SECTION **01 91 00**

**COMMISSIONING**

1. GENERAL
   * + 1. RELATED DOCUMENTS
          1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
       2. SUMMARY
          1. Section includes the contractor commissioning responsibilities.
          2. Commissioning includes:

Exterior Enclosure,

Fire Suppression,

Plumbing,

HVAC,

Electrical,

Fire Alarm,

Electronic Security and

Communications systems.

* + - * 1. Requirements in this Section apply to Divisions 03, 04, 07, 08, 09, 10, 21, 22, 23, 26, 27 and 28.
        2. Related Sections:

Materials, Equipment and Systems included in commissioning scope are identified in Sections:

Section 01 91 07 Building Envelope Commissioning

Section 01 91 21 Fire Suppression Commissioning

Section 01 91 22 Plumbing Commissioning

Section 01 91 23 HVAC Commissioning

Section 01 91 26 Electrical Commissioning

Section 01 91 27 Communications Commissioning

Section 01 91 28 Electronic Safety and Security Commissioning

Section XX XX XX Acoustical Commissioning

Section 01 77 00 Closeout Procedures

Section 01 79 00 Demonstration and Training

* + - * 1. Additional Demonstration and Training requirements for commissioned materials, equipment and systems are defined in Section 01 91 79 Demonstration and Training [for Commissioning].
        2. The CxA shall utilize a cloud-based software for all reporting, checklists, functional performance tests, etc. This software shall be utilized by any and all subconsultants to the CxA. The software is not dictated by the Owner but shall be as agreed upon by the project team through consultation with the Owner.
      1. COMMISSIONING OBJECTIVES
         1. Commissioning is the systematic process of ensuring that building systems perform interactively according to the Owner's project requirements and the operational requirements specified in other Divisions. The Commissioning Authority shall oversee and coordinate equipment start-up, system performance, testing, adjusting, and balancing, control system calibration, construction and system documentation, and Owner training
         2. Document that building materials, equipment and systems are installed and performing according to Contract Documents.
      2. ABBREVIATIONS
         1. Architectural Supplemental Instructions (ASI)
         2. Building Envelope Commissioning Authority (BECxA)
         3. Commissioning (Cx)
         4. Commissioning Authority (CxA)
         5. Construction Manager (CM)
         6. Design Professional (DP)
         7. Equipment Receiving Report (RR)
         8. Functional Performance Test (FPT)
         9. Installation, Operation and Maintenance (IOM)
         10. Integrated Systems Test (IST)
         11. Mechanical Electrical Plumbing (MEP)
         12. Operation and Maintenance (O&M)
         13. Owner’s Project Requirements (OPR)
         14. Prefunctional Checklist (PFC)
         15. Request for Information (RFI)
      3. DEFINITIONS
         1. Acceptance phase - phase of construction after initial start-up and check-out when functional testing, operational training, and operating and maintenance documentation development and review occurs.
         2. Basis of design (BOD) - the documentation of the primary thought processes and assumptions behind design decisions that were made to meet the Owner's project requirements. The basis of design describes the intent of the project and the systems, components, conditions, and methods chosen to meet the Owner's project requirements.
         3. Commissioning Plan - an overall plan that provides the structure, schedule, and coordination planning for the commissioning process.
         4. Commissioning team - the group responsible for accomplishing the commissioning process.
         5. Data logging - monitoring flows, currents, status, and pressures of equipment using stand-alone recording equipment, separate from the control system. Additional monitoring may be provided through the capabilities of the control system.
         6. Deferred functional tests - functional tests that are performed after the date of substantial completion, due to partial occupancy, equipment and seasonal testing requirements, design, or other site conditions that do not allow meaningful testing of a system or piece of equipment during the normal commissioning sequence.
         7. Owner's project requirements - a dynamic document prepared by the Owner that provides the explanation of the ideas, concepts and criteria that are considered to be critical to the Owner’s expectations. It is initially the outcome of the programming and conceptual design phases.
         8. Factory testing - testing of equipment at the factory (or on-site) by factory personnel with an Owner’s representative present.
         9. Fault Detection and Diagnostics (FD&D) - Automated Fault Detection & Diagnostic Tools are programs that are integrated with the BAS to automatically detect faults or abnormalities in operation of systems and alert operators when these faults occur in sensors, valves, dampers and energy efficiency sequences.
         10. Functional tests - tests of the dynamic function and operation of equipment and systems using manual (direct observation) or monitoring methods. Functional testing is the dynamic testing of systems (rather than just components) under full operation (e.g., the chilled water pump is tested interactively with the chiller functions to determine if the pump ramps up and down to maintain the differential pressure set point). Systems are tested under various modes, such as during low cooling or heating loads, high loads, component failures, unoccupied modes, varying outside air temperatures, fire alarm modes, and power failure. The systems are run through the control system’s sequences of operation and components are verified to respond properly. The Commissioning Authority develops the functional test procedures in a sequential written form, coordinates, oversees and documents the actual testing, which is performed by the Construction Professional’s subcontractor. Functional tests are performed after prefunctional checklists and start-up are complete.
