SECTION 01 91 13 – COMMISSIONING **Bold blue font are notes to Design Manager (DM) and Construction Manager (CM) and must be deleted from final document**

1. GENERAL
   * + 1. DESCRIPTION
          1. The Smithsonian will procure the services of independent Commissioning Consultant; other terms are Commissioning Provider, Commissioning Agent, and Commissioning Authority. The Commissioning Consultant is an independent and knowledgeable third party, contracted to verify that the systems **(Smithsonian Design Manager - DM and Construction Manager -CM select from HVAC, plumbing, electrical, fire protection, security, etc. Coordinate with paragraph 1.9 A.**) work as described in the Owners Project Requirements (OPR). The Commissioning Consultant will inform the Construction Manager (CM) COTR and the Architect of the results of the commissioning and provide suggestions, as necessary, to correct deficiencies in observed performance or installation.
          2. Commissioning is the process to verify to the Smithsonian that systems, equipment, mechanical, electrical, controls and special systems function together properly to meet performance requirements and design intent, and as described in the Contract Documents. The General Contractor shall be responsible for participation in the commissioning process as outlined below and in references and attachments throughout the Contract Documents. The General Contractor shall furnish labor and materials sufficient to meet all requirements of building commissioning under this contract.
          3. Various sections in the Division 23, 25 and 26 Specifications as well as specifications in other formats outline the specific commissioning responsibilities of each General Contractor and corresponding subcontractors for the division and obligate the General Contractor to coordinate and manage the commissioning responsibility of those subcontractors.
       2. REQUIREMENTS INCLUDED
          1. Duties of Contractor.
          2. Duties of Commissioning Consultant.
          3. Commissioning Field Notebook.
          4. Acceptance Procedures.
          5. Performance Period.
          6. Training and Instruction.
       3. RELATED SECTIONS
          1. All Division 1 Sections and Smithsonian General Requirements
          2. All Division 21 Sections
          3. All Division 22 Sections
          4. All Division 23 Sections
          5. All Division 25 Sections
          6. All Division 26 Sections
          7. All Division 28 Sections
       4. TERMS
          1. Acceptable Performance: A component or system being able to meet specified design parameters under actual load including satisfactory documented completion of all functional performance tests, control system trending and resolution of outstanding issues.
          2. Basis of Design: The Basis of Design is *a document that records the concepts, calculations, decisions, and product selections used to meet the Owner’s Project Requirements 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. (ASHRAE Guideline 0-2013).* The Basis of Design provided by the design engineer addresses the decisions to meet the design intent as defined by the Smithsonian Institution. The Basis of Design describes the systems, components, conditions and methods to meet the design intent.
          3. Commissioning Plan: The Smithsonian’s Commissioning Consultant prepares The Commissioning Plan. *The Commissioning plan is a document that outlines the organization, schedule, allocation of resources, and documentation requirements of the Commissioning Process (ASHRAE Guideline 0-2013)*. In addition, defines the scope and format of the commissioning process and the responsibilities of all involved parties. The commissioning team reviews the Commissioning Plan to inform the intent and scope of the commissioning process, to ensure inclusion in the construction project scope/schedule and to facilitate and expedite the commissioning process. The Commissioning Plan is to be distributed by the Commissioning Consultant during the first third of the construction timeframe. **(The DM to coordinate with CM to find out if the commissioning Plan should be included as an addendum in the Bid documents).**
          4. Functional Performance Testing: Is a full range of checkouts and tests carried out to determine if all components, sub-systems, systems and interfaces between systems function in accordance with the Contract Documents and meets the design intent. In this context, “function” includes all modes and sequences of control operation, all interlocks and conditional control responses and all specified responses to abnormal emergency conditions. The Commissioning Consultant will prepare the functional performance tests.
          5. Commissioning (Also Commissioning Process) is *a quality-focused process enhancing the delivery of a project. The process focusses upon verifying and documenting that the facility and all of its systems and assemblies are planned, designed, installed, tested, operated, and maintained to meet the Owner’s Project Requirements. (ASHRAE Guideline 0-2013).* Process to demonstrate the Smithsonian that building equipment controls and systems function together properly to meet design intent and performance requirements shown in a composite manner in the Contract Documents.
          6. Resolution Log: The purpose of this document is to provide a method for tracking and resolution of deficiencies discovered during the commissioning process. This list also includes the current disposition of issues and the date of final resolution as confirmed by the Commissioning Consultant. Deficiencies are issues where products, execution or performance does not satisfy the Specifications and/or the design intent. The Commissioning consultant creates and manages the Resolution Log.
          7. Pre-functional Construction Checklists: Commissioning Consultant prepares Checklist for equipment of systems and assemblies. See paragraph 1. A. Checklist shall be for the systems or equipment involved in the commissioning process to verify installation and start-up of equipment is complete and verify that systems are ready for functional testing. These documents require signature by the Contractor prior to continuing with the commissioning process, and are required as a pre-condition of beginning the Functional Performance Testing.
          8. Testing and balancing (TAB) process. A complete pencil copy of TAB reports, on a system-by-system basis, is required prior to the start of any final functional performance test.
       5. DUTIES OF CONTRACTOR
          1. Provide copies of all approved shop drawings, manufacturer’s literature, maintenance information or other information as may be needed for systems and assemblies to the Commissioning Consultant.
          2. Collect the information requested by Commissioning Consultant for development of a complete Commissioning Plan, Commissioning Field Notebook, and Functional Performance Tests and provide to the Commissioning Consultant. The General Contractor to review the Commissioning Plan, Commissioning Field Notebook, and Functional performance Test and confirm in writing to the CM COTR, Architect and Commissioning Consultant any known areas of conflict or areas requiring clarifications.
          3. Collect all proposed equipment start-up and Pre-Functional Construction Checklists documentation and place into the Commissioning Field Notebook. The General Contractor will provide the Commissioning Consultant with the completed commissioning field notebook.
          4. Provide the Contractor’s schedule to the commissioning Consultant for review and comment. Plan for and incorporate commissioning activities into the construction schedule. Provide a sufficient detailed level of scheduling, activity, detail to properly coordinate and schedule the trades. Provide a detailed Commissioning Schedule Fragnet to the project schedule, updated monthly.
          5. Provide Commissioning Consultant with submittals for all systems and assemblies for review and comments. Include submittals of controls system and wiring diagrams and narrative sequences of operation, in time for use in preparing the Functional Test Procedures. The Commissioning Consultant review comments of pertinent submittals is coordinated through the Construction Manager COTR.
          6. Provide a fully operational system per Specifications, started, verified, debugged, calibrated, balanced, tested and under automatic control.
          7. Provide qualified personnel to participate in the commissioning tests, including seasonal testing.
          8. Cooperate with the Commissioning Consultant’s personnel.
          9. Provide access to site for the Commissioning Consultant for review, verification and testing activities.
          10. Provide office space **(DM to coordinate with CM on the practicality of providing office space for Cx Consultant)** for Commissioning Consultant for preparation of daily reports. Dedicate space for Commissioning Field Notebook in dedicated area.
          11. Provide organized storage space for project drawings, Specifications, equipment and materials submittals, shop drawings and operation and maintenance manuals in the job site trailers or job site office space.
          12. Provide updates to all project documentation to reflect all supplemental instructions, addenda or other revisions to the project construction documents. Updates and architect’s supplemental instructions must be posted to the master set of documentation for review and reference by all Contractors and for the Commissioning Consultant’s use.
          13. Provide adequate time and resources to perform functional testing of systems and assemblies in contract. These times and activities shall be reflected in the Commissioning Fragnet schedule, updated monthly.
          14. Coordinate participation of the all pertinent subcontractors including mechanical, electrical, controls and Testing and Balancing TAB subcontractors in the commissioning process.
          15. Participate in any efforts to finalize sequences of operations with Construction Manager COTR, Designers and Commissioning Consultant.
          16. Verify that coordination, installation, quality control and final testing have been completed such that installed systems and equipment comply with construction documents.
          17. Review the Commissioning Plan, Project Reports and test results and submit comments to the Commissioning Authority.
          18. In a timely manner, address issues identified during construction that may affect the commissioning process or final system performance.
          19. Perform equipment start-up and testing of mechanical and electrical equipment and systems **(CM COTR and DM coordinate the equipment and systems during the design phase)** and document as required with start-up reports and completion of Pre-functional Construction Checklists. These checklists include installation documentation, start-up documentation, controls point-to-point documentation and calibration documentation, verification that controls sequence of operations meets design intent and TAB final documentation. Reports will be stored in the Contractor’s field trailer, as a part of the Commissioning Field Notebook. Contractor will coordinate efforts to complete the pre-functional documentation.
          20. Lead verification testing of fire/smoke dampers and direct the resolution of deficiencies. Each fire/smoke damper and its functions are tracked in a matrix spreadsheet. Owner’s Authority Having Jurisdiction (OSHEM) shall witness and approve all life safety systems including fire / smoke damper operation.
          21. Provide preliminary TAB report, indicating all actual field values recorded to the Commissioning Consultant through the Construction Manager COTR, prior to initiation of functional testing. These reports shall be incorporated in the commissioning field notebook. Provide these “pencil copy” TAB data on a system by system basis, as systems have been finally and completely balanced.
          22. Pre-test all systems prior to scheduling the final Functional Performance Test for the record. Operate equipment and systems as required in preparation of final functional performance testing. This includes, but is not limited to; manipulating the appropriate controls systems to execute the Functional Test Procedures.
          23. The Contractor shall issue a written Notice of Readiness *for each system*; include verification of system completion, TAB completion and controls. Provide the Commissioning Consultant a copy of the Notice of Readiness upon completion of all systems work, start-up and Pre-functional Construction Checklists requirements by trade contractors.
          24. Participate in the fine-tuning or troubleshooting of system performance, if of these measures becomes necessary.
