

SECTION 23 08 00

COMMISSIONING OF HVAC

PART 1 – GENERAL

1.1 PROVISIONS INCLUDED

- A. Include Division 00 and applicable parts of Division 01 for conditions and requirements which may affect the work of this Section.
- B. Examine all other Sections of the specifications for requirements which affect work under this Section whether or not such work is specifically mentioned in this Section.
- C. Coordinate work with that of all other Trades affecting, or affected by work of this Section. Cooperate with such Trades to ensure the steady progress of all work under the Contract.

1.2 COMMISSIONING EFFORT

- A. The Construction Manager shall be the prime contractor which is responsible for the overall commissioning program.
- B. The Construction Manager and all Contractors/Subcontractors shall completely assist the Commissioning Agent in establishing and maintaining the schedule of commissioning events, as developed for the complete check out of each individual mechanical and electrical sub-system and the integration of all building systems.
- C. The Contractor, BMS Contractor and TAB Contractor responsible for all work, installation, testing, balancing and controls under this Division shall be responsible to provide all set up, testing and services required in the commissioning of the systems under this Division.

1.3 COMMISSIONING TEAM

- A. A representative of each of the following parties shall be designated as a member of the Commissioning Team.
- B. Each member must attend weekly "schedule of events" meetings, in accordance with the Commissioning Agent's schedule.
- C. Each member must be closely associated with this design project to accommodate the actual scheduling of events upon mechanical and electrical systems which have been "completed" and thus in proper operation to be commissioned.
- D. Commissioning Team
  - 1. Commissioning Agent

2. Construction Manager
3. HVAC Contractor
4. ATC/BMS Contractor
5. Testing and Balancing Contractor
6. Plumbing Contractor
7. Fire Protection Contractor
8. Electrical Contractor
9. Selective Equipment Manufacturers
10. Maine Medical Hospital Representative

#### 1.4 SUBSTANTIAL COMPLETION

- A. The Construction Manager shall submit written notice that the project is substantially complete. Provide a detailed punch list of items not yet in conformance with the contract documents which require attention.
- B. Submit preliminary copies of the Operation and Maintenance Manuals.
- C. Submit the as-built drawings.
- D. Submit warranties, workmanship/maintenance bonds, maintenance agreements, final certifications, and similar documents.
- E. Obtain and submit releases enabling Owner's full and unrestricted use of the work and access to services and utilities, including occupancy permits, operating certifications, and similar releases.
- F. The Contractor shall have completed all commissioning requirements in Division 21,22,23 and 26 except Functional Performance Testing of systems.
- G. The Contractor shall have completed all training required for Owner's staff.
- H. Submit a letter to the Architect requesting inspection and the Certificate of Substantial Completion, which will be signed and submitted to the Owner.

#### 1.5 FUNCTIONAL COMPLETION

- A. The Construction Manager shall submit commissioning acceptance procedures test check-off sheets, signed by the Commissioning Agent, and the Commissioning Agent's letter recommending Functional Completion.

Formal records of all test procedures and results shall be included, as specified, in binders organized for convenient future reference by the Owner's operations staff.

- B. The Commissioning Agent will submit a final commissioning report recommending Function Completion when all requirements have been met and when the final report is accepted by the Client. The Commissioning Agent's report will be a comprehensive summary regarding the commissioning program, which shall also include formal records and data accumulated by the Commissioning Agent during the commissioning process.

- C. All Contractors shall participate in assisting the commissioning agent in indicating system compliance by performance ALL system tests to the satisfaction of the commissioning agent.