         11. Indirect indicators - indicators of a response or condition, such as a reading from a control system screen reporting a damper to be 100% closed.
         12. Integrated Systems Testing – Process of testing the interactive relationship of building systems. This testing occurs after the completion of functional performance testing of individual components and individual systems.
         13. Manual tests - using hand-held instruments, immediate control system read-outs or direct observation to verify performance (as opposed to analyzing monitored data taken over time to make the “observation”).
         14. Monitoring - the recording of parameters (flow, current, status, or pressure) of equipment operation using data loggers or the trending capabilities of control systems.
         15. Monitoring-Based Commissioning (MBCx) - A process variation of EBCx, Monitoring Based Commissioning employs remote energy system metering with trend log capability to identify inefficiencies in energy system operations, facilitate diagnostics, document energy savings, and ensure persistence of savings through ongoing re-commissioning.
         16. Over-written value – manually overriding a sensor value in the control system to determine the response of a system (e.g., changing the outside air temperature value from 50ºF to 75ºF to verify economizer operation). Also see “Simulated Signal.”
         17. Owner-contracted tests - tests paid for by the Owner which the Commissioning Authority does not oversee. These tests are not repeated during functional testing if properly documented.
         18. Owner’s Project Requirements (OPR) - 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, commissioning, training, documentation, and supporting information.
         19. Phased commissioning - commissioning that is completed in phases (by floors, for example) due to the size of the structure or other scheduling issues, in order minimize the total construction time.
         20. Prefunctional checklists - lists of items to inspect and elementary component tests to conduct to verify proper installation of equipment, provided by the Construction Professional to the Commissioning Authority. Prefunctional checklists are primarily static inspections and procedures to prepare the equipment or system for initial operation (e.g., belt tension, oil levels, labels affixed, gauges in place, sensors calibrated). However, some prefunctional checklist items may entail simple testing of the function of a component, a piece of equipment or system (such as measuring the voltage imbalance on a 3-phase pump motor). The word prefunctional refers to testing to be accomplished prior to the formal functional testing of the installed equipment. Prefunctional checklists augment and are often combined with the manufacturer’s start-up checklist. For most equipment, the Construction Professional’s subcontractor will execute the checklists.
         21. Receiving Report: Report produced by the CxA and completed by the applicable subcontractor which verifies that the manufacturer and model match the submittal, documents the equipment model numbers and serial numbers and documents the condition of the equipment as received.
         22. Sampling - functional testing of only a fraction of the total number of identical or near identical pieces of equipment.
         23. Simulated condition – a condition that is artificially created for the purpose of testing the response of a system (e.g., applying a hair dryer to a space temperature sensor to determine the response of a variable volume terminal unit).
         24. Simulated signal - disconnecting a sensor and using a signal generator to send an amperage, resistance, or pressure to the transducer and control system to simulate a sensor value.
         25. Start-up - the initial starting or activating of dynamic equipment, including executing prefunctional checklists.
         26. Test, adjust, and balance (TAB) - the process of measuring the actual flows of the air and hydronic systems, adjusting these flows to the values required by the construction documents, and documenting the results.
         27. TAB Verification - the CxA oversees the execution of TAB which includes verification of air and water flow measurements on a to-be-determined sampling basis. The verification takes place preferably during the TAB process rather than after completion though TAB field notes are a prerequisite for any TAB verification by the CxA. The CxA also reviews the final TAB Report and provides comments to the DP for consideration in their formal review. The CxA does not hold the contract for the TAB contractor and is not responsible for the accuracy of the certified TAB report.
         28. Trending - monitoring of equipment performance over a period of time, using data logging equipment or the building control system.
      4. SUBMITTALS TO COMMISSIONING AUTHORITY
         1. All Contract Documents and associated documentation including changes to the drawings Architectural Supplemental Instructions (ASI), Request for Information (RFI), Change Requests, and Change Orders. Refer to Section 3.1 for submittal review process.
         2. All submittals made to Design Professional (DP) by the [CM][GC][DB] for Cx Divisions. Includes transmittals, product data, shop drawings, coordination drawings, test reports, field reports, factory reports, installation instructions, operating and maintenance manuals, training documentation, warranty forms, manufacturer start-up reports, certificates from manufacturer, close out documentation, information for Material Completion, and as-built information.
         3. Commissioning Documents as each are completed by Contractor including:

Equipment Receiving Reports

Manufacturer Start-up and Test Reports

Pre-functional Checklists

Functional Performance Tests prepared by Contractor

* + - * 1. Submittal Format

All submittals to and from the Commissioning Authority (CxA) will be electronic /digital.

Organize submittals into logical groupings.

Organize information by specification Divisions and Sections.

Acceptable file types include Revit, AutoCAD, Microsoft Office (Word/Excel/PPT) or Adobe PDF format. Data delivered as PDF will be organized using Bookmarks for separation of data into logical groupings. Bookmarks will be provided to separate information.

* + - 1. COMMISSIONING TEAM
         1. Commissioning Authority (CxA): \_\_\_\_\_\_\_\_\_\_ for Div 21 thru 28
         2. BECxA \_\_\_\_\_\_\_\_\_\_ for Divisions 03, 04 07, 08, 09, 10.
         3. Owner (O): \_\_\_\_ [Georgia Tech] [BOR][GTRI][GT Facilities Inc][GSFIC]
         4. Owner’s Representative: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
         5. Using Agency (UA): \_\_\_\_\_\_\_\_\_\_\_\_ [Georgia Tech (GT)][GTRI][GT Housing]
         6. Design Professionals (DP): Identified on Drawing [inset Drawing Name and Number 00.00]

Architect: [\_\_\_\_\_\_\_\_\_\_\_]

Mechanical Electrical Plumbing (MEP) Engineer: [\_\_\_\_\_\_\_\_\_\_\_]

Fire Protection Engineer: [\_\_\_\_\_\_\_\_\_\_\_]

* + - * 1. [Construction Professional][Design-Builder]: [\_\_\_\_\_\_\_\_]
      1. QUALITY ASSURANCE
         1. Contractor to provide supervisor qualified to coordinate commissioning activities. The CxA scope is not a replacement for the [CM’s][GC’s][DB’s] Quality Assurance/Quality Control process.
         2. Provide supervisor for each Division included in the commissioning scope of work.
         3. Provide contractor personnel, factory representatives or factory trained personnel to participate in all tests to prevent testing or operating equipment or systems in any way that would damage or negatively impact any manufacturers warranties.
         4. Commissioning will be consistent with:

ASHRAE Standard 202-2013, Commissioning Process for Buildings and Systems

ASHRAE Guideline 1.1 - 2007, HVAC&R Technical Requirements for the Commissioning Process.

NIBS Guideline 3 - 2006, Exterior Enclosure Technical Requirements for the Commissioning Process.

NFPA 3 – 2012 Edition. Recommended Practice for Commissioning and Integrated Testing of Fire Protection and Life Safety Systems

* + - * 1. The testing and inspection will comply with applicable codes and standards.
      1. COMMISSIONING AUTHORITY RESPONSIBILITIES
         1. Direct and coordinate the commissioning activities.
         2. Update the Boilerplate OPR for project specificity.
         3. Develop and coordinate the execution of a Cx plan.
         4. Review design documents to confirm consistency with the OPR and Yellow Book compliance, including the energy model reports.
         5. Observe and document that systems are functioning in accordance with the Contract Documents.
         6. Assist Owner, DP and [CM][GC][DB] with problem-solving.
         7. Verify that O&M documentation is complete and operating personnel are provided training.
         8. Report Cx activities to Owner and/or the Using Agency’s Project Manager.
         9. Not responsible for design concept, design criteria, compliance with codes, design or general construction scheduling, cost estimating, or construction management.

