

SECTION 019100
COMMISSIONING REQUIREMENTS

PART 1 – GENERAL

1.1 STIPULATIONS

- A. The Specifications Sections "General Conditions of Contract", "Special Conditions" and "Division 1 – General Requirements" form a part of this Section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

- A. Commissioning is a systematic process of ensuring that all building systems perform interactively according to the Using Agency's project requirements and operational needs. The commissioning process shall encompass and coordinate the traditionally separate functions of system documentation, equipment startup, control system calibration, testing and balancing, performance testing and training.
- B. Commissioning during the construction phase is intended to achieve the following specific objectives according to the Contract Documents:
 - 1. Verify that applicable equipment and systems are installed according to the manufacturer's recommendations and to industry accepted minimum standards and that they receive adequate operational checkout by installing contractors.
 - 2. Verify and document proper performance of equipment and systems.
- C. The commissioning process does not take away from or reduce the responsibility of the installing contractors to provide a finished and fully functioning product.

1.3 REFERENCES, RESOURCES

- A. ASHRAE Guideline 0-2005: The Commissioning Process, ASHRAE, 2005
- B. ASHRAE Guideline 1.1-2007: HVAC&R Technical Requirements for the Commissioning Process, ASHRAE, 2007
- C. ASHRAE Guideline 4-1993: Preparation of Operations & Maintenance Documentation for Building Systems, ASHRAE, 1993

1.4 DEFINITIONS

- A. Use of terms and abbreviations referring to the Controls Subcontractor (CC) and the Testing and Balancing (TAB) Contractor shall be understood to mean the Subcontractors to the HVAC Contractor for these specific portions of the Work.

1.5 COORDINATION

- A. Commissioning Team. The members of the commissioning team consist of the Commissioning Authority (CxA), the DGS Representative (DGS), the Using Agency representative (UA), the General Contractor (0.1 Contractor), the Professional, the HVAC Contractor (0.2 Contractor), the Electrical Contractor (0.4 Contractor), the Test and Balance Contractor (TAB) representative, the Controls Subcontractor (CC), any other installing subcontractors or suppliers of equipment. The Using Agency's facilities staff is also a member of the commissioning team.
- B. Management. The CxA for this Project has been hired by the Department. The CxA directs and coordinates the commissioning activities and reports to the Department and the Professional.
- C. Scheduling. The CxA will provide the initial schedule of primary commissioning events using the information gathered from the commissioning scoping meeting. The Commissioning Plan provides a format for this schedule. The timeline is fine-tuned as construction progresses. In particular, 30 days prior to startup of the primary HVAC equipment, the CxA meets with the DGS, UA and Contractors and develops a detailed commissioning schedule. The CxA will approve the commissioning schedule.
 - 1. General Contractor shall coordinate requirements of Construction Scheduling with this work.

1.6 COMMISSIONING PROCESS

- A. Commissioning Process. The following narrative provides a brief overview of the typical commissioning tasks during construction and the general order in which they occur.
 - 1. Commissioning during construction begins with an initial commissioning meeting conducted by the CxA where the commissioning process is reviewed with the commissioning team members.
 - 2. Additional meetings will be required throughout construction, scheduled by the CxA with necessary parties attending, to plan, scope, coordinate, schedule future activities and resolve problems.
 - 3. Equipment documentation is submitted to the CxA, electronically through E-Builder, during normal submittals, including detailed start-up procedures.
 - 4. The Contractors develop the full start-up plan by combining the manufacturer's detailed start-up and checkout procedures from the O&M manual, the normally used field checkout sheets and Prefunctional checklists provide by the CxA and completed by the Contractor.
 - 5. The Contractors submit all completed startup plan documentation to the CxA for review and approval.
 - 6. The CxA develops and documents functional performance test procedures. The contractor and/or his controls sub-contractor will perform the functional tests per the procedures developed by and provided by the CxA.
 - 7. Items of non-compliance are resolved at commissioning meetings.
 - 8. Items of non-compliance in material, installation or setup are corrected at the Contractor's expense and the system retested.
 - 9. Contractor / manufacturer equipment start-ups, controls installation and

10. programming, and the preliminary TAB report are completed four weeks prior to Substantial Completion. This includes submission of all associated documentation to the CxA, which is required to allow sufficient time for the CxA's Functional Testing. Contingent on these items and weather conditions, functional testing may be completed prior to occupancy.
11. Deferred testing is conducted, as specified or required.

1.7 RESPONSIBILITIES

A. The responsibilities of various parties in the commissioning process are provided in this section. The responsibilities of the HVAC, TAB, and Controls Subcontractors are in Section 230800. The responsibilities of the Electrical Contractor are in Section 260800. It is noted that the services for the DGS Representative, Architect, mechanical and electrical designers/engineers, and Commissioning Authority are not provided for in this contract. That is, the Contractor is not responsible for providing their services. Their responsibilities are listed here to clarify the commissioning process.

B. All Parties

1. Attend the initial commissioning meeting conducted at the start of construction, the commissioning meeting held 30 days prior to startup of the primary equipment, and additional meetings, as necessary.

C. Professional

Construction and Acceptance Phase

1. Perform normal submittal review, construction observation, record drawing preparation, and O&M manual approval in accordance with Division 1, etc., as contracted.
2. Provide any design narrative documentation requested by the CxA.
3. Coordinate resolution of system deficiencies identified during commissioning, according to the contract documents.
4. Prepare and submit final record basis of design documentation for inclusion in the Commissioning Reports.

Warranty Period

5. Coordinate resolution of design non-conformance and design deficiencies identified during warranty-period commissioning.

D. Mechanical and Electrical Designers/Engineers (of the Professional)

Construction and Acceptance Phase

1. Perform normal submittal review, construction observation, record drawing preparation, and O&M manual approval in accordance with Division 1, etc., as contracted.
2. Provide any design narrative and sequences documentation requested by the CxA.
3. Participate in the resolution of system deficiencies identified during commissioning, according to the contract documents.

4. Prepare and submit the final record basis of design and operating parameters documentation for inclusion in the O&M manuals.

Warranty Period

5. Participate in the resolution of non-compliance, non-conformance and design deficiencies identified during commissioning during warranty-period commissioning.

E. Commissioning Authority (CxA)

The CxA is not responsible for design concept, design criteria, compliance with codes, design or general construction scheduling, cost estimating, or construction management. The CxA may assist with problem-solving, non-conformance or deficiencies, but ultimately that responsibility resides with the contractor and the Professional. The primary role of the CxA is to ensure that the Using Agency's project requirements are achieved through the construction and operation of the facility.

Construction and Acceptance Phase

1. Installation Observation: the CxA shall observe installation of each type of commissioned feature and system to ensure that they are properly installed according to the contract documents and manufacturers' instructions and that other building systems or components are not compromising the performance of the feature.
2. Coordinates and directs the commissioning activities in a logical, sequential and efficient manner using consistent protocols and forms, centralized documentation, clear and regular communications and consultations with all necessary parties, frequently updated timelines and schedules and technical expertise.
3. Coordinate the commissioning work and, with the GC and DGS, ensure that commissioning activities are being scheduled into the master schedule.
4. Plan and conduct a commissioning scoping meeting and other commissioning meetings.
5. Request and review additional information required to perform commissioning tasks, including O&M materials, contractor start-up and checkout procedures.
6. Recommend approval of systems startup by reviewing start-up reports and by selected site observation.
7. Create Prefunctional checklists for all HVAC equipment and provide to the Contractor.
8. Oversee sufficient construction and startup (construction checklist) of the control system and review the final point-to-point checkout completed by the Controls Contractor.
9. Develop, execute, and document functional performance test procedures.
10. Maintain a corrective action list and a separate testing record. Provide to the Department written progress reports and test results with recommended actions.
11. Review equipment warranties to ensure that the Department's responsibilities are clearly defined.
12. Provide a final commissioning report. The final commissioning report shall include an executive summary, list of participants and roles, brief building description, overview of commissioning and testing scope and a general description of testing and verification methods. For each piece of commissioned equipment, the report shall contain the disposition of the commissioning authority regarding the adequacy of the equipment, documentation and training meeting the contract documents in the following areas:

- a. Equipment meeting the Using Agency's project requirements
- b. Equipment meeting the equipment specifications
- c. Equipment ensuring proper installation
- d. Functional performance and efficiency
- e. Equipment documentation
- f. All outstanding non-compliance items shall be specifically listed.
- g. Recommendations for improvement to equipment or operations, future actions, commissioning process changes, etc. shall also be listed. Each non-compliance issue shall be referenced to the specific functional test, inspection, trend log, etc. where the deficiency is documented. The functional performance and efficiency section for each piece of equipment shall include a brief description of the verification method used (manual testing, BAS trend logs, data loggers, etc.) and include observations and conclusions from the testing.

Warranty Period

13. Coordinate and supervise required seasonal or deferred testing and deficiency corrections and provide the final testing documentation for the commissioning record and O&M manuals.

F. DGS Representative (DGS)

Construction and Acceptance Phase

1. The Department manages the CxA contract.
2. Arrange for facility operating and maintenance personnel to attend various field commissioning activities and field training sessions according to the Commissioning Plan—Construction Phase.
3. Provide final approval for the completion of the commissioning work.

Warranty Period

4. Ensure that any seasonal or deferred testing and any deficiency issues are addressed.

1.8 SYSTEMS TO BE COMMISSIONED

- A. The systems that shall be commissioned in this project include but are not limited to the following:
 1. Boilers and ancillary equipment (i.e. deaerator, pumps, feed water tanks, combustion air and other such similar boiler system equipment).
 2. Fuel systems (Gas and Oil).
 3. Boiler Controls System.
 4. Air Conditioning Unit.
 5. HVAC Control System.
 6. Electrical Power Distribution Systems.
 7. Lighting and Control Systems.

PART 2 – PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 MEETINGS

- A. Initial Commissioning Meeting. Within thirty (30) days of commencement of construction, the CxA will schedule, plan and conduct a commissioning scoping meeting with the entire commissioning team in attendance. Meeting minutes will be distributed to all parties by the CxA. Information gathered from this meeting will allow the CxA to prepare the *Commissioning Plan*, which will also be distributed to all parties.
- B. Equipment Startup Coordination Meeting. Thirty (30) days prior to startup of the primary HVAC equipment, the CxA meets with the DGS, UA, Professional and Contractors and develops a detailed commissioning schedule. Prior to this meeting, the Contractors shall submit to the CxA the full start-up plan.
- C. Miscellaneous Meetings. Other meetings will be planned and conducted by the CxA as construction progresses. These meetings will cover coordination, deficiency resolution and planning issues with particular Contractors.

3.2 REPORTING

- A. The CxA will provide regular reports to the Department, with increasing frequency as construction and commissioning progresses.
- B. The CxA will regularly communicate with all members of the commissioning team, keeping them apprised of commissioning progress and scheduling changes through progress reports.
- C. Testing or review approvals and non-conformance and deficiency reports are made regularly with the review and testing as described in later sections.

3.3 SUBMITTALS

- A. Copies of MEP shop drawings will be provided to CxA, when they are submitted to the Professional, electronically through E-Builder. CxA will review shop drawings concurrently with the Professional and provide any comments to the Professional so they may be included in their comments. Copies of approved shop drawings and startup reports for all commissioned equipment will be forwarded to the CxA through E-Builder. Supplement the shop drawing data with the manufacturer's installation and start-up procedures. This material should be identical to the literature which will be included in the Operation and Maintenance Manuals.
- B. The CxA may request additional design narrative from the Professional and Controls Contractor, depending on the completeness of the basis of design documentation and sequences provided with the Specifications.

- C. These submittals to the CxA do not constitute compliance for O&M manual documentation. The O&M manuals are the responsibility of the Contractor, though the Professional will approve them.

3.4 START-UP AND INITIAL CHECKOUT

- A. The following procedures apply to all equipment to be commissioned.
- B. General. Contractor start-ups are important to ensure that the equipment and systems are hooked up and operational. It ensures that functional performance testing (in-depth system checkout) may proceed without unnecessary delays. Each piece of equipment receives full Contractor start-up. The start-up for a given system must be successfully completed prior to formal functional performance testing of equipment or subsystems of the given system.
- C. Start-up and Initial Checkout Plan. The primary role of the CxA in this process is to ensure that there is written documentation that each of the manufacturer-recommended procedures have been completed.
 - 1. The Contractors develop the full start-up plan by combining the manufacturer's detailed start-up and checkout procedures from the O&M manual, the normally used field checkout sheets and the Prefunctional Checklists. Prefunctional Checklist will be prepared by the CxA and provided to the Contractor. The Contractor will fill out the Prefunctional Checklists. The plan shall include checklists and procedures with specific boxes or lines for recording and documenting the checking and inspections of each procedure and a summary statement with a signature block at the end of the plan.
 - 2. The Contractors submit all completed startup plan documentation to the CxA for review and approval.
 - 3. For systems that may not have adequate manufacturer startup and checkout procedures, particularly for components being integrated with other equipment, the contractor should provide the added necessary detail and documenting format to the CxA for approval, prior to execution.
 - 4. The full start-up plan shall consist of:
 - a. The manufacturer's standard written start-up procedures copied from the installation manuals with check boxes by each procedure and a signature block added by hand at the end.
 - b. The manufacturer's normally used field checkout sheets.
 - c. Completed Prefunctional Checklists,
- D. Execution of Startup and Checkout Procedures.
 - 1. Thirty (30) days prior to startup, the contractors and vendors schedule startup and initial checkout with the DGS, UA, Professional and CxA. A commissioning meeting will be held at this time for all parties.
 - 2. The Contractors and vendors shall execute startup and provide the CxA with a signed and dated copy of the completed start-up and checkout procedures and completed Prefunctional Checklists.