#### 1.6 FINAL COMPLETION AND FINAL ACCEPTANCE

- A. Final Completion occurs when the work is fully and finally completed in accordance with the Contract Documents and all deficiencies have been corrected. Final Acceptance is the written acceptance issued to the Contractor by the Construction Manager and Owner after the Contractor has achieved Final Completion. The specific requirements are:
  - 1. Submit "Consent of Surety to Final Payment". This letter is to be completed by the surety and mailed to the Owner.
  - 2. Submit final payment request with final releases and supporting documentation not previously submitted or accepted.
  - 3. Submit a copy of the Architect's final punch list of itemized work to be completed or corrected, stating that each item is complete (or otherwise resolved) for acceptance, endorsed and dated by the Architect.
  - 4. Deliver tools, spare parts, extra stock of materials, and similar physical items to the Owner.
  - 5. Make the final change-over of locks and transmit the new keys to the Owner. Return any loaned construction access keys. Advise Owner's personnel regarding change-over in security provisions.
  - 6. Discontinue and remove from the project site temporary facilities and services, along with construction tools and facilities, mock-ups, and similar elements.
  - 7. Complete final cleaning requirements, including touch-up of marred surfaces, and repair, restore and touch-up exposed finishes.
  - 8. Submit a letter to the Architect requesting inspection and the Certificate of Final Acceptance, which will be signed and submitted to the Owner.

#### 1.7 COMMISSIONING SCHEDULE

- A. The Construction Managers schedule for construction, control implementation and completion, start, and point-by-point checkout must be complete for Owner occupancy, in accordance with the Construction Managers schedule.

#### 1.8 RESPONSIBILITIES

- A. The Contractors shall cooperate with the Construction Manager and Commissioning Agent to accomplish the following tasks:
  - 1. Review and approve all functional performance tests, results, and documentation required by the contract documents, for all equipment and systems, as performed by subcontractors, vendors, etc.
  - 2. Develop schedules for all testing, integrate testing into the master construction activity schedule and coordinate all subcontractor testing as required.

3. Assist and participate in all equipment tests, system functional tests, and cross system functional tests. Test procedures shall be in accordance with equipment manufacturer's recommendations, where applicable. Test procedures shall fully describe system configuration and steps required for each test, appropriately documented so that another party can repeat the tests with virtually identical results.
4. Submit test procedure schedule, procedures, forms and other documentation to the Construction Manager and Owner for approval three months prior to starting any testing required and stipulated by the construction Manager.
5. Coordinate directly with subcontractor on the project specific to their responsibilities and contractual obligations.
6. Provide qualified personnel for participation in commissioning tests, including seasonal testing required after the initial commissioning.
7. Provide engineering and technical expertise to oversee and direct the correction of deficiencies found during the commissioning process.
8. Provide all start-up and initial testing of all systems and equipment by the Contractor and subcontractors, and then all final tests of equipment and systems in accordance with the Commissioning Agent procedures.
9. Manage all cross system testing such as HVAC, building fire alarm, emergency power, life safety, elevators, etc.
10. Participate in and perform all smoke evacuation testing in cooperation with the TAB and BMS contractors.
11. Note any inconsistencies or deficiencies in system operations and enforce system compliance or recommend to the Architect modifications to system design which will enhance system performance.
12. Coordinate with the Commissioning Agent and Construction Manager the required A/E, and Owner testing participation and approval procedures, after verifying that pretests have been satisfactorily conducted and final testes are ready to be performed.
13. In the event that a functional test fails, the cause of failure shall be determined and rectified as soon as possible, and then retested. If more than three functional tests of the same system(s) are required, the Contractor shall reimburse all associated costs for the extraordinary participation of the A/E, Commissioning Agent, Construction Manager and Owner's staff, as required by the particular test being performed.
14. Review operation and maintenance information and as-built drawings provided by the various subcontractors and vendors for verification, organization and distribution.
15. Obtain all documentation from tests and assemble a final test report to be submitted to the Construction Manager, Commissioning Agent, Architect and the Owner for approval.
16. Oversee and/or provide training for the systems specified in the Division with coordination by the Division 23 Subcontractors.