1. PRODUCTS
   * + 1. TEST EQUIPMENT
          1. Equipment required to perform prefunctional checking, startup, and functional performance testing.
          2. Special equipment, tools and instruments required for testing installed materials, components, assemblies, equipment and system in accordance with the Contract Documents.
          3. All testing equipment will be of sufficient quality and accuracy to test and measure system performance with the tolerances required by Contract Documents.
          4. Equipment calibrated according to the manufacturer’s recommended intervals and when dropped or damaged.
          5. Provide proof of calibration upon request.
          6. Accuracy of sensors used for testing must be at least twice that of the instrumentation being tested.
2. EXECUTION
   * + 1. COMMISSIONING OVERVIEW
          1. Commissioning during construction begins with a scope review meeting conducted by the CxA where the commissioning process is reviewed with the commissioning team.
          2. Additional meetings are throughout construction, scheduled by the CxA with necessary parties attending. Meetings function to plan, coordinate, schedule activities and resolve problems.
          3. The CxA will distribute and periodically update the Commissioning Plan. The Cx Plan is a report, prepared by CxA that communicates detailed Cx related information including goals, scope, systems, team structure and schedule for the commissioning process. The Cx Plan also serves as a record of the Cx process.
          4. The CxA will communicate problems that require attention of other team members using the Cx Reports, Cx Issues (Cx Issue) and Commissioning Request for Information (Cx RFI).
          5. Product data and shop drawings are submitted to the CxA by the Contractor. CxA will review submittals and forward comments to DP for review and, as determined by DP, for inclusion in the submittal review comments returned to the Contractor.
          6. Contractor provides DP’s submittal comments and submittal logs that summarize submittal status.
          7. Contractor provides Installation, Operating, Maintenance and start-up procedures to CxA.
          8. Contractor develops Pre-Installation Plans.
          9. Contractor develops startup plans.
          10. Contractor prepares Receiving Reports. CxA reviews Receiving Reports.
          11. Contractor prepares prefunctional checklists (PFC) to be completed by the Contractor, during the startup process and prior to functional testing.
          12. Contractor submits test results required by contract documents to the DP and the CxA for coincident review.
          13. The CxA witnesses pre-functional tests and start-up of selected equipment.
          14. Contractor completes Prefunctional checklists before functional testing.
          15. Contractor performs and documents the equipment receipt, installation, pre-functional checkout and initial startup. The CxA verifies that the installation, pre-functional checkout and initial startup were completed according to the plans. After tests are complete and DP punchlist has been completed, Functional Performance Testing begins.
          16. CxA develops specific equipment and system functional performance test (FPT) procedures.
          17. Contractor reviews and executes the FPT procedures under the direction of the CxA. Contractor operates all equipment.
          18. CxA engages the Owner’s O&M personnel to participate as desired in the execution of FPTs.
          19. Any items of non-compliance in material, installation or setup are corrected by the Contractors and then the system is retested.
          20. The CxA reviews the Installation, Operation and Maintenance (IOM) documentation for completeness.
          21. Except as defined by specification or agreed as Deferred, Functional Performance Testing is completed before the Using Agency occupies the facility.
          22. Contractor provides the training. The CxA reviews, pre-approves the content and agenda and verifies that proper training was completed.
       2. CONTRACTORS RESPONSIBILITIES
          1. Provide all test equipment unless noted otherwise.
          2. Provide tools, equipment, ladders and lifts to support the commissioning process.
          3. Provide all requested submittal data, including detailed start-up procedures and specific responsibilities of the Using Agency to keep warranties in force.
          4. Provide a temporary conditioning plan detailing intended approach to temporary use of permanent HVAC systems during construction.
          5. Provide equipment sequence of operation and testing procedures to CxA.
          6. Review test procedures and FPT results.
          7. Schedule all commissioning activities in the master construction schedule. Make adjustments to commissioning activities schedule when impacted by construction progress.
          8. Notify CxA of all activities defined in Contract Documents that require CxA attendance.
          9. Copy CxA with contract documents including addenda, RFIs, change orders.
          10. Copy CxA with all submittal data required by the contract documents for each of the Cx Divisions including product data, shop drawings, reports, installation instructions, Operating and Maintenance (O&M) data.
          11. Invite Owner’s O&M personnel to applicable meetings and site walk-throughs including for MEP inspections and scheduled CxA visits.
          12. Attend Cx meetings including commissioning initial scope review meeting (kick-off meeting) and other meetings scheduled by the CxA to facilitate the Cx process.
          13. Provide skilled technicians to execute starting and operation of commissioned equipment and systems. Schedule technician to attend tests, make adjustments to systems for testing.
          14. Correct deficiencies.
          15. Retest commissioned equipment and systems until operating as specified.
          16. Provide training to Using Agency’s operating staff using expert qualified personnel.
          17. Coordinate with equipment manufacturers to determine specific requirements to maintain the validity of the warranty.
          18. Execute seasonal and deferred functional testing, directed by the CxA.
          19. Correct deficiencies and make necessary adjustments to O&M manuals and as-built drawings for applicable issues identified in any seasonal testing.
       3. SCHEDULING
          1. Schedule commissioning activities with assistance from the CxA.
          2. Integrate all commissioning activities into the project schedule and critically path items from installation through FPTs.
          3. Include the following commissioning events in the schedule generally broken out by system.