3. Only individuals that have direct knowledge and witnessed that a line item task on the checklist was actually performed shall initial or check that item off. It is not acceptable for witnessing supervisors to fill out these forms.

E. Deficiencies, Non-Conformance and Approval in Checklists and Startup.

1. The Contractors shall clearly list any outstanding items of the initial start-up and checkout procedures that were not completed successfully, at the bottom of the procedures form or on an attached sheet. The procedures form and any outstanding deficiencies are provided to the CxA within two days of test completion.
2. The CxA will review the report and submits either a non-compliance report or recommend approval to the DGS. The installing Contractors or vendors shall correct all areas that are deficient or incomplete in the checklists and tests in a timely manner, and shall notify the CxA as soon as outstanding items have been corrected and resubmit an updated start-up report and a Statement of Correction on the original non-compliance report. When satisfactorily completed, the CxA will recommend approval of the start-up plan to the DGS.

3.5 FUNCTIONAL PERFORMANCE TESTING

- A. The Contractor shall execute all functional performance testing. The CxA will witness and document all performance testing.
- B. Objectives and Scope. The objective of functional performance testing is to demonstrate that each system is operating according to the documented Owner's Project Requirements (OPR), Basis of Design (BOD) and Contract Documents. Functional testing facilitates bringing the systems from a state of substantial completion to full dynamic operation. Additionally, during the testing process, areas of deficient performance are identified and corrected, improving the operation and functioning of the systems. In general, each system should be operated through all modes of operation (seasonal, occupied, unoccupied, warm-up, cool-down, part- and full-load) where there is a specified system response. Verifying each sequence in the sequences of operation is required. Proper responses to such modes and conditions as power failure, freeze condition, low oil pressure, no flow, equipment failure, etc. shall also be tested.
- C. Coordination and Scheduling. The Contractors shall provide sufficient notice to the CxA regarding their completion schedule for the startup of all equipment and systems. The CxA shall provide written notice of testing dates. In general, functional testing is conducted after startup has been satisfactorily completed. The control system is sufficiently tested and approved before it is used for TAB or to verify performance of other components or systems. The air balancing and water balancing is completed and debugged before functional testing of air-related or water-related equipment or systems. Testing proceeds from components to subsystems to systems. When the proper performance of all interacting, individual systems has been achieved, the interface or coordinated responses between systems is checked.
- D. Problem Solving. The CxA will recommend solutions to problems found, however the burden of responsibility to solve and correct problems is with the Contractors and Professional.

3.6 DOCUMENTATION, NON-CONFORMANCE AND APPROVAL OF TESTS

- A. Documentation. The CxA will document the results of all functional performance tests using the specific procedural forms developed for that purpose. The CxA will include the filled out forms in the Commissioning Record.
- B. Non-Conformance.
 - 1. If the Contractor is available, corrections of minor deficiencies identified may be made during the tests at the discretion of the CxA. In such cases the deficiency and resolution shall be documented on the procedure form.
 - 2. Every effort shall be made to expedite the testing process and minimize unnecessary delays, while not compromising the integrity of the procedures. However, the CxA will not be pressured into overlooking deficient work or loosening acceptance criteria to satisfy scheduling or cost issues, unless there is an overriding reason to do so at the request of the Department.
 - 3. As tests progress and a deficiency is identified, the CxA discusses the issue with the executing contractor.
 - a. When there is no dispute on the deficiency, the Contractor accepts responsibility to document and complete the corrective action.
 - b. If there is a dispute about a deficiency, regarding whether it is a deficiency or who is responsible, the deficiency shall be documented and submitted to the Professional and DGS for further review. Final interpretive authority is with the Professional. Final acceptance authority is with the DGS.

3.7 WARRANTY PERIOD TESTING

- A. During the warranty period, the CxA shall complete seasonal testing (tests delayed until weather conditions are closer to the system's design). The Professional shall coordinate resolution of design non-conformance and design deficiencies identified during warranty-period commissioning. Any final adjustments to the O&M manuals and record drawings due to the testing shall be made.

END OF SECTION