

SECTION 230800 - COMMISSIONING OF HVAC

LEED-NC Prerequisite EA 1 requires fundamental commissioning of the building energy systems. If applying for LEED certification, review LEED requirements and revise the Text to meet specific requirements.

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes commissioning process requirements for HVAC&R systems, assemblies, and equipment.
- B. Related Sections:
 - 1. Division 01 Section "General Commissioning Requirements" for general commissioning process requirements.
- C. Owner will engage the Commissioning Authority under separate contract.

1.3 DEFINITIONS

- A. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.
- B. AExA: Commissioning representative of the Architect/Engineer.
- C. CxA: Commissioning Authority.
- D. CxM: Commissioning Manager. The commissioning representative of the CM, appointed by the CM to manage and lead the commissioning effort on behalf of the CM.
- E. CxR: Commissioning Representatives. Members of the Construction Manager's (CM) staff, contractor's, sub-contractors', manufacturers' and suppliers' staff, Owner's staff, Architect/Engineer's staff, or Owner's independent contractor assigned to participate in the commissioning process.
- F. HVAC&R: Heating, Ventilating, Air Conditioning, and Refrigeration.
- G. TAB: Testing, Adjusting and Balancing.

- H. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.

1.4 CONTRACTOR'S RESPONSIBILITIES

- A. Perform commissioning tests at the direction of the CxA.
- B. Attend construction phase controls coordination meeting.
- C. Attend testing, adjusting, and balancing review and coordination meeting.
- D. Participate in HVAC&R systems, assemblies, equipment, and component maintenance orientation and inspection as directed by the CxA.
- E. Provide information requested by the CxA for final commissioning documentation.
- F. Mechanical Contractor CxR shall submit approved equipment data sheets on systems to be commissioned to the CxA for review; these will include, but not limited to, the following:
 - 1. Air handling units.
 - 2. Fans.
 - 3. Terminal units.
 - 4. Sound attenuators.
 - 5. Vibration isolation equipment.
 - 6. Pumps.
 - 7. Chillers.
 - 8. Cooling towers.
 - 9. Heat exchangers.
 - 10. Balancing valves.
 - 11. Coils.
 - 12. Humidifiers.
 - 13. Chemical treatment equipment/systems.
 - 14. Snow melt equipment/systems.
- G. Control Contractor CxR shall submit all approved equipment data sheets, approved control drawings and approved sequence of operations to the CxA.
- H. TAB Contractor CxR shall submit certification documentation, TAB procedures plan, and preliminary project layout (which shall include an inventory of required flow rates for each air and hydronic system).

1.5 CxA'S RESPONSIBILITIES

- A. Provide Project-specific construction checklists and commissioning process test procedures for actual HVAC&R systems, assemblies, equipment, and components to be furnished and installed as part of the construction contract.
- B. Direct commissioning testing.

- C. Verify testing, adjusting, and balancing of Work are complete.
- D. Provide test data, inspection reports, and certificates in Systems Manual.

1.6 COMMISSIONING DOCUMENTATION

- A. Provide the following information to the CxA for inclusion in the commissioning plan:
 - 1. Plan for delivery and review of submittals, systems manuals, and other documents and reports.
 - 2. Identification of installed systems, assemblies, equipment, and components including design changes that occurred during the construction phase.
 - 3. Process and schedule for completing construction checklists and manufacturer's prestart and startup checklists for HVAC&R systems, assemblies, equipment, and components to be verified and tested.
 - 4. Certificate of completion certifying that installation, prestart checks, and startup procedures have been completed.
 - 5. Certificate of readiness certifying that HVAC&R systems, subsystems, equipment, and associated controls are ready for testing.
 - 6. Test and inspection reports and certificates.
 - 7. Corrective action documents.
 - 8. Testing, adjusting, and balancing reports.
 - 9. Laser alignment reports.
 - 10. Vibration testing and analysis reports.
 - 11. Completion report of pipe cleaning, flushing hydrostatic testing and chemical water treatment.
- B. The CxA shall provide and include the following documentation:
 - 1. Commissioning plan
 - 2. Pre-installation checklists
 - 3. Pre-startup verification checklists (installation and pre-startup phases)
 - 4. Startup testing and verification checklists (startup phase)
 - 5. Functional performance testing plan with procedures and checklists for each series of tests. Submittals shall include samples of data reporting sheets that will be part of the reports.
 - 6. Final commissioning report