Each test required by the specifications for the Commissioned Systems

Equipment installation

Equipment Start-up

Manufacturer start-up and testing

System completion

Test and Balance

Controls point-to-point and programming

Functional Performance Testing

Integrated Systems Testing

Demonstration and Training

Deferred/Seasonal/Warranty Testing

Warranty Inspections

* + - * 1. Update schedule to include information provided by the CxA.
        2. Provide the CxA with no less than [5][10] business days’ notice of tests.
        3. Installation Instructions and O&M Documentation for all commissioned materials, equipment and systems will be submitted to CxA within [14][30] days of receiving product approval by DP. Information will not be held until all submittals in Section or Division are Approved or Approved As Noted.
        4. Submit procedures and results for all tests of equipment and system included in the Cx scope of work within 5 days of test.
        5. Allow [\_\_\_] weeks in schedule for Functional Performance Testing by CxA before [Material Completion][Substantial Completion].
      1. COMMISSIONING FUNCTIONAL TESTING SCHEDULE

|  |  |  |
| --- | --- | --- |
| **Discipline** | **Testing Duration (days)** | **Retesting Allowance (days)** |
| TAB Verification |  |  |
| Fire Protection |  |  |
| Plumbing |  |  |
| HVAC |  |  |
| Controls |  |  |
| Integration/FD&D/Monitoring |  |  |
| Electrical |  |  |
| Fire Alarm |  |  |
| Access Control |  |  |
| Integrated Systems Test (aka Level 5 Testing) |  |  |

