PART 1 - GENERAL

1.1 SUMMARY

A. This Section specifies minimum administrative and procedural requirements for mechanical and electrical systems functional performance testing required by the Contract Documents.

B. Related Sections:

1. 01 91 00 “General Commissioning Requirements”

1.2 SERVICES

A. Test Engineer - provided by Contractor.

B. Commissioning Authority - provided by Owner.

C. Electrical Testing Contractor (ETC) - provided by Electrical Subcontractor (working through the Contractor’s Test Engineer).

D. Testing, Adjusting and Balancing (TAB) - provided by Contractor, unless otherwise noted in the Work Order Scope of Work.

1.3 REQUIREMENTS FOR TEST ENGINEER

A. The Contractor shall provide the services of a “Test Engineer” experienced in commissioning including the troubleshooting of equipment and systems. The Test Engineer shall be qualified to develop and write, coordinate and schedule, and manage and document mechanical systems functional performance tests (FPT). The Test Engineer shall also coordinate the work of the ETC and assemble the required electrical commissioning documentation.

1. Qualified personnel experienced in the technical aspects of each system to be commissioned shall be provided, if necessary, to augment the expertise of the Test Engineer.

1.4 TEST ENGINEER DUTIES

A. The Test Engineer shall prepare and submit all FPT and commissioning documentation required by the Contract Documents for the actual equipment and systems installed, including but not limited to, start-up plans, installation verification audit reports, start-up and FPT deficiency report forms, test equipment identification lists, FPT procedures, FPT data forms, and one-line system and riser diagrams.

1. Maintain separate mechanical and electrical (M&E) systems “Commissioning Binders,” indexed and tabbed according to the equipment or systems requiring commissioning, to compile the start-up and FPT documentation. Blank start-up forms,

approved by the Commissioning Authority, shall populate the initial binders and be replaced with completed forms that shall be submitted in final M&E systems Commissioning Binders, as a requirement of Final Completion. The binders shall be on-site during the work. (see Section 01 91 00 for the Commissioning Binders documentation requirements)

2. Prior to testing, the Test Engineer shall have applicable Subcontractor's and manufacturer's representatives review the test and commissioning documentation to identify personnel safety issues, equipment protection issues, and to validate relevance to the actual equipment provided.

B. Prepare and submit a "Commissioning Plan" for Owner's review and comment before developing the FPT procedures and prior to any equipment or systems testing and/or start-up required by the Contract Documents.

C. Develop a commissioning schedule for all FPT and commissioning activities required by the Contract Documents and integrate into the construction Progress Schedule. Identify:

1. Commissioning Plan preparation, submittal, and review;

2. Each required functional performance test;

3. Sequence of testing, including commissioning activity start-up prerequisites, point-to-point testing, and balancing activities; and

4. Submission and approval of test results.

D. Develop and write FPT procedures for all equipment tests, and systems and cross-systems tests required by the Contract Documents. Test procedures shall be in accordance with equipment manufacturer's recommendations, where applicable. Test procedures shall fully describe the equipment or system configuration and steps required for each test. The procedures shall be appropriately documented so that another party can repeat the identical test.

1. Maintain a set of drawings for recording the sign-off of each component of the plumbing and piping system pressure testing, heating, ventilation, and air conditioning (HVAC) system duct work pressure testing, and the completed flushing/cleaning and treatment activities.

E. Coordinate the participation of each Subcontractor, including the ETC, specific to their start-up and testing responsibilities. Inform each Subcontractor as to what their test and expected results will be prior to commissioning.

F. Observe the progress of the work to assure that all installations requiring commissioning are being made in accordance with the Contract Documents. Prepare and submit installation verification audit reports prior to the start-up of equipment or systems for which a formal start-up is specified in the Contract Documents.

G. Coordinate all cross-systems testing such as HVAC, environmental controls, fire alarm, emergency power, life safety, elevators, and chiller controls.

H. Manage and observe the start-up testing and all final tests of equipment and systems required by the commissioning plan and document test results.

I. Report any deficiency in equipment or systems and either enforce compliance with the Contract Documents or provide Owner with technical expertise to recommend modifications to the equipment or systems to correct the deficiency. Oversee and direct the correction of deficiencies found during commissioning.

J. Coordinate the required Commissioning Authority, A/E or other Owner-witness participant for all test/approval procedures, after verifying that pretests have been satisfactorily conducted and final tests are ready to be performed.

1. Notify the Owner's Representative in writing of the date, time, location, and anticipated duration of start-up and test activities, with a minimum of five (5) working days advance notice.