1.9 RELATED WORK

- A. All start-up and testing procedures and documentation requirements specified within Divisions 21, 22, 23 and 26.
- B. The Test, Adjust and Balance (TAB) firm shall provided the following:
  - 1. Allow sufficient time before final commissioning dates so that testing, adjusting and balancing can be accomplished.
  - 2. Put all heating, ventilating and air conditioning equipment and systems into full operation and continue the operation during each working day of testing, adjusting and balancing and commissioning so they are fully functional. This includes the complete installation of all equipment, materials, pipe, duct, wire, insulation, controls, etc., per the contract documents and related directives, clarifications, change orders, etc.
- C. A commissioning plan will be developed by the Commissioning Agent. Divisions, 21, 22, 23 and 26 are obligated to assist the Commissioning Agent in preparing the commissioning plan by providing all necessary information pertaining to the actual equipment and installation. If system modifications/clarifications are in the contractual requirements of this and related sections of work, they will be made at no additional cost to the Owner. If Contractor initiated system changes have been made that alter the commissioning process, the Test Engineer will notify the Commissioning Agent and Owner's Representative for approval.
- D. Normal start-up services required to bring each system into a fully operational state. This includes cleaning, filling, purging, leak testing, motor rotation check, control sequences of operation, full and part load performance, etc. The TAB firm will not begin the TAB work until each system is complete, including normal contractor start-up. The Commissioning Agent will not begin the commissioning process until each system is complete, including normal contractor start-up and the TAB work has been completed.
- E. Provide labor and material to make corrections when required, without undue delay.
- F. The HVAC Contractor shall include the cost of exchanged sheaves and belts as may be required by the TAB firm.
- G. Provide test holes in ducts and plenums where directed or necessary for pitot tubes to take air measurements and to balance the air systems. Test holes shall be provided with an approved removable plug or seal. At each location where ducts or plenums are insulated, test holes shall be provided with an approved extension with plug fitting.
- H. Provide pressure and temperature taps as indicated on construction documents in locations as required by the TAB firm to adequately test and/or balance the hydronic systems.
- I. The Contractor shall include a two week "flush out" period, in which the air handling systems are sequenced into a 100% outside air mode, to assist in the removal of any construction material out-gassing.

1.10 TEST EQUIPMENT

- A. Provide test equipment as necessary for start-up and commissioning of the mechanical equipment and systems. The TAB firm will provide the test equipment required to perform their service.

1.11 TEST EQUIPMENT - PROPRIETARY

- A. Proprietary test equipment required by the manufacturer, whether specified or not, shall be provided by the manufacturer of the equipment. Manufacturer shall provide the test equipment, demonstrate its use, and assist the Commissioning Test Engineer in the commissioning process. Proprietary test equipment shall become the property of the Owner upon completion of commissioning.
- B. Identify the proprietary test equipment required in the test procedures submittals and in a separate list of equipment to be included in the operations and maintenance manuals.

1.12 WORK PRIOR TO COMMISSIONING

- A. Complete all phases of work so the system can be started, tested, adjusted, balanced, controlled and otherwise commissioned. Divisions 21, 22, 23 and 26 have primary start-up responsibilities with obligations to complete systems, including all sub-systems completion will not relieve these Divisions from completing those systems as per the Construction and Commissioning schedule.

1.13 WORK TO RESOLVE DEFICIENCIES

- A. In some systems, mis-adjustments, misapplied equipment and/or deficient performance under varying loads will result in additional work being required by the Contractors to commission the systems. This work will be completed under the direction of the Construction Manager, Architect and Owner's Representative, with input from the Contractor, equipment supplier, and Commissioning Agent. Whereas all members will have input and the opportunity to discuss the work and resolve problems, the Architect will have final jurisdiction on the necessary work to be done to achieve performance.
- B. Corrective work shall be completed in a timely fashion to permit timely completion of the commissioning process. Experimentation to render system performance will be permitted. If the Commissioning Agent deems the experimentation work to be ineffective or untimely as it relates to the commissioning process, the Commissioning Agent will notify the Owner indicating the nature of the problem, expected steps to be taken, and the deadline for completion of activities. If deadlines pass without resolution of the problem, the Owner reserves the right to obtain supplementary services and/or equipment to resolve the problem. Costs incurred to solve the problems in an expeditious manner will be the Contractor's responsibility.