* + - 1. MEETINGS
         1. Cx Scope Review (Kickoff) Meeting: Within approximately [30][60] days of commencement of construction,] schedule a commissioning meeting to generally review the Cx process. This meeting will require attendance by each trade affected by the commissioning process.
         2. Cx Meetings: Other meetings focused on Cx activities by trades and specification Divisions will be held as construction progresses. These meetings will include process, procedures, coordination, progress reports, deficiency resolution, planning and O&M issues. These meetings will be held monthly, until the final 3 months of construction when they will be held as frequently as one per week.
         3. Commissioning meetings will be scheduled and held in conjunction with normal construction meetings.
         4. Integrated Systems Testing (IST) meetings will be conducted by CxA to coordinate readiness and review procedures for Integrated Testing. Attendance will be required by each trade, Division and manufacturer involved in the Integrated test.
      2. SUBMITTAL REVIEW PROCESS
         1. The Commissioning Authority (CxA) will review product and shop drawing submittals related to the commissioned equipment and systems. CxA will check for conformance to the Contract Documents as it relates to the commissioning process. CxA review is intended primarily to aid in the development of functional testing procedures and only secondarily for to check for compliance with Contract Documents.
         2. CxA will review product and shop drawing submittals concurrently with the DP. CxA will forward Commissioning submittal review comments to the DP for review and consideration. DP will determine which CxA comments to forward to Contractor. The CxA comments are not sent directly to the Contractor unless directly incorporated into the formal review comments by the DP.
      3. RECEIVING REPORT (RR)
         1. Product and Equipment Receiving Reports (RRs) will be prepared by contractor for product and equipment specifically noted in the Cx specification sections as requiring a RR. The RR verifies that the manufacturer and model match the submittal, documents the equipment model numbers and serial numbers and documents the condition of the equipment as received.
         2. The RR includes photographs of equipment and components in sufficient detail to document the condition of the product as delivered to the site. Include photographs of product labels, equipment nameplates. Organize photos in folders for each product and piece of equipment as described for submittals and IOM manuals.
         3. CxA prepares the blank Equipment Receiving Reports forms. Contractor completes the RR and returns completed RRs with photos to the CxA for review.
      4. PREFUNCTIONAL CHECKLISTS (PFC)
         1. Prefunctional checking is required to establish that the materials, components, assemblies, equipment and systems are provided in accordance with the contract documents.
         2. Prefunctional checking is performed by the Contractor.
         3. Prefunctional Checklists (PFCs) are forms prepared and executed by the Contractor.
         4. Prefunctional checking includes:

Contractor’s Quality Control checklists,

Manufacturer’s installation checklists

Manufacturer’s or authorized representative’s start-up checklists

Manufacturer’s or authorized representative’s start-up documentation.

Other installation inspections or reports required by the contract documents

[Certificate of Manufacturers (Form: GSFIC-AD 114)]

* + - * 1. PFCs are specific to the materials, components, assemblies, equipment and systems for this project.
        2. Contractor submits blank PFCs to CxA for approval. The CxA reviews and comments on the blank PFC. The CxA adds to the contractor’s blank PFC if the CxA determines additional detail is necessary. The CxA will add items to the PFC if necessary to determine compliance with the contract documents.
        3. Contractor completes a PFC for each assembly, each piece of equipment and systems included in the Cx scope of work. Sampling is not acceptable.
        4. Prefunctional checking is completed prior to functional testing.
        5. Contractor submits equipment startup plan to the CxA for review and approval. The Contractor executes startup and provides the CxA with a signed and dated copy of the completed start-up. Equipment start-up is completed prior to functional testing of equipment and systems.
        6. Contractor signs each completed PFC attesting to:

Compliance with the contract documents

Readiness for PFC verification by the CxA and

Readiness for Functional Performance Testing.

* + - * 1. The CxA will verify that the Contractor has completed the prefunctional checking by sampling to determine readiness for Functional Performance Testing.
        2. The individuals that sign the PFCs and checklists must have direct knowledge and have witnessed that each item on the prefunctional checklist was actually performed. It is not acceptable for supervisors to fill out these forms unless they have actually observed the installation and witnessed the tests.
        3. Prefunctional Checklists will follow industry standards for commissioning. For an indication of rigor required for the prefunctional checklists and start-up documentation reference: <http://commissioning.org/documents/Appendix%20C.doc>
      1. FUNCTIONAL PERFORMANCE TEST (FPT)
         1. Functional Performance Testing is the dynamic testing of material, equipment and systems to demonstrate performance and operation in accordance with contract documents and commissioning objectives.
         2. As part of functional testing, all commissioned equipment and each commissioned system will be operated through all specified modes of operation. Sampling will not be permitted.
         3. Contractor prepares manufacturer specific functional performance tests.
         4. In addition to manufacturer specific tests prepared by the contractor, the CxA develops specific test procedures and forms to document operation of each piece of equipment and system. Contractor will provide assistance to the CxA in developing the procedures by reviewing and commenting on the test procedures. Prior to execution, the CxA will provide a copy of the test procedures to the Contractor who will review the tests for feasibility, safety and warranty protection.
         5. Each functional performance test will be performed under conditions that simulate actual conditions as close as practically possible.
         6. The Contractor will operate the equipment and systems and will provide all necessary materials and system modifications to produce the necessary flows, pressures and temperatures necessary to execute the test according to the specified conditions. At completion of the test, the Contractor will return all affected building equipment and systems to their pre-test condition.
         7. The CxA will direct, witness and document the functional testing.
         8. Functional Testing will follow industry standards for commissioning. For an indication of the rigor required, refer to [\_\_\_\_] “[Sample functional tests and checklists](http://www.peci.org/sites/default/files/documents/cxtests.zip) (800k, v2.05, Feb. 1998)” at [\_\_\_\_\_] http://www.peci.org/sites/default/files/documents/cxtests.zip.
         9. Contractor preferred FPT forms may be acceptable if they comply with the rigor, clarity and intent of all the commissioning specifications and are approved by the CxA.
         10. Integrated Testing includes simultaneous testing of Div 21, 22, 23, 26, 27 and 28 systems to demonstrate operation of connected components, equipment and systems. Integrated testing will take place after each system has been individually tested. Tests will follow NFPA 3 – 2012 Edition recommendations for testing of fire protection and life safety systems. Tests include operation in normal and standby power systems modes.
         11. Functional Performance Test forms include:

The Contractor responsible to operate the equipment and execute the test

Readiness sign-off

List of the materials, equipment or systems to be tested

Prefunctional checklists associated with test

Prerequisites for the test

Function or modes tested

Required pre-conditions of the test for each mode

Identification of any special procedures

Test methodology

Monitoring requirements

Acceptance criteria

Sampling rates and strategies

* + - * 1. Prerequisites: Before Functions Performance Tests will be conducted, prerequisite items will be completed. The prerequisites will be identified on functional performance test forms.
      1. FAILED TESTS, DISPUTED TESTS, NON-CONFORMANCE AND TEST APPROVAL
         1. The CxA will record the results of the functional performance test on the test form. All failed tests, deficiencies or non-conformance issues will be noted and reported to the [\_\_\_\_\_\_] Using Agency as a Cx Issue.
         2. Minor Deficiencies: Corrections of minor deficiencies identified during testing may be made during the tests at the discretion of the CxA. In such cases the deficiency and resolution will be documented on the FPT form.
         3. Failed Test without Dispute: When there is no dispute on the deficiency and the Contractor accepts responsibility to correct:

The CxA will document the deficiency and the Contractor’s intention to correct and proceed to another test.

The CxA submits the non-compliance report as a Cx Issue to the [\_\_\_\_] Using Agency and the Contractor.

The Contractor corrects the deficiency, furnishes a statement of correction and notifies CxA.

The CxA re-schedules the re-test.

* + - * 1. Disputed Test Results: If there is a disagreement or dispute about a deficiency:

The deficiency will be documented on the non-compliance form with the Contractor’s response and a copy given to the [\_\_\_] Using Agency and to the Contractor.

Resolutions are made in accordance with the Contract Documents. Final acceptance authority will be per the Contract Documents.

The CxA documents the planned resolution process.

Once any necessary interpretations are determined and resolution process agreed, Contractor notifies the CxA and reschedules the re-test. Test is repeated until satisfactory performance is achieved.

* + - * 1. Approval: The CxA notes each satisfactorily demonstrated test on CxA form. Formal approval of the functional test occurs after review by the CxA and by the Using Agency. The CxA recommends acceptance of each test to the Using Agency PM using a CxA standard form. The Using Agency gives final approval on each test using the same form, providing a signed copy to the CxA and the Contractor.
        2. Contractor will be back charged for retests in excess of retesting allowance as stipulated in Section 3.4 above. The CxA shall coordinate additional costs and reimbursement with the Owner with the Contractor to be directly backcharged by the Owner.
      1. DEFERRED TESTING
         1. Deferred Tests are tests performed after Material Completion due to unforeseen conditions, Owner requirements, insufficient loads, partial occupancy, seasonal requirements, weather, design constraints, or other reasons as agreed by Owner.
         2. Seasonal Testing. Some tests will be delayed until weather conditions are favorable for accurate testing results. Contractor will perform Seasonal tests including Integrated tests that require participation by multiple trades. Seasonal tests will be performed within ten months of material completion unless agreed otherwise by Owner or Using Agency. Tests will be executed, documented and deficiencies corrected by the Contractor, with the CxA witnessing.
         3. Contractor will update the O&M manuals and as-builts as required by test results.

END OF SECTION