

SECTION 230800 - HVAC SYSTEMS COMMISSIONING

1 GENERAL

1.1 Intent: This section describes the work performed by the HVAC Commissioning Authority and the supporting work required by the Contractor. The Commissioning Authority will be provided by the Owner. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

1.2 Intent of Commissioning Process:

1.2.1 Verify operation and functional performance of HVAC systems for compliance with "Design Intent". "Design Intent" is used to indicate the detailed requirements for the HVAC system, comprised of:

1.2.1.1 Design criteria and assumptions

1.2.1.2 HVAC system description and contract documentation

1.2.1.3 Intended methods of system operation and maintenance

1.2.2 Document HVAC tests and inspections.

1.2.3 Verify application of operation and maintenance manuals, as-built (record) documents, spare parts listing, special tools listing, and other items as may be specified herein for support of HVAC systems and equipment.

1.2.4 Coordinate and direct training to personnel for operation and maintenance of HVAC equipment and systems.

1.3 Contractor Scope of Work: Contractor shall perform all testing and demonstrate system operation to support the Commissioning Authority. Furnish labor and materials to support complete HVAC commissioning as specified herein. Support interim commissioning of HVAC systems during initial season operation and follow-up commissioning of required HVAC systems during additional season operation.

1.4 Quality Assurance:

1.4.1 Reference: ASHRAE Guideline 1-1989, *Guideline for Commissioning of HVAC Systems*.

1.5 Documentation:

1.5.1 Provide the following to the Commissioning Authority:

1.5.1.1 Project plans and specification (contract documents), authorized revisions, approved HVAC shop drawings and submittals, Startup Reports, Test and Balance Reports, factory start-up and certification reports, etc.

1.5.1.2 Records of required code authority inspections, documentation sign-offs, etc.

1.6 Submittals:

1.6.1 HVAC Commissioning Authority will provide the following to the Contractor prior to starting the commissioning process.

22019

- 1.6.1.1 Commissioning Plan consisting of specific equipment and system checklists.
- 1.6.1.2 Training Plan outlining required training and documentation.
- 1.6.2 Contractor shall submit the following prior to starting the commissioning process.
 - 1.6.2.1 O & M Manuals.
 - 1.6.2.2 Startup Reports per Division-15 section 15970.
 - 1.6.2.3 Test and Balance Report per Division-15 section 15985.
 - 1.6.2.4 List of tools and spare parts required by other Division-15 sections.
- 1.7 Responsibilities:
 - 1.7.1 Contractor:
 - 1.7.1.1 Contractor shall verify completeness of the building envelope, perimeter and interior items which effect proper operation and control of HVAC equipment and systems.
 - 1.7.1.2 The Contractor shall assure participation and cooperation of trade subcontractors (electrical, Test and Balance, controls/energy management, IAQ, and HVAC) under his contract as required for the commissioning process.
 - 1.7.1.3 The Contractor shall secure the services of a professional video service to record all training sessions provided by the subcontractors. All training sessions shall be professionally videotaped and two copies provided to the Owner.
 - 1.7.2 Subcontractors:
 - 1.7.2.1 The subcontractors shall be responsible for providing labor, material, equipment, etc., required within the scope of their specialty to facilitate the commissioning process. The subcontractors shall perform tests and verification procedures required by the commissioning process when requested by the Commissioning Authority and directed by the Contractor.
 - 1.7.3 Owner:
 - 1.7.3.1 Owner will schedule their personnel to participate in the HVAC Commissioning process. This may include building security personnel, HVAC operation personnel and maintenance personnel. Personnel operating and maintaining equipment and systems will attend training sessions., factory schools, and educational institutions where indicated.
 - 1.7.3.2 Owner shall advise HVAC Commissioning Authority regarding changes in building occupancy and/or usage.
- 2 PRODUCTS
 - 2.1 Instrumentation: Instrumentation shall be provided by agency performing prior tests. Instruments shall be operated by the individual agency requested by the HVAC Commissioning Authority, as specified elsewhere herein.
- 3 EXECUTION
 - 3.1 General: The HVAC Commissioning Authority will actively participate in construction phase of the

project to assure compliance with HVAC Commissioning requirements.

3.2 Procedure:

3.3 The Contractor and designated subcontractors shall attend a pre-commissioning meeting and establish requirements for HVAC Commissioning. The meeting shall outline:

3.3.1 Responsibility of each trade affected by HVAC Commissioning, as required by appropriate section of the specification and indicated on equipment and system checklists provided by the Commissioning Authority.

3.3.2 Requirements for documentation as listed elsewhere herein.

3.3.3 Requirements for documentation of HVAC test and inspections required by code authorities.

3.3.4 Requirements for the HVAC Commissioning program during specified operational seasons, part and full loads and as further delineated in Paragraph 3.4.

