

**SECTION 01 91 13**  
**GENERAL COMMISSIONING 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.
- B. Section 230800 - Commissioning of HVAC
- C. Commissioning Plan (Cx Plan)- The contractor's responsibilities set forth in the Cx Plan are meant to supplement the services set forth in this specifications. If there is a conflict between the services set forth in this specification and the services set forth in the Cx Plan, the more onerous shall take precedence.

1.2 SUMMARY

- A. This section includes general requirements that apply to implementation of commissioning. All applicable sub-contractors shall include cost for their involvement in the commissioning process including demonstration of installed equipment to the commissioning team members during the acceptance portion of the project, and other responsibilities as described in this specification. The commissioned systems for this project are listed below. A more detailed list of commissioned equipment and systems can be found in the Cx Plan:
  - 1. HVAC equipment listed in the mechanical schedule including but not limited to steam boilers, feedwater economizers, condensate polishers, and safety devices.
  - 2. HVAC Controls including the Boiler Control System (including the controls for new Boiler #3, and the plant control and SCADA system).
  - 3. Electrical systems consisting of emergency power supply systems, UPS systems, automatic transfer switches, switchboards, power monitoring, power & lighting panel boards, lighting controls, and connections to equipment.
- B. RELATED SECTIONS:
  - 1. Division 23 Section: HVAC & R - HVAC&R systems, assemblies, equipment, and components.
  - 2. Division 23 Section: General Testing, Adjusting, Balancing.
  - 3. Division 23 Section: Instrumentation and Digital Control - integrated building automation systems, assemblies, equipment, and components.
  - 4. Division 23 Section: Commissioning of HVAC

5. Division 26 Section: Electrical Systems - electrical systems, assemblies, equipment, and components.
  6. Division 26 Section: Lighting Control Systems - lighting control systems, assemblies, equipment, and components.
  7. Division 28 Section: Electronic Safety and Security - electronic safety and security systems, assemblies, equipment, and components.
- C. Commissioning is a comprehensive and systematic process to verify that the building systems perform as designed to meet the owner's requirements. Commissioning during the design, construction, acceptance, and warranty phases is intended to achieve the following specific objectives:
1. Verify and document that equipment is installed and started per manufacturer's recommendations and to industry accepted standards.
  2. Verify and document that equipment and systems receive complete operational checkout by installing contractors.
  3. Verify and document equipment and system performance.
  4. Verify the completeness of operations and maintenance materials.
  5. Ensure that the owner's operating personnel are adequately trained on the operation and maintenance of building equipment.
- D. The Commissioning Authority will witness all testing indicated in the Cx Plan. The testing scope is included in the respective specification sections and the testing forms will be generated 3 weeks prior to testing, but the scope of the testing will not change.
- E. The commissioning process does not take away from or reduce the responsibility of the system designers or installing contractors to provide a finished and fully functioning product.

### 1.3 DEFINITIONS

- A. BOD - Basis of Design. A document that records concepts, calculations, decisions, and product selections used to meet the OPR and to satisfy applicable regulatory requirements, standards, and guidelines. The document includes both narrative descriptions and lists of individual items that support the design process.
- B. Cx Plan - Commissioning Plan. A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.
- C. CxA - Commissioning Authority.
- D. EOR - Engineer of Record.
- E. FPT - Functional Performance Test. A written Method of Procedure (MOP) and test script for all Integrated System (IST) and Pull-the-Plug (PTP) tests that shall include step by step description of each activity in chronological order including duration, required personnel, and back out procedure for each step. Test scripts

shall also include any requirements for supplemental monitoring equipment and radio communications to be provided by the contractor(s) during the tests. FPTs can be multi-discipline and multi-trade activities that require choreographing and rehearsing with the project team.

- F. HVAC&R - Heating, Ventilating, Air Conditioning, and Refrigeration.
- G. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.
- H. OPR - Owner's Project Requirements. A document that details the functional requirements of a project and the expectations of how it will be used and operated. These include Project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information.
- I. PFC - Pre-Functional Checklist. The PFC documents the construction status of the equipment or system and ensures that pre-requisite systems and checks are completed prior to energizing and operating the equipment. Upon completion of the PFC, the equipment and / or systems are complete and operational, so that the functional performance testing can be scheduled. The PFC may require that a start-up certification from the vendor, control points lists, and sequence verification forms are attached.

#### 1.4 COMMISSIONING TEAM

- A. At a minimum, the members of the commissioning team consist of the Commissioning Authority (CxA), the Owner's Representative (PM), the General Contractor (GC or Contractor), the Mechanical Contractor (MC), the Electrical Contractor (EC), the Controls Contractor (CC), the Test and Balance Contractor (TAB), the owner's maintenance staff, and any other installing subcontractors or suppliers of equipment.
- B. Members Appointed by Contractor(s): Individuals, each having the authority to act on behalf of the entity he or she represents, explicitly organized to implement the commissioning process through coordinated action. The commissioning team shall consist of, but not be limited to, representatives of each Contractor, including Project superintendent and subcontractors, installers, suppliers, and specialists deemed appropriate by the CxA.
- C. Management. The Commissioning Authority (CxA) - All applicable sub-contractors shall include cost for their involvement in the commissioning process including demonstration of installed equipment to the commissioning team members during the acceptance portion of the project, and other responsibilities as described in the specification.
- D. Members Appointed by Owner:

1. CxA: The designated person, company, or entity that plans, schedules, and coordinates the commissioning team to implement the commissioning process.
2. Representatives of the facility user and operation and maintenance personnel.
3. Architect and engineering design professionals.

#### 1.5 COMMISSIONING PROCESS

- A. The following activities describe the commissioning tasks during construction and the general order in which they occur. The commissioning provider coordinates all activities.
  1. Kick-Off Meeting. Appropriate members of the design and construction team that will be involved in the commissioning process will attend a commissioning scoping meeting to be introduced to the requirements of the commissioning: checklists, tests, scope of work, schedule, tasks, and contractor responsibilities with regard to the implementation of the Commissioning Plan.
  2. Commissioning Plan. The commissioning plan provides guidance in the execution of the commissioning process.
  3. Submittals. Equipment submittals are to be submitted by the contractor to the CxA and concurrently to the EOR for review and approval for the all equipment and systems to be commissioned (refer to section 1.2.A).
  4. Start-Up/Pre-Functional Checklists. The CxA works with the contractors to develop startup plans and verification of readiness for commissioning documentation format. Pre-functional checklists will be provided to the contractors to be completed during the startup process, or pre-functional checklists may be provided by the contractor with prior review and approval by the CxA. Completion of the Pre-functional checklists indicates readiness for functional testing. If the CxA is notified by the installing contractor that the systems is ready for testing, and the CxA is unable to test because of the state of system readiness, the installing subcontractor will be back charged for the CxA's time and expense at the current year's labor rate for the CxA.
  5. Functional Performance Testing. The objective of functional performance testing is to demonstrate that each system is operating according to the documented OPR, BOD and Construction Documents. Functional performance testing comprises a full range of tests to verify that all components, equipment, systems, and interfaces between systems operate correctly. This includes all operating modes, interlocks, control sequences, and responses to emergency conditions. All verification procedures are directed, witnessed, and documented by the CxA. Any testing or manipulation of electrical power, interlocks, alarms or system controls will be by the installing contractor.
  6. Deficiencies and Resolution. The CxA documents items of non-compliance in materials, installation or operation. In collaboration with the entity responsible for system and equipment installation, perform corrective action until the

issues are resolved to the satisfaction of the owner or the CxA. When the deficiencies are rectified, the contractor will notify the CxA for final re-testing. Any subsequent re-testing due to un-resolved deficiencies will be back charged to the contractor for the CxA's time and expense at the current year's labor rate for the CxA.

7. Operations and Maintenance Documentation. The CxA reviews the O&M documentation for completeness.
8. Training. The CxA reviews and coordinates the training provided by the contractors and verifies that it is completed.
9. Seasonal Testing. Deferred or seasonal testing is conducted, as required. Contractors will be responsible to repair any deficiencies found during this testing. If contractor is required for this testing, it will be negotiated separately.

#### 1.6 SUBMITTALS

- A. The CxA will require submittals for all commissioned equipment to formulate the pre-functional tests and functional tests. Additionally, the CxA reviews submittals related to the commissioned equipment and their controls for conformance to the OPR, BOD and Construction Documents. Equipment submittals are to be submitted by the contractor to the CxA and concurrently to the EOR for review and approval for the all equipment and systems to be commissioned (refer to section 1.2.A).
- B. The CxA may submit written requests for additional information from contractors to facilitate the commissioning process.
- C. The CxA may request additional design and operations narrative from the design team and Controls Contractor.

#### 1.7 REPORTING

- A. The CxA will provide regular reports to the Owner and the GC with increasing frequency as construction and the process of commissioning progresses.
- B. The CxA will regularly communicate with all members of the commissioning team, apprising them of commissioning progress and scheduling changes through memos, progress reports, etc.
- C. The CxA compiles a final Commissioning Report which summarizes all of the tasks, findings, and documentation of the commissioning process. The report addresses the actual performance of the building systems in reference to the design intent and contract documents. The report includes completed pre-functional inspection checklists, functional performance testing records, diagnostic monitoring results, identified deficiencies, recommendations, and a summary of commissioning activities.
- D. The CxA will maintain meeting minutes for all weekly commissioning meetings.

## 1.8 MEETINGS

- A. Scoping Meeting. The CxA will schedule, plan and conduct a commissioning scoping meeting with the entire commissioning team in attendance. The CxA will distribute meeting minutes to all parties.
- B. Miscellaneous Meetings. Other meetings will be planned and conducted by the CxA as construction progresses as appropriate. These meetings will cover coordination, deficiency resolution and planning issues. The attendance of a representative of each subcontractor on the commissioning team will be required.

## PART 2 - RESPONSIBILITIES

- 2.1 The responsibilities of various parties in the commissioning process are provided in the following sections. Note that the services for the Owner, Design Team, and Commissioning Provider are not included in this contract. The Contractor is not responsible for providing their services. Their responsibilities are listed here to clarify the commissioning process only.

### 2.2 OWNER'S RESPONSIBILITIES

- A. Provide the OPR documentation to the CxA and each Contractor for information and use.
- B. Assign operation and maintenance personnel and schedule them to participate in commissioning team activities.
- C. Provide the OPR prepared by the Owner and provide the BOD documentation, prepared by Design Engineers/Architect and approved by Owner, to the CxA and each Contractor for use in developing the commissioning plan, systems manual, and operation and maintenance training plan.

### 2.3 CONTRACTING OFFICER REPRESENTATIVE (COR) RECORD'S OF RESPONSIBILITIES

- A. Construction and Acceptance Phase
  - 1. Attend the commissioning kick-off meeting and selected commissioning team meetings.
  - 2. Perform normal submittal review, construction observation, as-built drawing preparation, O&M manual preparation, etc., as contracted and provide a copy to the CxA.
  - 3. Provide design narrative documentation requested by the CxA.
  - 4. Coordinate resolution of system deficiencies identified during commissioning, according to the contract documents.
  - 5. Resolve issues identified by the CxA that are related to errors in design.
  - 6. Prepare and submit final as-built BOD documentation for inclusion in the O&M manuals. Review and approve the O&M manuals.

B. Warranty Period

1. Coordinate resolution of design non-conformance and design deficiencies identified during warranty period commissioning. Warranty - minimum of 1 year from initial firing of boiler, limited to 18 months after date of equipment shipment. Installation to include 1 year guarantee or insurance policy.

2.4 GENERAL CONTRACTOR (GC)

A. Construction and Acceptance Phase

1. Facilitate the coordination of the commissioning work by the CxA.
2. Integrate all commissioning activities into the master construction schedule. The schedule will include the following information for each piece of equipment: Factory acceptance tests, pre-functional testing, equipment functional testing, system performance testing and site integration testing.
3. A representative shall attend a commissioning kick-off meeting and other necessary meetings scheduled by the CxA to facilitate the commissioning process.
4. Furnish a copy of all construction documents, addenda, change orders and approved submittals and shop drawings related to commissioned equipment and systems to the CxA.
5. In each purchase order or subcontract written, include requirements for submittal data, O&M data, commissioning tasks and training.
6. Ensure that all subcontractors execute their commissioning responsibilities according to this specification and the commissioning plan.
7. Ensure that equipment vendors (or their local representative) that are required to perform on site start-up will attend functional testing. GC is to include this clause in specified vendor's RFP.
8. Coordinate and ensure that the sub-contractors and equipment vendors complete and document required Pre-Functional and Functional Performance testing including testing that requires multi-discipline and multi-trade activities. Collect and collate the pre-functional equipment checklists and documents required by these checklists for all equipment and system to be commissioned. The GC is to deliver the pre-functional checklists completed and signed by all required disciplines to the CxA, along with supporting documentation for all commissioned equipment and systems one (1) week prior to Functional Performance Testing. All completed pre-functional checklists must be approved by the CxA before functional performance testing is started. If the GC indicates inaccurate completion of these checklists, and it results in the CxA unable to perform the Functional Performance Tests, the GC will be back charged for the CxA's time and expense at the current year's labor rate for the CxA.
9. Ensure that Subcontractors correct deficiencies and make necessary adjustments to O&M manuals and as-built drawings per the issues identified by the CxA.
10. Coordinate the training of owner personnel.
11. Prepare O&M manuals, as-builts (including clarifying and updating the original sequences of operation to as-built conditions), warranties, spare parts, submittals and submittal logs, RFI's and RFI logs, etc (as referenced elsewhere in the complete Project

Manual) according to the format developed by the CxA and/or the EOR, and reviewed and approved by the Owner. The documents shall be submitted by the Contractor to the Commissioning Authority both electronically and in hard copy. All electronic PDF documents shall be searchable with bookmarks mimicking the tabs in the binder.

12. Provide the CxA and owner with ongoing operation instructions for all energy- and water-saving features and strategies, operating instructions for integrated building systems, recommendations for recalibration frequency of sensors and actuators by type and use, and single line diagrams of each commissioned system

B. Warranty Period

1. Ensure that subcontractors correct deficiencies and make necessary adjustments to O&M manuals and as-built drawings for issues identified in seasonal testing. Warranty - minimum of 1 year from initial firing of boiler, limited to 18 months after date of equipment shipment. Installation to include 1 year guarantee or insurance policy.

2.5 INSTALLING CONTRACTORS RESPONSIBILITIES: (Mechanical Contractor (MC), Plumbing Contractor (PC), Electrical Contractor (EC), Controls Contractor (CC), Fire Protection Contractor (FPC))

- A. The responsibilities of Contractors in the commissioning process are provided in this section to clarify the commissioning process.

- B. Contractors shall assign representatives with expertise and authority to act on its behalf and shall schedule them to participate in and perform commissioning process activities including, but not limited to, the following:

1. The CxA will work with the GC to schedule commissioning activities. The GC shall integrate all commissioning activities into the master construction schedule. All parties will address scheduling issues in a timely manner in order to expedite the commissioning process.
2. Equipment submittals are to be submitted by the contractor to the CxA and concurrently to the EOR for review and approval for the all equipment and systems to be commissioned (refer to section 1.2.A).
3. Attend Commissioning and Coordination Meetings during the construction, acceptance and warranty phases as designated by the CxA.
4. Attend construction phase controls coordination meeting.
5. Integrate and coordinate commissioning process activities into the construction schedule.
6. Document equipment installation, testing, and startup activities as defined by the manufacturer and provide to the CxA as supporting documents attached to the Pre-Functional Checklists.
7. Labor, instrumentation, tools, test gasses, test equipment and costs for manufacturers representatives or additional technicians for the performance of all commissioning related testing are to be provided by the contractor responsible for the installation of the equipment or system to be commissioned. Tools and test equipment are to be calibrated and in good working order.



- Testing equipment calibration certifications must be current in accordance with all requirements of the Project Manual.
8. Provide measuring instruments and logging devices to record test data, and provide data acquisition equipment to record data for the complete range of testing for the required test period as designated by the CxA.
  9. Perform the pre-functional equipment checks and document these requirements and tests in the pre-functional checklists provided by the CxA for all equipment and system to be commissioned. Contractor is to deliver the pre-functional checklists completed and signed to the GC, along with supporting documentation for all commissioned equipment and systems two (2) weeks prior to Functional Performance Testing. All completed pre-functional checklists must be approved by the CxA before functional performance testing is started. If the contractor indicates inaccurate completion of these checklists, and it results in the CxA unable to perform the Functional Performance Tests, the contractor will be back charged for the CxA's time and expense at the current year's labor rate for the CxA.
  10. Review the commissioning process functional test procedures (Functional Performance Tests - FPTs ) provided by the Commissioning Authority. The FPTs include test scripts for all Integrated System and Pull-the-Plug tests that shall include step by step description of each activity in chronological order including duration, required personnel, and back out procedure for each step. Testing will include all operation and alarm modes.
  11. At least one (1) week prior to functional performance testing the Contractors will provide written verification that all electrical connections are complete, dust making activities have ceased, all control's point to point verification is completed, all commissioned systems and equipment start-ups are completed, Pre-Functional Checklists and Pre-Functional Verification Forms Completed and signed, all equipment to be commissioned is in operation, the Building Automation System's Graphics and Trending are Complete, TAB is completed, Lighting and Fire Protection Controls and Sensors are completed and O&M Manuals are available.
  12. Address current A/E punch list items before functional testing.
  13. The HVAC contractor will provide a preliminary TAB report to the CxA one (1) week prior to testing.
  14. The Contractor(s) will demonstrate and perform commissioning process functional performance tests under the direction of the CxA and with the CxA acting as a witness to the tests. If the functional performance tests result in deficiencies, the contractor will be given an Issues Log listing the deficiencies discovered during testing. When the deficiencies are rectified, the contractor will notify the CxA for final re-testing. Any subsequent re-testing due to un-resolved deficiencies will be back charged to the contractor for the CxA's time and expense at the current year's labor rate for the CxA.
  15. Cooperate with the CxA for resolution of issues recorded in the Issues Log, Construction Observation and test reports. In collaboration with the entity responsible for system and equipment installation, perform corrective action until the issues are resolved to the satisfaction of the owner or the CxA.

16. Participate in systems, assemblies, equipment, and component maintenance orientation and inspection as called out in the installation specifications.
  17. Provide the CxA with training curricula for review and approval for all commissioned equipment and systems a minimum of four weeks prior to the scheduled training. Provide a record of attendance for Owner's Operation and Maintenance Training on required commissioned systems.
  18. Provide EOR and CxA with site specific copies of Operation and Maintenance Manuals detailing all manufacturer's recommended maintenance procedures and spare parts lists for review and approval for all commissioned equipment and systems a minimum of four weeks prior to submission for substantial completion.
  19. Provide "As Built" drawings for all commissioned equipment and systems to the EOR and the CxA for review and approval.
  20. Provide the GC, CxA and owner with ongoing operation instructions for all energy- and water-saving features and strategies, operating instructions for integrated building systems, recommendations for recalibration frequency of sensors and actuators by type and use, and single line diagrams of each commissioned system
- C. If the installing contractor requires the vendor to perform start-up, then the factory start-up technician or qualified local representative will be required to attend functional testing.

2.6 ADDITIONAL RESPONSIBILITIES FOR CONTROLS CONTRACTOR (CC), LIGHTING CONTROLS (EC) AND FIRE PROTECTION CONTRACTOR (FPC)

- A. Upon completion of the installation, Contractor will provide evidence (pre-functional checklists with acceptance signatures) to the Commissioning Authority that all:
1. Analog input points have been tested and calibrated.
  2. Digital input points have been tested.
  3. Analog output points stroke / function properly.
  4. Digital output points operate properly.
- B. Work with the Commissioning Authority to develop tuning validation tests using appropriate trend logs to show that control loops have been properly tuned to optimize energy usage while maintaining stable operation and occupant comfort. A record of actions taken, problems encountered and how the resolution was implemented for loop tuning, system and energy optimization is to be kept by the CC and delivered to the CxA as a part of the CC's documentation.
- C. Commissioning Tools Graphic shall be created for each unique System for Global and specific override of input values, positions and/or set points to assist in commissioning. Graphic shall be accessible from each System or Unitary Graphic. A commissioning graphic for the chilled water system would allow all of the cooling control valves to be opened or closed. A graphic would provide temperature override to all zones in the building, similar graphics will be created for all other systems. This graphic should also display individual zone values including maximums and minimums - e.g. for fan coil unit graphic, this includes fan status, fan command,

heating water valve command, chilled water valve command, supply air temperature, filter status, etc.

## 2.7 ADDITIONAL RESPONSIBILITIES FOR MECHANICAL / PLUMBING CONTRACTOR (MC)

- A. The Contractor(s) will demonstrate and perform hydrostatic test and flush requirements including HVAC piping pressure testing under the direction of the CxA and with the CxA acting as a witness to the tests. If the tests result in deficiencies, the contractor will be given an Issues Log listing the deficiencies discovered during testing. When the deficiencies are rectified, the contractor will notify the CxA for final re-testing. Any subsequent re-testing due to un-resolved deficiencies will be back charged to the contractor for the CxA's time and expense at the current year's labor rate for the CxA.
- B. Perform applicable construction integrity testing as outlined in the Cx Plan.

## 2.8 ADDITIONAL RESPONSIBILITIES FOR ELECTRICAL CONTRACTOR (EC)

- A. The Contractor(s) will demonstrate and perform electrical insulation resistance testing under the direction of the CxA and with the CxA acting as a witness to the tests. If the tests result in deficiencies, the contractor will be given an Issues Log listing the deficiencies discovered during testing. When the deficiencies are rectified, the contractor will notify the CxA for final re-testing. Any subsequent re-testing due to un-resolved deficiencies will be back charged to the contractor for the CxA's time and expense at the current year's labor rate for the CxA.
- B. Perform applicable construction integrity testing as outlined in the Cx Plan.
- C. The Contractor(s) will conduct the Pull the Plug testing under the guidance and coordination of the CxA.