          25. The Contractor shall compensate the Government for retesting and/or troubleshooting time required by the Commissioning Consultant when the Contractor’s systems do not meet specified performance and are not ready for commissioning. Back-charge Contractors as necessary to collect reimbursement for Commissioning Consultant compensation.
          26. Review operating and maintenance data for verification, organization, distribution and conformance to requirement of the Contract Documents.
          27. Submit complete operation and maintenance information and as-built drawings to the Commissioning Consultant for compliance review of the requirement of the Contract Documents. Incorporate changes and recommendations provided by the commissioning Consultant into the
          28. Provide all documentation of training for the systems specified.
          29. Provide all proprietary test equipment required to test all the systems and equipment in this project. The Contractor shall provide all necessary tools, lifts, ladders, access, PPE and other equipment required for the Commissioning Consultant to witness Functional Performance Testing.
          30. The Commissioning Field Notebook will be stored in the Contractors field trailer and will be managed by the Contractor. The Contractor shall confirm in writing to the Commissioning Consultant that systems are complete, functional and the appropriate subcontractors have completed the specified tasks and signed off all pre function documentation.
       6. DUTIES OF COMMISSIOING CONSULTANT
          1. Develop the draft Commissioning Plan during Pre-Design phase. Commissioning plan updated at each design phase and construction phase**. (DM to coordinate with CM the Commissioning Plan inclusion as addendum to the Bid Documents).**
          2. Review the Commissioning Field Notebook with appropriate documentation provided from Contractor. Provide supplemental documentation as necessary to ensure that all aspects of start-up and testing have been complete and documented prior to functional testing.
          3. Develop Functional Test Procedures from Contract Documents and final equipment submittals including narrative sequences of operation, control diagrams and software code for execution with the assistance of Contractor staff as required.
          4. Review the Contractor’s submittals relative to the systems and assemblies. Provide comments on the submittals during the same timeframe as the architect / engineer’s review. Architect / Engineer have final decision on incorporating comments by the Commissioning Consultant. CM COTR formally incorporates the response to the General Contractor.
          5. Perform site observations to follow installation progress and to verify system installation quality and readiness for testing.
          6. Observe the start-up activities and initial testing of selected equipment and systems as required and review Contractor’s start-up documentation.
          7. Observe or review documentation of validation activities including: Proper test and balance activities, rotating equipment drive alignment, vibration testing, acoustical testing, electrical testing and functional tests for normal and off-normal operating sequences.
          8. Review submittal of all required pre-functional and start-up documentation provided by the General Contractor for completeness and reasonableness. This includes installation documentation, start-up documentation, point-to-point checklists and preliminary TAB report, prior to initiation of functional testing.
          9. Witness a random selection of TAB readings (10**%) (DM to provide feedback to the percentage of TAB readings for the project)** performed by the TAB contractor. Coordinate with Division 23 and 25 project specifications. This witnessing activity is during the execution of regular TAB activities.
          10. TAB verification to be a separate activity, occurring prior to the final Functional Performance Testing activities.
          11. Assist with scheduling, direct and witness complete functional testing as defined in the Commissioning Plan and Functional Test Procedures. All testing to be performed and verified by the General Contractor and documented by the Commissioning Consultant.
          12. Witness and verify satisfactory completion of equipment and system tests and inter-systems functional performance tests.
          13. Conduct commissioning meetings, and distribute minutes of those meetings to all attendees.
          14. Provide site observation, functional tests or other project reports in a timely manner.
          15. Document inconsistencies or deficiencies in system operations and system compliance. System deficiencies shall be forwarded to the CM COTR and documented in the Resolution Log.
          16. Coordinate via the General Contractor participation of Government’s personnel with equipment, component and systems performance verification and participation in required training.
          17. When commissioning has been successfully completed, recommend acceptance to the Smithsonian Institution, and provide suggestions for those systems not performing as expected.
          18. Once all functional tests is successfully completed and all outstanding issues resolved, the Commissioning Consultant will provide the Smithsonian Institution with a Final Commissioning Report of all commissioning activities that occurred during the project.
          19. Provide technically qualified personnel when scheduled.
          20. The Commissioning Consultant will formally communicate with the Contractor via approved project channels. It is expected, however, that informal communication and coordination will be conducted directly with the subcontractors; records of all contacts will be sent to the Architect through the normal channels.
          21. The Commissioning Consultant is not authorized to release, revoke, alter or expand requirements of Contract Documents, to approve or accept any portion of the work or to perform any duties of the Contractor.
       7. COMMISSIONING PLAN
          1. The Commissioning Plan is a tool through which the commissioning process is described and incorporates the Construction Manager COTR, Architect, Contractor and Commissioning Authority roles relative to the commissioning process. Commissioning team members are all contractors, subcontractors and design professionals whose participation is of benefit in the delivery of a fully functioning building to the Government. The plan shall describe the communication, authority and responsibility of commissioning team members. The Commissioning Plan will include the following:

The purpose of commissioning.

Detail the commissioning process.

Commissioning team members’ responsibilities.

Describe Pre-functional Construction Checklist Procedures.

Provide a guideline for acceptance of each piece of equipment or system.

Systems to be commissioned.

* + - 1. COMMISSIONING FIELD NOTEBOOK
         1. The Commissioning Field Notebook is assembled by the General Contractor and reviewed by the Commissioning Consultant to identify and track all pertinent commissioning documentation. The Contractor will maintain and manage completion of this Notebook. The Notebook provides a central location for the Commissioning Consultant to identify and organize all pertinent information and will include the following format:

Summary describing Notebook contents and use.

Commissioning Plan for contractor field reference.

Listing of all specification documentation requirements listed by specification section, with construction completion sign offs for appropriate parties. These types of documents include piping pressure testing, flushing reports, factory start-up reports and any field-testing relative to the project.

Copy of final approved submittal / shop drawings for each major piece of equipment involved in commissioning, as well as systems such as controls.

Tabs for each specification section with copies of completed, signed off pre-functional checklists and final Functional Performance Tests.

Commissioning project reports, resolution logs schedule information or any other documentation provided by the Commissioning Consultant.

Provide a .pdf copy of entire completed Commissioning Field Notebook to Commissioning Consultant at conclusion of project for use in developing final Commissioning Report, prepared by the Commissioning Consultant.

* + - 1. SYSTEMS TO BE COMMISSIONED
         1. Systems and Equipment to Be Functionally Tested: The system features are to be functionally tested and other building features will be evaluated for installation quality during construction. The functional performance testing will include the following systems and equipment. **(The following list shall be coordinated with paragraph 1.1 A. and customized by DM ad CM for the requirements of each project).**

Mechanical Systems:

Air handling units

Computer room units

Fan coil units

Pumps

Fans

Energy recovery units

Air volume control boxes with reheat coils

Air curtains

Energy recovery tube bundles

Unit heaters (all types)

Condensate pumps (electric & pressure powered)

Building automation system

Building automation air compressors

Building automation air dryers

Electrical Systems:

Variable Frequency Controllers

Lighting Control System

* + - 1. COMMISSIONING ACTIVITIES
         1. The Commissioning Fragnet Schedule: This schedule defines the milestones and conditions that must be achieved before system testing and other commissioning activities can commence. The schedule also includes the expected duration of the various tasks so that the commissioning process can be incorporated into the overall construction schedule.
         2. Commissioning Field Notebook: The General Contractor is required to created, developed and maintained the Commissioning Field Notebook. The General Contractor to identify and track all pertinent commissioning documentation required during the installation start-up and checkout phases in the Commissioning Field Notebook. The Commissioning Notebook will be kept by the General Contractor on site and will be made available to all subcontractors for their use. The Notebook provides a central location for the subcontractors and Commissioning Consultant to identify, copy, and organize all pertinent information.
         3. Preparation for Testing: To prepare for the system performance testing, the Commissioning Consultant will examine the design and Construction Documents, develop with appropriate Contractors Pre-functional Construction Checklists of construction responsibilities that must be completed prior to testing and develop detailed Functional Test Procedures and data forms. Using the Pre-functional Construction Checklists, the Contractor must verify that the systems they install comply with the Construction Documents and are fully functional. Commissioning is not intended to be a testing or inspection function that replaces any of the Contractors’ obligations for testing and proof of performance. Functional testing will only begin when checklists are completed by the appropriate subcontractors, initialed, signed and returned to the Commissioning Consultant, the TAB process is complete for both air and water balancing, and the controls are completed and all control loops properly tuned.
         4. Functional Testing: Functional testing is performed by experienced and qualified technicians of the Contractor(s), responsible for installation as facilitated by the Commissioning Consultant and may be observed by other members of the commissioning team including the Owner. Functional testing will verify proper sequencing, operation and performance of installed equipment and systems under realistic operating conditions. The functional testing will follow with written Functional Test Procedures with test results documented for permanent record.
         5. Documentation: In addition to the Pre-functional Construction Checklists and Functional Test Procedures, written documentation will be maintained for all other commissioning activities. Project communication reports shall be issued by the Commissioning Authority to the Contractor and key members of the commissioning team to document apparent deficiencies identified during examination of design and construction documents, daily activities on-site, construction deficiencies and successful or unsuccessful functional test results. At the end of the commissioning process, all documentation will be assembled and summarized in the Final Commissioning Report.
         6. Deficiency Resolution: When an Issues Log, Resolution Log or Field Report is issued to address an identified deficiency, the Contractor shall forward the reports to the appropriate parties to initiate corrective action in an expeditious manner. The designer is relied on for supplemental instructions or design modifications and issuance of final design details and the Contractors are relied on for implementation of that design. Change orders must be issued through proper contract channels.
      2. FUNCTIONAL TEST PROCEDURES
         1. The Functional Test Procedures include, but are not limited to, the following: **(DM to expand language for the Commissioning Consultant to change this section to correspond with the project)**

Verification of testing, adjusting and balancing performance.

Verification of all equipment’s ability to perform to the design intent.

Verification of the performance of sub-systems consisting of combinations of equipment (e.g., refrigeration cycle, pumps and interconnecting piping).

Verification of the performance of the automatic controls in all seasonal modes.

Verification of the performance of the HVAC system as a whole.

Verification of the performance of all life safety devices and systems that interface with the HVAC systems. Commissioning of life safety systems by the Commissioning Authority shall be limited to the fire alarm interface with the HVAC systems.

1. PRODUCTS (NOT USED)
2. EXECUTION
   * + 1. GENERAL
          1. Operating equipment and systems shall be tested in presence of Government’s Commissioning Consultant and Project Officer (Construction Manager COTR) to demonstrate compliance with specified requirements.

Notify COTR, in writing, fourteen (14) days prior to tests, twenty-one (21) days prior if a utility shutdown is required, scheduled under requirements of this Section.

Testing shall be conducted under specified design operating conditions as recommended or approved by construction Manager COTR and Architect.

* + - * 1. The Functional Performance Testing shall be completed by the Contractor as a requirement of Substantial Completion. The acceptance of Functional Performance Test by Construction Manager COTR is a requirement of Final Completion.
        2. All elements of systems shall be tested to demonstrate that total systems satisfy all requirements of these Specifications. Testing shall be accomplished on hierarchical basis. Test each piece of equipment for proper operation, followed by each sub-system, followed by entire system, followed by interaction with other major systems.
        3. Proprietary test equipment required by the manufacturer, whether specified or not, shall be provided by the manufacturer of the equipment through the installing contractor. Manufacturer shall provide the test equipment, demonstrate its use, and assist the Commissioning Consultant in the commissioning process.
        4. Acceptance Documentation: A copy of the functional performance tests results shall be necessary acceptance documentation along with other specified requirements. Documentation must be signed and dated.
      1. ACCEPTANCE PROCEDURES
         1. Prior to functional performance testing of each system, the Commissioning Consultant shall observe and verify that the physical installation of components and systems being tested is substantially installed in accordance with the Contract Documents.
         2. Contractor’s Tests:

System shall be checked for proper installation, shall be adjusted and calibrated to verify that it is ready to function as specified.

All system elements shall be checked to verify that they have been installed properly and that all connections have been made correctly.

All discrete elements and sub-systems shall be adjusted and checked for proper operation.

Start-up and operational tests shall be complete, with all required Pre-functional Construction Checklists signed and submitted for review by Commissioning Consultant within five (5) days of each activity, prior to starting functional performance testing.

* + - * 1. Smithsonian Institution witnessed Functional Tests:

Objective of these tests is to demonstrate that system is operating and complying with specified performance requirements.

Smithsonian Institution witnessed functional performance tests shall be performed on complete system. Each function shall be demonstrated to satisfaction of the Architect / Engineer through the CM COTR and Smithsonian Institution’s Commissioning Consultant on paragraph-by-paragraph basis of Commissioning Consultant’s written test procedure, developed to demonstrate conformance to requirements of the Specifications.

Functional performance tests shall be witnessed and endorsed by the Commissioning Consultant upon satisfactory completion.

Actual testing program shall be conducted in accordance with prior approved procedures and shall be documented as required herein.

Contractor shall notify Architect and Construction Manager COTR at least two (2) weeks prior to date of functional performance tests.