3.3.5 Format for training program for operation and maintenance personnel.

3.4 HVAC Commissioning:

3.4.1 To assist in the commissioning process, Operation and Maintenance manuals shall be completed and turned over to the Commissioning Authority as soon as possible during the course of the project, but in no case later than one month prior to the initial date scheduled for substantial completion.

3.4.2 The Commissioning Authority will develop and submit a specific start-up, check-out and sign-off form for every piece of major equipment and system, as well as other equipment hereinafter listed. These forms and lists do not necessarily indicate all the activities, tests and procedures which will be required for the commissioning and start-up of each piece of equipment and system.

3.4.3 The Contractor shall develop a work plan to demonstrate system and equipment operation. Systems shall be operated under actual or simulated full load conditions. Identify the operating conditions in the work plan. Where appropriate, systems shall be operated, tested, and started up, to assure operation for each of their seasonal or different characteristics, (for example heating and cooling).

3.4.4 After all components and every system has been completely commissioned, provide a 2-week, 24-hour per day fully functional automatic operation period of all systems simultaneously. This shall be successfully concluded before systems are accepted by the Owner.

3.4.5 Execute the final approved start-up and commissioning plan.

3.4.6 HVAC Commissioning shall begin only after HVAC equipment and systems, along with related equipment, systems, structures and areas are complete. Systems may be commissioned individually if requested by the Contractor and approved by the Commissioning Authority.

3.4.6.1 Verify Test and Balance readings, such as:

3.4.6.1.1 Supply and return air volumes

3.4.6.1.2 Fan performance

3.4.6.1.3 Hydronic performance

3.4.6.1.4 Branch duct readings

- 3.4.6.1.5 Chiller performance
- 3.4.6.1.6 Cooling tower performance
- 3.4.6.2 Verify calibration of thermostats and related controls, such as:
 - 3.4.6.2.1 VAV boxes
 - 3.4.6.2.2 Fan coil units
 - 3.4.6.2.3 Damper settings
 - 3.4.6.2.4 Valve positions
- 3.4.6.3 Verify readings of remote data and control systems (Energy Management Control System), such as:
 - 3.4.6.3.1 Temperatures
 - 3.4.6.3.2 Air Flows
 - 3.4.6.3.3 Damper positions
 - 3.4.6.3.4 Differential pressures
 - 3.4.6.3.5 Water temperatures
- 3.4.6.4 Verify operation of smoke removal system modes, as follows:
 - 3.4.6.4.1 Smoke damper and fan operation
 - 3.4.6.4.2 Smoke detector response
 - 3.4.6.4.3 Smoke zone response
 - 3.4.6.4.4 Smoke control panel manual operation
- 3.4.6.5 Verify that the total HVAC system is performing to provide conditions as outlined in "Design Intent", for seasonal full load and part load conditions, as follows:
 - 3.4.6.5.1 Temperature
 - 3.4.6.5.2 Humidity
 - 3.4.6.5.3 Air changes
 - 3.4.6.5.4 Air movement
 - 3.4.6.5.5 Air quality
 - 3.4.6.5.6 Zone control
 - 3.4.6.5.7 Energy Management
 - 3.4.6.5.8 Pressurization

22019

3.4.6.5.9 Control response

3.5 HVAC Start-Up Procedures:

3.5.1 Prior to start-up of any air handling equipment, the Commissioning Authority and the Contractor shall inspect the installation and verify that:

3.5.1.1 Ductwork is complete, clean and pressure-tested per specifications.

3.5.1.2 Prefilters and final filters are installed by the Contractor per design specifications; prefilters are to be replaced by the Contractor as required during this start-up period. The final filters shall be replaced by the Contractor any time that the static pressure drop across the filter exceeds 1.0". The filters installed shall meet design specifications and shall be dated with a felt-tip marker upon installation.

3.5.1.3 All electrical work is complete.

3.5.1.4 Safety devices are in place and operational.

3.5.1.5 Energy Management controls are installed and have been verified to be operational by the controls contractor.

3.5.1.6 All piping has been installed and insulated per specifications.

3.5.2 Prior to Occupancy:

3.5.2.1 No less than two weeks prior to substantial completion, the HVAC system for the space to be occupied shall be approved by the Commissioning Authority to be operational under the start-up procedures and shall be set up by the Contractor to operate continuously on a 24-hour basis. The following requirements shall be established by the Commissioning Authority and adhered to by the contractors during this period:

3.5.2.1.1 The Energy Management Control System is completely installed, and the EMCS Contractor has submitted a statement verifying that the system is complete and operational.

3.5.2.1.2 The HVAC air side and water systems shall be balanced at design levels by the Contractor, all systems and devices shall be operating according to specifications, and the Contractor's TAB report has been submitted to and approved by the HVAC system Design Engineer.

3.5.2.1.3 Outdoor air shall be set at maximum design levels and maintained at those levels continuously during the two-week ventilation period.

3.5.2.1.4 Chilled water temperature (where applicable) shall be operating at design levels. Supply air off-coil temperatures shall be at design levels.

3.5.2.1.5 All exhaust systems are operational and functioning according to design CFM and specifications.

3.5.2.1.6 All electric heaters and hydronic reheat systems are installed and operational.

3.5.2.1.7 Prefilters shall continue to be replaced by the Contractor as required per the start-up schedule. The final filter shall be replaced by the Contractor at any time that the static pressure drop across the filter exceeds 1.0".

3.5.2.1.8 All interior spaces are secured with doors and windows normally closed.

3.5.2.1.9 Interior air quality shall be maintained at 75°F and relative humidity less than 60%.

3.5.3 At Occupancy: Following the date of final completion and prior to occupancy, the Commissioning Authority shall verify all prefilters and final filters have been replaced with new, approved, specified filters.

3.6 Scheduling of Commissioning Activities

3.6.1 *The contractor shall develop a schedule of commissioning related activities. The activities to include in the schedule and their relationship are listed below, in this specification section and in other specification sections.*

3.6.2 *The Commissioning Schedule shall include milestones and activities listed below:*

- *Notice to Proceed*
- *Commissioning Kickoff Meeting*
- *Equipment Startup*
- *Start of Functional Testing*
- *Training Planning Workshop*
- *Owner Training Session*
- *Substantial Completion Inspection*

COMMISSIONING ACTIVITIES AND SCHEDULE RELATIONSHIP

Task	Specification Paragraph	Schedule Relationship
<i>Contractor to provide current Contract Documents and changes to CxA</i>	<i>1.5.1.1</i>	<i>Upon contractor's <u>Notice-To-Proceed</u> and throughout the project if changed.</i>
<i>Commissioning Schedule</i>		<i>Seven days prior to <u>Commissioning Kickoff Meeting</u>.</i>
<i>Schedule Commissioning Kickoff Meeting</i>		<i>Schedule <u>Commissioning Kickoff Meeting</u> within 30 days after mobilization to the site.</i>
<i>Contractor to provide Approved HVAC shop drawings and submittals to CxA</i>	<i>1.5.1.1</i>	<i>Within 15 days of <u>Engineers' Approval</u>.</i>
<i>Contractor to provide O & M Manuals</i>	<i>1.6.2.1 & 3.4.1</i>	<i>No Later than one month prior to date of scheduled <u>Substantial Completion Inspection</u>.</i>
<i>Contractor to provide Startup Reports to CxA</i>	<i>1.5.1.1 & 1.6.2.2</i>	<i>Within one week of <u>Equipment Startup</u>.</i>
<i>Contractor to provide Test and Balance Report to CxA</i>	<i>1.5.1.1 & 1.6.2.3</i>	<i>Prior to <u>Start of Functional Testing</u></i>
<i>Contractor & CxA Pre-Start-Up Inspection</i>	<i>3.5.1</i>	<i>No less than three days prior to any <u>Equipment Startup</u> activity.</i>
<i>Contractor to provide Certification Reports to CxA.</i> <i>Ductwork Pressure Test</i> <i>DDC Statement of Completeness</i> <i>Engineer's approval of T&B Report</i> <i>Verification of completeness</i>	<i>1.5.1.1</i> <i>3.5.1.1</i> <i>3.5.2.1.1</i> <i>3.5.2.1.2</i> <i>1.7.1.1 & 3.4.6</i>	<i>No later than seven days prior to <u>Start of Functional Testing</u>.</i>

Task	Specification Paragraph	Schedule Relationship
<i>Contractor shall coordinate, schedule and train Owner's personnel in accordance with Training Plan provided by CxA.</i>	<i>1.7.1</i>	<i>Attend Training Planning Workshop 30 days prior to Substantial Completion Inspection. Conduct Training Session 10 days prior to Substantial Completion Inspection.</i>
<i>Contractor to provide Training and videographer</i>	<i>1.6.1.2</i>	<i>At Training Session</i>
<i>Contractor to provide a list of manufacturers recommended tools and spare parts.</i>	<i>1.6.2.4</i>	<i>Prior to Training Planning Workshop</i>
<i>Contractor to support Initial Season Commissioning Activities</i>	<i>1.3</i>	<i>Construction Commissioning activity</i>
<i>Contractor to support Additional Season Commissioning Activity</i>	<i>1.3</i>	<i>Post Construction Change of Season</i>
<i>Contractor to provide Records of Code Authority Inspections to CxA</i>	<i>1.5.1.2</i>	<i>Within Ten-days of Code Inspection.</i>
<i>Contractor to perform Equipment Prefunctional Checklist</i>	<i>3.4.2</i>	<i>Seven Days prior to Equipment Startup.</i>
<i>MC and Cntrls Contractor Demonstration</i>	<i>3.4.3</i>	<i>Upon receipt of DDC Statement of Completeness (both program and graphics)</i>
<i>Two-week Operational Test Period</i>	<i>3.4.4</i>	<i>Start two-week period upon successful Functional Testing Demonstration</i>

END OF SECTION 230800