the schedule.

E. Final Commissioning Binders and CD

1. Submit the Final Commissioning Binders in paper format (1 original with wet signatures) and in electronic PDF format scanned from signed originals (1 CD). These binders shall contain completed and signed-off ISV and FPT checklists documenting the successful installation, start-up, and functional performance of all systems and equipment.
2. Completed and signed off ISV and FPT checklists for all systems and equipment shall be accepted by the University's Representative as a condition for Substantial Completion.

1.6 QUALITY ASSURANCE

A. Quality Assurance Manager (QAM)

1. Employ a competent QAM satisfactory to the University who shall be in attendance at the Project site for all commissioning activities.
2. The QAM shall be a representative of the Contractor and shall be a different individual than the Superintendent [or the Project Manager]. All communication between the QAM and the University shall be binding to the Contractor.
3. The QAM shall have at least 5 years experience, or experience on at least 5 separate similar projects, in performing the roles described in this section. The Contractor shall submit to the University the QAM qualifications for review and approval prior to commencement of the Work.
4. The QAM shall manage, coordinate and supervise the Contractor's Quality Assurance Program and the Commissioning activities including the following:
 - a. Coordinate construction activities.
 - b. Coordinate submittals, Requests for Information, Coordination Drawings and O&M documentation to the University.
 - c. Coordinate and supervise the installation, start-up and testing of equipment and systems.
 - d. Coordinate inspections and testing activities with University's Representative.
 - e. Supervise the commissioning process and coordinate commissioning activities of all trades and the University's Representative. Require each trade to assign a Cx Coordinator authorized as a representative of that trade in commissioning activities. The Cx Coordinators shall have expertise and experience in systems commissioning and shall participate in and perform commissioning team activities. Manage the Cx Coordinators and their Cx activities.
 - f. Assemble the Commissioning Binders.
 - g. Signoff commissioning checklists.
 - h. Develop the orientation and training plan.
 - i. Coordinate orientation and training of University's operating personnel.
 - j. Attend and conduct Cx coordination meetings and coordinate attendance of trade Cx Coordinators as applicable.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 QUALITY CONTROL

- A. All ISV and FPT testing shall be witnessed by the University's Representative. Notify the University's Representative of testing schedule 48 hours in advance.
- B. All testing procedures for electrical systems shall comply with the requirements of the latest version of Acceptance Testing Specification by the National Electrical Testing Association, Inc. (NETA). Include NETA requirements in the checklist.
- C. Independent Testing Agencies: For systems where testing by independent agencies is specified, the Contractor shall notify the University's Representative when the testing activities are scheduled. Aspects of EFPT and SFPT accomplished during the independent agency testing may be accepted if they meet the intent of the EFPT and SFPT as determined by the University's Representative. The Contractor shall submit the independent testing agency reports prior to the commencement of EFPT and SFPT for acceptance.

3.2 COMMISSIONING BINDERS

- A. The commissioning documents shall be organized in three volumes (binders) which shall be maintained on the project site at all times.
 - 1. The first volume shall contain the Commissioning Plan which shall consist of:
 - a. Commissioning Report (provided by the Commissioning Agent when commissioning is completed)
 - b. Commissioning Issues Log (provided by the University and updated by the Contractor)
 - c. Installation/Start-up Verification Checklist and Functional Performance Checklist Summary (provided by the University and customized by the Contractor)
 - d. Commissioning Meeting Minutes
 - e. Commissioning Schedule (provided by the Contractor)
 - f. Construction Commissioning Plan Narrative (provided by the University)
 - g. Training Plan Summary (provided by the Contractor)
 - h. Reference Information (provided by the University)
 - 1) University's Project Requirements
 - 2) Basis of design Narratives for systems to be commissioned
 - 3) Commissioning Specifications
 - 2. The second volume shall contain project specific ISV checklists.
 - 3. The third volume shall contain project specific FPT checklists.
 - 4. The second and third volumes shall contain all wet-signature certifications completed as part of the commissioning process.

3.3 SYSTEM INSTALLATION

- A. Document the successful installation of systems and equipment using the ISV Checklists. Completion and sign-off of ISV Checklists are a prerequisite to beginning the FPTs.

3.4 SYSTEM START UP

- A. Document the successful start-up of systems and equipment using the ISV checklists.
- B. Factory Start Ups: Contractor shall notify the University's Representative 48 hours in advance of scheduled factory start-ups. Aspects of EFPT and SFPT accomplished during the factory start-up may be accomplished and accepted if they meet the intent of the EFPT and SFPT as determined by the University's Representative.
- C. Start-up, Testing, Adjusting and Balancing
 - 1. Provide the services of a qualified Factory authorized Service Representative to perform equipment/device start-up. Start-up procedures shall be in accordance with the Contract Documents, manufacturer's requirements, and reference or industry standards.
 - 2. Provide the services of a qualified Factory authorized Service Representative or, where required, a certified Independent Testing Agency to perform system testing and adjustment.

3.5 FUNCTIONAL PERFORMANCE TESTING

- A. Equipment Functional Performance Tests (EFPT)
 - 1. Perform all equipment functional performance testing described in the FPT checklists.
 - 2. Document the successful operation and performance of equipment using the FPT checklists.
- B. Operational Tests (OT)
 - 1. Once EFPTs are completed, each system shall be set up to perform per contract requirements. A preliminary TAB report shall be submitted and approved prior to executing the OTs.
 - 2. Final sequences of operation and testing procedures shall be developed and submitted as attachments to the FPT Checklists.
 - 3. OT data shall be generated prior to the System Functional Performance Tests (SFPT). As part of the Operational Testing, all dynamic systems powered by electricity shall be tested to

simulate a power outage. Those systems on emergency power shall be tested on all sources. Recovery from power outage conditions shall also be observed for proper return to regular system operation.

4. All adjusted, balanced, and controlled systems shall be assessed to determine the optimal setting for the system as applicable. The optimal settings shall be determined to establish reliable, efficient, safe and stable operation. Electrical settings shall conform to Power System Study Mechanical systems shall be balanced by the TAB to meet Contract Document requirements.

C. System Functional Performance Tests (SFPT)

1. Perform all system functional performance testing described in the FPT checklists.
2. Document the successful operation and performance of systems using the FPT checklists.

D. Test Equipment

1. Have on site the following equipment in support of commissioning activities:
 - a. Standard testing equipment required to perform startup and initial checkout and functional performance testing.
 - b. Data logging equipment to trend the operation of standalone equipment which is not connected to an Energy Management and Control System.
 - c. Two-way radios for the duration of the FPT testing.
2. Calibration
 - a. All testing equipment shall be of sufficient quality and accuracy to test and measure system performance within the tolerances specified. All equipment used for testing and calibration shall be National Institute of Standards and Technology/National Bureau of Standards (NIST/NBS) traceable and calibrated within the current 12 month period. Calibration tags shall be affixed or certificates readily available. If not otherwise noted, the following minimum requirements apply:
 - 1) Temperature sensors and digital thermometers shall be calibrated in accordance with ANSI/ASME B40.1, shall have a certified calibration to an accuracy of 0.5 degree Fahrenheit and a resolution of + or - 0.1 degrees Fahrenheit.
 - 2) Pressure sensors shall be calibrated in accordance with ANSI/ASME B40.1, and shall have an accuracy of + or - 2.0 percent of the value range being measured (not full range of meter).

E. Calibration of Installed Sensing Equipment

1. All meters, thermometers, and sensing instruments provided as part of the Project shall have documented calibration using appropriate test equipment or factory calibration certificates. The factory calibration sheet shall identify the device serial number on the certification.
2. Certificates of calibration shall be included with the FPT Checklists.

3.6 SEASONAL / DEFERRED TESTING

- A. Provide an allowance for 16 hours of QAM's time [and 16 hours of Control Technician's time] to assist the University's Representative with seasonal or deferred functional performance testing during the warranty period.

END OF SECTION 01 91 00