1.7 SUBMITTALS

- A. Certificates of readiness.
- B. Certificates of completion of installation, prestart, and startup activities.

1.8 SYSTEMS TO BE COMMISSIONED

- A. HVAC&R systems and associated control systems:

1. Air Handling Systems.
2. HVAC Zone Control Systems
3. Chilled Water Systems.
4. Steam and Condensate Systems.
5. Hot Water Heating Systems.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PRE-INSTALLATION VERIFICATION (PIV)

- A. CxR for respective trade as indicated on PIV form will complete this scope of work; a sample PIV form for each equipment type has been included in Appendix 1 of this specification.
- B. Review approved submittals for equipment included in systems to be commissioned.
- C. Prior to the installation of each piece of equipment, verify that equipment arriving on site is consistent with that required.
- D. The CxA shall carry out a 20% PIV sampling of each piece of equipment.

3.2 PRE-STARTUP VERIFICATION (PSV)

- A. Prior to the installation of each piece of equipment, verify that equipment arriving on site is consistent with that required (ie, verify that the PIV for each piece of equipment has been completed and accepted)
- B. CxR for respective trade as indicated on PSV form will complete this scope of work; a sample PSV form for each equipment type has been included in Appendix 1 of this specification.
- C. Certify that HVAC&R systems, subsystems, and equipment have been installed according to the Contract Documents.
- D. Certify that HVAC&R instrumentation and control systems have been installed, connected, calibrated and are ready for start-up procedures.
- E. Inspect and verify the position of each device and interlock identified on checklists.

3.3 STARTUP TESTING AND VERIFICATION (STV)

- A. Prior to the startup of each piece of equipment, verify that equipment installed is consistent with that required (ie, verify that the PSV for each piece of equipment has been completed and accepted)

- B. Certify that HVAC&R instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents, and that pretest set points have been recorded.
- C. Set systems, subsystems, and equipment into operating mode to be tested (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).
- D. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.
- E. Testing Instrumentation: Install measuring instruments and logging devices to record test data as directed by the CxA.

3.4 TESTING, ADJUSTING AND BALANCING (TAB) VERIFICATION

- A. Testing, adjusting and balancing shall be carried out in direct contract with the Owner.
- B. Prior to performance of TAB Work, provide copy of completed system readiness checklists, preliminary report (comprehensive project layout in electronic format), and certification documentation to the CxA.
- C. Notify the CxA at least 10 days in advance of testing and balancing Work, and provide access for the CxA to witness testing and balancing Work.
- D. Provide technicians, instrumentation, and tools to verify testing and balancing of HVAC&R systems at the direction of the CxA.
 - 1. The CxA will notify testing and balancing Contractor 10 days in advance of the date of field verification. Notice will not include data points to be verified.
 - 2. The testing and balancing Contractor shall use the same instruments (by model and serial number) that were used when original data were collected.
 - 3. Failure of an item includes, other than sound, a deviation of more than 10 percent. Failure of more than 10 percent of selected items shall result in rejection of final testing, adjusting, and balancing report. For sound pressure readings, a deviation of 3 dB shall result in rejection of final testing. Variations in background noise must be considered.
 - 4. Remedy the deficiency and notify the CxA so verification of failed portions can be performed.
- E. Vibration and Sound Tests: Upon completion of TAB Work, the Owner will provide technicians, instrumentation, tools, and equipment to test performance of vibration isolation and seismic controls. Notify CxA at least 10 days prior to testing.

3.5 FUNCTIONAL PERFORMANCE TESTING REQUIREMENTS (FPT)

- A. Certify that HVAC&R systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents.

- B. Prior to the functional performance testing of each piece of equipment, verify that equipment has been correctly brought online and TAB report has been accepted (ie, verify that the STV for each piece of equipment has been completed and accepted)
- C. Certify that testing, adjusting, and balancing procedures have been completed and that testing, adjusting, and balancing reports have been submitted, discrepancies corrected, and corrective work approved.
- D. All members of the Cx team shall provide technicians, instrumentation, and tools as required in the respective FPT test format (see Appendix 1 for CxR requirements) to perform commissioning test at the direction of the CxA.
- E. Scope of HVAC&R testing shall include entire HVAC&R installation, from central equipment for heat generation and refrigeration through distribution systems to each conditioned space. Testing shall include measuring capacities and effectiveness of operational and control functions.
- F. Test all operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.
- G. The CxA along with the HVAC&R Subcontractor, testing and balancing Subcontractor, and HVAC&R Instrumentation and Control Subcontractor shall prepare detailed testing plans, procedures, and checklists for HVAC&R systems, subsystems, and equipment.
- H. Tests will be performed using design conditions whenever possible.
- I. Simulated conditions may need to be imposed using an artificial load when it is not practical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by the CxA and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.
- J. The CxA may direct that set points be altered when simulating conditions is not practical.
- K. The CxA may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are not practical.
- L. If tests cannot be completed because of a deficiency outside the scope of the HVAC&R system, document the deficiency and report it to the Owner. After deficiencies are resolved, reschedule tests.
- M. If the testing plan indicates specific seasonal testing, complete appropriate initial performance tests and documentation and schedule seasonal tests.

3.6 HVAC&R SYSTEMS, SUBSYSTEMS, AND EQUIPMENT TESTING PROCEDURES

- A. Boiler Testing and Acceptance Procedures: Testing requirements are specified in Division 23 boiler Sections. Provide submittals, test data, inspector record, and boiler certification to the CxA.
- B. HVAC&R Instrumentation and Control System Testing: Field testing plans and testing requirements are specified in Division 23 Sections "Instrumentation and Control for HVAC" and "Sequence of Operations for HVAC Controls." Assist the CxA with preparation of testing plans.
- C. Pipe system cleaning, flushing, hydrostatic tests, and chemical treatment requirements are specified in Division 23 piping Sections. HVAC&R Contractor shall prepare a pipe system cleaning, flushing, and hydrostatic testing plan. Provide cleaning, flushing, testing, and treating plan and final reports to the CxA. Plan shall include the following:
 - 1. Sequence of testing and testing procedures for each section of pipe to be tested, identified by pipe zone or sector identification marker. Markers shall be keyed to Drawings for each pipe sector, showing the physical location of each designated pipe test section. Drawings keyed to pipe zones or sectors shall be formatted to allow each section of piping to be physically located and identified when referred to in pipe system cleaning, flushing, hydrostatic testing, and chemical treatment plan.
 - 2. Description of equipment for flushing operations.
 - 3. Minimum flushing water velocity.
 - 4. Tracking checklist for managing and ensuring that all pipe sections have been cleaned, flushed, hydrostatically tested, and chemically treated.
- D. Refrigeration System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of chillers, cooling towers, refrigerant compressors and condensers, heat pumps, and other refrigeration systems. The CxA shall determine the sequence of testing and testing procedures for each equipment item and pipe section to be tested.
- E. HVAC&R Distribution System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of air, steam, and hydronic distribution systems; special exhaust; and other distribution systems, including HVAC&R terminal equipment and unitary equipment.
- F. Vibration and Sound Tests: Provide technicians, instrumentation, tools, and equipment to test performance of vibration isolation and seismic controls.

END OF SECTION 230800