2. Obtain the signature of the designated witness on all data forms. If the witness is unavailable at the scheduled time and location of the activity, so note, and proceed per schedule without the witness.

K. Compare operation and maintenance information provided by the various Subcontractors and vendors with the Project Record documents and report any discrepancies to the Owner's Representative.

L. Oversee and provide Owner with operating instruction and training for the mechanical and electrical equipment and systems specified in the Contract Documents, with coordination by the M&E Subcontractors.

M. Provide as-built information to update the commissioning basis-of-design criteria.

1.5 TEST FAILURES

A. In the event that a functional test fails, the Contractor shall determine the cause of failure, rectify the failure as soon as possible, and then retest. If more than two (2) functional tests of the same system are required, all costs for additional testing shall be borne by the Contractor, at the Owner's sole discretion.

1.6 CANCELLATIONS

A. The Test Engineer shall give at least 48 hours advance notice to the Owner's Representative of cancellation of any scheduled test.

1. Any costs incurred by Owner due to insufficient advance notice of cancellations shall be borne by the Contractor, at the Owner's sole discretion.

1.7 WARRANTY TESTS

A. In the event a product fails during the warranty period, the Contractor shall determine the cause of failure, rectify the failure as soon as possible, and then retest. All warranty testing shall be borne by the Contractor.

1.8 TEST ENGINEER QUALIFICATIONS

A. The Contractor shall propose a Test Engineer, who is competent in the Project's M&E systems design and intent, for the Owner to evaluate and approve or reject in writing, based upon the following criteria which shall be documented in the Test Engineer resume.

1. The Test Engineer shall have extensive experience in start-up and troubleshooting of HVAC, hot water heating, chilled water, steam, plumbing, electrical, emergency power, fire alarm, lighting controls, life safety systems and other systems of similar complexity to those contained in the Contract Documents that are required to be commissioned.

2. The Test Engineer shall:

a. Be familiar with the Project's control operating system(s);

b. Be capable of troubleshooting control code and recommending necessary modifications;

c. Be knowledgeable in testing and balancing of both air and hydronic systems;

d. Have an excellent working knowledge of complex fire alarm, environmental and electric power control systems;

e. Have excellent communication and writing skills, be highly organized, and be able to work well with the Project's Subcontractors; and

f. Have a Bachelor's degree in mechanical engineering, PE certifications, and related field experience.

(1) However, in lieu of a Bachelor's degree and PE certifications, other technical training with extensive practical field experience may be considered.

B. Test Engineer Resume - The Contractor shall submit the Test Engineer's resume, including the following documentation:

1. Present or most recent employment:

a. Company name and address
b. Present title and job description
c. Dates of employment

2. Other relevant work experience:

    a. Company name and address
    b. Job title and description
    c. Dates of employment

3. For a minimum of three (3) similar projects, description of commissioning experience and roles performed in commissioning activities that demonstrate working knowledge of complex systems.

4. Samples of a commissioning plan, a start-up plan, and a FPT with data forms written by the Test Engineer.

5. References from a minimum of three (3) project owners and/or commissioning authorities.

6. Description of education, certifications, and other technical training or field experience.

1.9 COMMISSIONING AUTHORITY

A. The Owner will provide a “Commissioning Authority,” or appoint an Owner-designated witness, to act as the commissioning authority.

1. The Commissioning Authority will provide no labor or equipment in the commissioning process.

B. The duties of the Commissioning Authority are to:

1. Provide commissioning basis-of-design criteria, for Contractor’s information;

2. Ascertain that the Project commissioning processes and information provided is in accordance with the requirements of the Contract Documents;

3. Review the Contractor's Commissioning Plan, start-up plans, installation verification audit reports, start-up and FPT deficiency report forms, and FPT data forms;

4. Review the Contractor's equipment, systems and cross-systems FPT procedures;

5. Witness, verify, and approve satisfactory completion of equipment, systems and cross-systems FPT, based upon the Contract Documents requirements;

6. Review for accuracy, comment on, and approve specified close-out documentation;

7. Recommend Substantial Completion when commissioning and training has been successfully completed; and

8. Provide final commissioning reports to the Owner.

C. The Commissioning Authority will communicate as follows:

1. The Commissioning Authority will formally communicate with the Contractor via approved project channels. It is expected, however, that informal communication and coordination will be conducted directly with the Test Engineer. As the Owner's commissioning representative, it is expected that the Commissioning Authority will communicate directly with A/E, as may be appropriate.

2. The Commissioning Authority will keep the Owner's Representative advised regarding commissioning activities and progress, equipment and systems performance, and any problems and solutions thereto.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION