

SECTION 01810

COMMISSIONING

PART 1 –GENERAL

1.01 SCOPE OF SPECIFICATION

At the onset of the project the Stanford Project Manager

- A. Will review the scope of the project to determine if commissioning (Cx) will be done by the General Contractor (GC) or a 3rd party commissioning agent (CxA). If the GC is selected to take on commissioning responsibilities, the Cx agent's scope of work will be transferred to the GC. General requirements for the commissioning of the listed systems, is to demonstrate that each system has been provided and installed in strict accordance with the Contract Documents and that each system operates as specified to meet end user needs. Commissioning is ultimately the responsibility of the GC and associated subcontractors. The CxA will be under direct contract with Stanford to check on commissioning status and verify that contractors have commissioned systems completely.

The following systems (and all integrated equipment / controls) are to be included in the Commissioning Scope of Work. Additional systems may be added as applicable.

Plumbing / Process Piping:

1. Domestic water systems
2. Storm Drainage systems Roof Storm and Overflow Drainage Systems
3. Sanitary Waste System
4. Natural Gas
5. Fuel Oil System
6. Lab Waste & Drain System
7. Process Gas systems (O₂, CO₂, H₂, N₂ and LN₂)
8. Process Vacuum System
9. CDA System
10. RO / DI Water System
11. Reclaimed Water Systems

Mechanical

1. Chilled Water System (including controls, piping, pumps and VFD's)
2. Heating Hot Water System (including heat exchanger, pumps, controls and VFD's)
3. Process Cooling Water (Controls, Piping, Heat Exchangers, Pumps, VFD's)
4. Chemical Treatment

5. Steam and Steam Condensate System
6. Air handling systems
7. HVAC Terminal units
8. Packaged HVAC equipment
9. Radiant Heating System
10. Exhaust Systems
11. Clean room Testing, Adjusting and Balancing
12. Building Automation System (Controlled Devices, Control Loops, System Integration and Trending)

Electrical

1. Electrical Distribution (Main Service, Switchboard, MCC's & Panels)
2. Grounding System
3. Emergency Power System (Generator and ATS)
4. Lighting Control System (Occupancy Sensors, Daylight Sensors)
5. Exterior Lighting System
6. Photo-Voltaic System

Life Safety Systems

1. Fire Detection System
2. Fire Suppression/Protection Systems
3. Emergency Egress Lighting
4. Smoke Control /Smoke Dampers
5. Gas Detection Systems (CO /TGO)
6. Fire Shutters/Smoke Curtains

Process Labs

1. Fume Hoods
2. Safety Showers and Eyewashes
3. Controlled Environment Rooms

Conveyance and Lifting Systems

1. Elevator
2. Motor Operated Roll-up Doors
3. Overhead Cranes
4. Loading Dock Levelers

B. The design review shall provide the following deliverables:

1. Review of the drawings and specifications – for design / operation / commissionability of equipment and systems.
2. Review of the specifications for construction quality-check requirements for each system.
3. Develop the turnover package (TOP) requirements with the GC and client, which include the number of systems and the boundaries for the commissioned systems.

- C. Commissioning shall include Functional Performance Tests: Conduct a systematic performance test of each individual element, subsystem, and total system to a predefined test method with the option of the attendance of the Architect/Engineer and / or Owner's representative. The testing shall include all controls, alarms, and systems integral to and/or necessary for the proper function of the facility, and will also include a summary commissioning report.
- D. Corrections and Adjustments: Sub Contractors shall record, correct and adjust all deficiencies in operation noted during testing and then perform a retest. Any additional costs for retesting will be the responsibility of the sub contractors.
- E. Acceptance: Project substantial completion will not be accepted until all building systems have been successfully commissioned, and system performance demonstrated to and signed off by the Owner.

1.02 RELATED SECTIONS

- A. Section 15950 – Testing, Adjusting and Balancing for HVAC.
- B. Other Divisions: Technical Specifications on Specific System Performance.

1.03 DEFINITIONS

- A. Commissioning: The systematic process of ensuring, by verification and documentation that all building systems perform interactively, in accordance with the Design Documents and the Owner's operational needs.
- B. Commissioning Team: DPM, BGM, SEM, General Contractor (GC), Commissioning Agent (CxA), Installing Subcontractors, Testing and Balancing Agency and A/E.
- C. Functional Performance Test: Testing of an entire system to ensure that the whole system performs as specified, this testing would typically include any system challenges, e.g. for an HVAC system performance testing of the system would include testing the system airflow with simulated dirty filters.

1.04 INSTALLER SUBMITTALS (INFORMATIONAL): Follow Section 01330.

- A. Work Schedules: Detailed work schedules at least thirty (30) days before beginning work of this Section.
- B. Startup Procedures: Detailed startup procedures based on manufacturer's recommendations for each system component at least thirty (30) days before startup work.

- C. Work Plans: Detailed plans showing each step of the work of this section at least thirty (30) days before beginning this work. Submit names of individuals, company affiliation, and who will be performing the work, and who are managing the work.
- D. Certification of Work Conditions: Certification that conditions required to start each item of work is completed. Submit certification at least five (5) days prior to beginning work on the subject system.
- E. Field Reports: Provide format for final turn over documentation

1.05 QUALITY ASSURANCE: Comply with:

- A. Associated Air Balance Council (AABC). National Standards for Total System Balance
- B. National Environmental Balancing Bureau (NEBB). Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems.
- C. Air-Conditioning and Refrigeration Institute (ARI) Standards.
- D. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Standards for commissioning.
- E. American Society of Mechanical Engineers (ASME) Standards.
- F. National Fire Protection Association (NFPA) Standards including, but not limited to, NFPA 70E, National Electrical Code (NEC).
- G. SMACNA Standards (1995 Version)

1.06 COMMISSIONING TEAM RESPONSIBILITIES

- A. OWNER'S REPRESENTATIVE
 1. Reviews all costs and provides funding to the team (BGM/SEM submits to DPM)
 2. Coordinates work between GC, BGM and SEM.
 3. Reviews and approves all Cx Documents (BGM/SEM and DPM Representatives).
 4. Final approval of the Cx Plan (BGM / SEM and DPM).
 5. BGM/SEM will provide Facility Operations personnel to join in job walks during the construction phase, as well as insuring that their personnel are available during the FPT's, so that they have a better understanding of the new facility.
 6. Coordinate attendance at start-up and/or training sessions by operating

personnel.

B. Architect/Engineers (A/E)

1. A/E is responsible for responding to requests for information related to contract documents, operational qualification requirements, and/or design intent.
2. A/E is responsible for providing a complete and comprehensive Sequence of Operations. Note that the generation of a project specific method statement is considered necessary to ensure that the commissioning contractor has an understanding of how the system operates, and any potential interactions with other systems.

C. GENERAL CONTRACTOR

1. General Contractor shall provide purchasing, installation, supervision and management services to the project. The GC shall be responsible to ensure all trade contractors under contract to or falling under the responsibility of the GC to perform all quality assurance and testing requirements to the standards established by the project specific construction quality program. The GC will work with subs and equipment vendors to develop Cx plan which includes: factory testing, field verification, installation inspection, system pre functional testing, global systems functional testing and training.
2. The GC shall be responsible for supervising and authorizing work of this Section. The GC shall organize and maintain comprehensive system manuals which shall consist of all documentation described herein, and organized as follows:
 - a. Section 1 - General Information with TOP Acceptance Letter from CM, Certificate of Substantial Completion, Copy of Permits
 - b. Section 2 – Copy of Specifications, Copy of BOD, Design review reports, As-Built Drawings
 - c. Section 3 – Copy of RFI’s applicable to the individual trades / systems
 - d. Section 4 – Copy of all approved submittals
 - e. Section 5 – Copy of all O&M Manuals, list of spare parts, list of scheduled maintenance requirements, warranty information
 - f. Section 6 - Installation inspection reports / construction quality test records (FAT/SAT’s) along with high-lighted shop drawings, indicating specific sections included in each of the pressure tests), Copy of signed-off punch-lists
 - g. Section 7 – Copy of all equipment start-up sheets / reports
 - h. Section 8 - Copy of all Functional Performance Tests (Cx Documents)
 - i. Section 9 – Training Records
 - j. Section 10 – Electronic Copy of the Items in Sections 1 thru 9
3. The GC shall be responsible to collect and verify that all installation checks and start-up procedures have been completed in compliance with the contract documents. This pertains to all equipment, material and devices.
4. GC is responsible to insure that the schedule incorporates all activities and

personnel availability, which would allow / facilitate the commissioning of all systems to be complete prior to the project turnover date.

5. GC is responsible to verify that all as-built (record) drawings have been submitted, that they are complete and accurate.
6. GC is responsible to develop each subcontractor's start-up and training schedule, and coordinate these activities with the Owner (BGM). The training sessions are to be supervised by the GC, and they should notify the Owner.

D. INSTALLER (Installing Subcontractor)

1. Provide labor, equipment manufacturers' representatives, consultants, equipment and materials necessary to start-up all equipment within their scope of work and perform the documented testing necessary to demonstrate that the installation meets the specified requirements.
2. Review the commissioning test requirements as specified, and provide any additional test ports or instrumentation required but not shown on drawings, to accomplish performance tests.
3. Provide to the Commissioning Team a detailed commissioning plan and documentation of field calibration of all controls in accordance with the Owner's calibration policies. Documentation shall include dates, set-points, calibration coefficients, control loop verification, start-up reports and any other data required to verify system checkout. Documentation shall be dated and initialed by the field engineer or technician performing the work.

E. COMMISSIONING AGENT (CxA)

1. Review of Design Documents to become familiar with project, not for comments.
2. Participation in LEED certification (if applicable)
3. Review the Cx Plan developed by contractors including the Installation / Verification Documentation, comment to enhance if needed.
4. Review all start-up, factory acceptance tests (FAT), and site acceptance tests (SAT) procedures for each piece of equipment (provided by the installing contractor or vendor). Spot check execution of FAT and SAT and all pressure testing of piping and ductwork systems to ensure contractors are performing tests.
5. Formal walk down per system to verify that installation is completed in accordance with design, code requirements, and per the approved shop drawings, and that all equipment and components have been installed so that they are accessible for maintenance procedures.
6. Planning – the commissioning contractor will provide input into the schedule to ensure that systems are put to work in the correct sequence allowing for interdependencies, and the status of other systems that may affect the ability to complete commissioning.
7. Develop Functional Performance Tests (FPT) to confirm systems are performing as designed.

1.07 INSTALLATION VERIFICATION AND PRE-OPERATIONAL INSPECTION

A. General: Installation Verification activities are ongoing throughout the submittal, purchasing and installation phases by the installation contractor. The objective here is to ensure that the installation is as specified. All materials / equipment that are installed are in accordance with the approved submittals and shop drawings, as well as being in compliance with all codes. Additionally, this ensures that the “As-Built” or “Record” drawings are accurate.

B. CxA’s Responsibilities:

1. Develop a specific project scope of work within the commissioning plan. Assist with the definition for turnover packages with the GC/client, which includes the number of systems and the boundary definitions for the commissioned systems.
2. Develop a list of all submitted and approved materials and equipment to aid in field verification.
3. The CxA will assist in the management of and planning and scheduling of all startup and commissioning activities. The CxA will provide input into the schedule to ensure that systems are put to work in the correct sequence, allowing for interdependencies, and will provide the status of other systems that may affect the ability to complete commissioning within the project schedule. Meet with the Commissioning Team members for weekly meetings and status reports.
4. The CxA will create the facility and system specific Functional Performance Tests (FPT’s) based on a Sequence of Operations. Review and approve the creation of FAT, SAT, start-up and checkout forms and oversee all equipment start-up and pressure testing of systems. Formal system walk-down to confirm that the installation is completed to the design and sign off on all testing of components / systems.
5. Develop and compile the commissioning report for each system. Verify that deficiencies are corrected in a timely manner. Document the resolution of all discrepancies and variations on a “Problem and Resolution” report form. Include completed forms in commissioning report. Assemble documentation in a manner acceptable to the Owner. This documentation will then be forwarded to the Owner for final acceptance.

C. Installer's Responsibilities:

1. Completely install and thoroughly inspect, startup, test, adjust, balance, and document all systems and equipment.
2. Attend Commissioning progress and coordination meetings. Assist General Contractor (GC) in the development of work schedules relating to commissioning and testing activities in conformance with Contractor’s guidelines.

3. Subcontractors are to provide a complete set of coordinated shop drawings, data sheets and check-lists to the GC/CxA which is to be used to document as-built conditions. These documents would be considered a formal documentation of the subcontractors QA/QC program and be reviewed on a monthly basis with the subcontractors for verification as to work in place for progress payment requests.
4. Complete punch-list and observation report items prior to installation verification inspections. Make necessary changes and/or adjustments as required to complete checklist items. These are to be done within a given time frame in order to maintain the project schedule. Note: Installer shall follow the Owner's change control procedures (CCP) and provide documented evidence that Owner's change control procedures are being followed.
5. Review the Cx test requirements and provide any additional test ports or instrumentation required but not shown on drawings, to accomplish performance tests. Manipulate control systems and perform all testing procedures to demonstrate component and system operation for the Commissioning Agent.
6. All documentation shall be provided in an acceptable format and follow QA/QC requirements along with Good Documentation Practices (GDP). At a minimum the documentation shall:
 - a. Include project name, number, volume number, and volume title
 - b. Be typewritten on 8-1/2 by 11-inch paper suitable for insertion into a three-ring binder.
 - c. Pages shall be numbered and centered on the bottom in sequential numerical order (i.e. Page X of Y).
 - d. Entries shall be in ink and Initialed and dated by the personnel performing the work.
7. Additional responsibilities: Installer is responsible for verifying and obtaining any third party documentation related to system which may include but is not limited to:
 - a. Establish trend logs of system operation
 - b. Obtaining/ verifying any third party documentation related to system
 - c. Completed electrical transformer / switchgear reports
 - d. Completed air / water balance reports
 - e. Verification of vibration isolation adjustment and seismic restraints
8. Provide O & M manuals and spare parts lists as specified and required, along with developing a recommended maintenance schedule. The installer along with associated manufacturer's representatives will be responsible for training of facilities operations personnel. Installer training sessions shall provide a detailed analogy of system operation, maintenance and repair. Video taping of these sessions may be required.

1.08 STARTUP AND COMMISSIONING

General: System startup shall commence after installation verification and preoperational inspections are complete. The objective is to assure that all components and equipment are prepared and started up safely, and in accordance with manufacturer's instructions.

A. General Contractor's (GC's) Responsibilities:

1. Review, coordinate and finalize schedule of Installers' work associated with system startup activities.
2. Coordinate schedule with other Commissioning Team and or specialist manufacturing suppliers to allow for participation as necessary.
3. Review/approve startup procedures.
4. Witness system startup.
5. List any deficiencies found during system startup. Document the resolution of all discrepancies and variations on a "Problem and Resolution" report form. Include completed forms in system manual.
6. Compile startup information and assemble in system manual.
7. Complete all checklists and FPT's for each specific system. Note: Specialized equipment, such as Chillers or compressors will generally have a separate commissioning report from the supplier, this is typically used as a reference, with the "proof of performance" extracted to simplify review. Proof of the unit capacity is usually required in the specification, and typically provided by the manufacturer based on the FAT

B. Installer's Responsibilities:

1. Develop a startup plan and schedule for each system to be commissioned.
2. Coordinate with the GC for schedule development relating to system startup activities.
3. Perform system startup. Coordinate with other Installers as required.
4. Rectify any system or equipment deficiencies found during system startup.
5. Assist Contractor in the development of schedules relating to Operational Qualification (OQ) testing activities.
6. Execute Operational Qualification (OQ) testing activities specified.
7. Complete OQ Data Sheets and checklists.

C. A/E's Responsibilities:

1. Respond to requests for information related to Contract Documents or design intent, startup procedures or requirements.

D. Owner's Responsibilities:

1. Witness all startup activities as desired.
2. Additional discretionary participation as desired.

1.09 ACCEPTANCE:

A. Design team will define acceptance criteria for each system.

B. Commissioning Agent will define testing required for acceptance and document testing results.

1.10 CLOSEOUT

A. Commissioning Agent's (CxA's) Responsibilities:

1. Review and sign-off test record sheets in the commissioning report
2. Develop and compile the commissioning report for each system
3. Submit the final report to the Owner.

B. General Contractor's Responsibilities:

1. Witness all OQ activities and attest to satisfactory completion by signing off on functional performance test summary sheets.
2. Additional discretionary participation, as desired.

1.11 OPERATIONAL STAFF TRAINING

A. Operational staff training shall be conducted after all FPT work is completed. The objective is to provide Facilities Operations personnel with the necessary information and instruction to assure that they can efficiently and safely operate and maintain the facility systems at their peak performance levels.

PART 2 EXECUTION

For Functional Performance Testing requirements, include 10% device verification for systems that are not considered critical, i.e. Fan Coils, VAV Boxes, Chilled beams, etc. If there are discrepancies found in the documents provided by the subcontractors that exceed more than 10% failure of devices tested or incorrect documentation, (this percentage is adjustable as to what is acceptable to the Owner) the installing contractor will repair and pay CxA for retesting of failed devices and another 10%. The additional verification cost to be borne by the GC and subcontractor. This would apply, but not limited to the following systems:

- Domestic Water System (Hot and Cold)
- SW&V System
- Storm Drainage System
- Irrigation System

- Natural Gas System
- HVAC – Wet side (CHW, CW, HHW, TCHW, THHW, Steam)
- HVAC Dry side systems
- Radiant Heating System
- Electrical Distribution.
- Lighting Controls System

For systems that are considered critical or essential to the operation of the facility, we recommend that the CxA do 100% inspection and testing. These systems would include, but not limited to the following systems:

- Life Safety Systems (emergency generator, Emergency Lighting, FSD's, Elevators)
- Equipment and systems serving any Laboratories
- BMS Systems
- CO Detection System
- Fuel Oil System
- Atrium Smoke Control System (Including operable doors & windows)
- Fire Detection System*
- Fire Suppression Systems*
- Kitchen Hoods and Fire Suppression Systems*

*(Performed by SUFMO- CxA to gather testing documentation)

Compensation for Retesting: General Contractor and Sub-Contractors shall compensate Stanford for site time necessitated by incompleteness of systems or equipment at time of Functional Performance Testing. All testing failures which require on-site time for retesting will be considered actual damages to Stanford. All parties under contract with Stanford who are affected by the retesting shall be included in the contract modification