#### 1.14 SEASONAL COMMISSIONING AND OCCUPANCY VARIATIONS

- A. Seasonal commissioning pertains to testing under full-load conditions during peak heating and peak cooling seasons, as well as part-load conditions in the spring and fall. Initial commissioning will be done as soon as contract work is completed regardless of season. Subsequent commissioning may be undertaken at any time thereafter to ascertain adequate performance during the different seasons.
- B. All equipment and systems will be tested and commissioned in a peak season to observe full-load performance. Heating equipment will be tested during winter design extremes. Cooling equipment will be tested during summer design extremes, with a fully occupied building. Each Contractor and supplier will be responsible to participate in the initial and the alternate peak season test of the systems required to demonstrate performance, as scheduled by the Commission Agent, with three day (minimum) advance notification.
- C. Subsequent commissioning may be required under conditions of minimum and/or maximum occupancy or use. All equipment and systems affected by occupancy variations will be tested and commissioned at the minimum and peak loads to observe system performance. The Contractor will be responsible to participate in the occupancy sensitive testing of systems to provide verification of adequate performance.

#### 1.15 RECOMMISSIONING

- A. Upon notification by the Commissioning Agent of successful system/equipment performance/checkout test, the Owner shall witness Test No. 1. If any system/equipment/component/device fails to perform correctly during Test No. 1, the Contractor and/or equipment supplier must correct any systems/wiring deficiencies, and must incur any travel/airfares/food/hotel expenses of the designated Agent, to be available for the Retest No. 1.

#### 1.16 TRAINING

- A. Participate in the training of the Owner's engineering and maintenance staff, as required in Divisions 01, 21, 22, 23 and 26, on each system and related components. Training, in part, will be conducted in a classroom setting, with system and component documentation, and suitable classroom training aids.
- B. Training will be conducted jointly by the Commissioning Agent, the Contractor, and the equipment vendors. The Test Engineer will be responsible for highlighting system peculiarities specific to this project.

#### 1.17 SYSTEMS DOCUMENTATION

- A. In addition to the requirements of Division 01, The Contractor shall update contract documents to incorporate field changes and revisions to system designs to account for actual constructed configurations. All drawings shall be red-lined on two sets. Divisions 21, 22, 23 and 26 as-built drawings shall include architectural

floor plans, elevations, and details, and the individual mechanical or electrical systems in relation to actual building layout.

- B. Maintain as-built red-lines as required by Division 01. Given the size and complexity of this project, red-line drawings at completion of construction, based on memory of key personnel, is not satisfactory. Continuous and regular red-lining of drawings is considered essential and mandatory.

#### 1.18 MISCELLANEOUS SUPPORT

- A. Divisions 21, 22, 23 and 26 shall remove and replace covers of mechanical equipment, open access panels, etc., to permit the Commissioning Agent, Architect and Owner's representative to observe equipment and controllers provided. Furnish ladders and flashlights as necessary.

#### 1.19 SYSTEMS TO BE COMMISSIONED

##### A. HVAC

1. Each exhaust fan.
2. Each supply fan.
3. Each return fan.
4. Each supply air unit including verification of all air and water flows at each coil and filter.
5. Each air flow station.
6. Each Variable Frequency Drive.
7. Each humidifier
8. Verify the final accuracy of the air and water test and balancing report.
9. BMS functional and operational control sequences.
10. Each kilowatt metering interface.

##### B. Electrical

1. Circuit breaker trip setting verification.
2. Fire alarm interface to HVAC/ATC.
3. Emergency Power

#### 1.20 POST OCCUPANCY COMMISSIONING

- A. This Contractor shall fully cooperate in all regards with this phase of commissioning.
- B. The Commissioning Agent will prepare a complete building operations review within ten (10) months after substantial completion with the owners operating personnel and note in the report any outstanding construction and/or operational deficiencies that are identified during this post occupancy review. This report shall be provided to the owner, Construction Manager and A/E. This Post-Occupancy deficiency list shall be corrected by the Construction Manager under the one year guarantee/warranty period and shall be submitted as being completed by the Contractor and Equipment Suppliers. The Commissioning Agent shall also procure all equipment manufacturer test data verifying post-occupancy equipment

efficiencies and compare all such data to the information published by the manufacturer. This data shall be used to verify overall equipment efficiency against the contract specifications.

- C. Divisions 21, 22, 23 and 26 shall correct any and all system deficiencies noted by the Commissioning Agent during the first one year after substantial completion and as noted by the Commissioning Agent during the 10<sup>th</sup> month building operating review.

END OF SECTION