## 2.9 TESTING, ADJUSTING, AND BALANCING (TAB) CONTRACTOR RESPONSIBILITIES

- A. Construction and Acceptance Phases
  - 1. Attend a commissioning kick-off meeting and other necessary meetings scheduled by the CxA to facilitate the commissioning process.
  - 2. Contractors shall coordinate equipment names with CxA commissioned equipment and systems when unique names of the equipment have not been assigned by the EOR.
  - 3. Provide the CxA with a list of deficiencies discovered during the TAB process before functional performance testing.
  - 4. Provide the CxA with a preliminary TAB report at least 1 week prior to functional performance testing for review and approval.
  - 5. After the TAB process is performed and the balance report is submitted, the CxA shall witness a verification test to be performed by the TAB contractor using the same calibrated and

certified measurement equipment used for the balance report. The extent of verification shall be to the discretion of the commissioning Authority; however a minimum of 15% of all readings shall be verified. If readings deviate more than + or - 10% from the report the TAB contractor shall be directed to re-balance the system and submit new reports.

6. Correct deficiencies (differences between specified and observed performance) as interpreted by the CxA, PM and A/E and retest the equipment. Make necessary adjustments to the TAB report and provide the CxA with a final copy of the TAB report.

## 2.10 EQUIPMENT SUPPLIERS

- A. Provide all requested submittal data, including detailed start-up procedures and specific responsibilities of the Owner to keep warranties in force.
- B. If the installing subcontractor requires the vendor to perform start-up, then the factory start-up technician or qualified local representative will be required to attend functional testing and assist in equipment testing after start-up.
- C. Provide information requested by CxA regarding equipment sequence of operation and testing procedures.

## 2.11 CxA RESPONSIBILITIES

- A. Coordinates and directs all commissioning activities. Work with the GC and PM to ensure that commissioning activities are being scheduled.
- B. Plan, conduct and notate the commissioning kick-off meeting and subsequent weekly meetings.
- C. Review Contractor submittals applicable to commissioned systems, concurrent with the EOR reviews.
- D. Provide and revise as necessary, the commissioning plan (Cx Plan).
- E. Request and review additional information required to perform commissioning tasks, including O&M materials, contractor start-up and checkout procedures, and sequences of operation.
- F. Perform site visits, as contracted, to observe component and system installations. Attend selected planning and job-site meetings to obtain information on construction progress.
- G. The CxA develops project-specific construction checklists (pre-functional checklists), commissioning process test procedures (Functional Performance Tests - FPTs, Integrated System - IST, and Pull-the-Plug - PTP tests) for the equipment and systems to be commissioned. These procedures are based on the construction documents prepared by the design team as well as the OPR and BOD. The tests include step by step descriptions of each activity in

chronological order including duration, required personnel, and back out procedure for each step. Test scripts shall also include any requirements for supplemental monitoring equipment and radio communications during the tests. FPTs, ISTs and PTPs are multi-discipline and multi-trade activities that may require choreographing and rehearsing with the contractors and Cx Team members. All verification procedures are directed, witnessed, and documented by the CxA, with other parties present as appropriate.

- H. Coordinate, witness, and document functional performance tests performed by installing contractors. Coordinate a final re-testing to determine whether a satisfactory performance is achieved.
- I. Prepare and maintain the Commissioning Issues Log.
- J. Review and witness systems, assemblies, equipment, and component startup.
- K. The CxA, in coordination with the Engineer, shall be responsible for developing for Owner review and approval, the requirements and format of all close-out material including O&M manuals, as-builts, warranties, spare parts, submittals and submittal logs, RFI's and RFI logs, etc. The CxA shall be responsible to collect, compile, schedule, review and approve, and deliver all close-out documentation in a consistent and professional format as described in section VII of the Commissioning Standards Manual. The documents shall be submitted by the Contractor to the CxA both electronically and in hard copy. All electronic PDF documents shall be searchable with bookmarks mimicking the tabs in the binder.
- L. Compile test data, inspection reports, and certificates; include them in the systems manual and final commissioning report.
- M. Review the Operation and Maintenance Manuals.
- N. Review Owner Operation and Maintenance training curricula and document owner training has taken place as required.

END OF SECTION 019113