* + - * 1. The functional performance testing process shall be accomplished for all equipment, sub-systems, systems and system interfaces. The order of functional performance testing shall be reflected in the Commissioning Fragnet Schedule. All must be tested for acceptances and there shall be a separate checklist for each to ensure documentation specific to each is complete.
        2. Each system shall be operated through all modes of system operation (e.g., seasonal, occupied, unoccupied, warm-up, cool-down, etc., as applicable) including every individual interlock and conditional control logic, all control sequences, both full-load and part-load conditions and simulation of all abnormal conditions for which there is a specified system or controls response. The warm-up and cool-down test shall be a performance test, as applicable.
        3. Temporary upsets of systems, such as distribution fault, control loss, set-point change, equilibrium upset and component failure, shall be imposed at different operation loads to determine system stability and recovery time.
        4. When the functional performance of all individual systems has been proven, the interface or coordinated responses between systems shall be checked. The systems involved may be within the overall HVAC work or they may involve other systems, such as emergency systems for life safety.
        5. Corrective Measures: If acceptable performance cannot be achieved, the cause of the deficiency will be identified. If it is determined, that the deficiency was caused by the system or component not being installed per the manufacturer’s recommendations or Contract Documents, the necessary corrective measures shall be carried out by the General Contractor. Every check or test for which acceptable performance was not achieved shall be repeated after the necessary corrective measures have been completed. This re-testing process should be repeated until acceptable performance is achieved. The Contractor will be allowed one retest after initial testing of the equipment. If the retest fails, the Contractor shall be financially responsible, at standard rates, to reimburse the Commissioning Consultant for the additional time taken to achieve acceptable performance.
      1. TRAINING AND INSTRUCTION
         1. Training and instruction of Government personnel is a part of the commissioning process and essential for the proper operation of the facility. The contractors and vendors providing the training will complete training plans and submit to the Commissioning Consultant for review and approval in conjunction with the COTR.
      2. SEASONAL COMMISSIONING AND OCCUPANCY VARIATIONS
         1. Seasonal commissioning pertains to testing under full-load conditions during peak heating and peak cooling seasons, as well as part-load conditions in the spring and fall. Initial commissioning will be done as soon as contract work is completed, regardless of season. Subsequent commissioning may be undertaken at any time thereafter to ascertain adequate performance during the different seasons.
         2. All equipment and systems will be tested and commissioned in a peak season to observe full-load performance. Heating equipment will be tested during winter design conditions. Cooling equipment will be tested during summer design conditions, with a fully occupied building. Each Contractor and supplier will be responsible to participate in the initial and the alternate peak season test of the systems required demonstrating performance.
         3. Subsequent commissioning may be required under conditions of minimum and/or maximum occupancy or use. All equipment and systems affected by occupancy variations will be tested and commissioned at the minimum and peak loads to observe system performance. Each Contactor and supplier will be responsible to participate in the occupancy sensitive testing of systems to provide verification of adequate performance.
         4. Commissioning team including contractor, subcontractors, commissioning personnel and COTR shall meet at site roughly ten months after Substantial Completion to review any system issues, and correct any operational concerns covered by warranty. Commissioning Consultant shall lead this site meeting, and shall summarize findings in a site report.
      3. SCHEDULE
         1. The schedule includes the probable expected sequence and duration for the various tasks, so that the commissioning process can be integrated with the general construction schedule and refined over the course of the project. Actual sequencing and durations shall be by the General Contractor and Sub-Contractors, coordinated with the Commissioning Consultant.
         2. Note: Attention to these scheduling needs are important to prevent conflicts that have been problematic within the commissioning process **(DM CM to address duration to be customized to each particular project)** :

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| Milestone | Duration | Successor | Predecessor |
| Commissioning Kick off Mtg. | 1 day | All contractors on board including Controls and TAB | Before major MEP installation |
| Review equipment submittals | 2 weeks | After receipt of submittals | Before ordering or installation |
| Develop Pre-functional Construction Checklists | 2 weeks | After equipment submittal review and after receipt of O&M literature | Before MEP installation |
| Walk contractors through Pre-functional Construction Checklists | 1 day | After development of Pre-Functional Checklist documentation | Before MEP installation |
| Write Functional Tests | 3 to 5 weeks | After controls submittal review | 3 weeks prior to functional testing |
| Submit Functional Tests for review by COTR and Contractors | 1 week | After development of Functional Tests | Before Functional testing |
| Complete Pre-functional Construction Checklists (contractor task) | On Going | During installation, startup and test, adjust and balance | Before TAB Backcheck and functional testing |
| Site Observations (CxA) | on-going | After majority of MEP installation | Before TAB Backcheck and functional testing |
| Test, Adjust and Balance  (contractor task) | See CPM schedule | After Start-up and Pre-functional Construction checks. All walls, windows, doors, ceilings must be installed. | Before TAB Backcheck |
| Test, Adjust and Balance Backcheck (10%) | 1 week | After Start-up and receipt of completed Pre-functional Construction Checklists from contractors | Before functional testing |
| Functional Testing | 2 months | After TAB Backcheck and receipt of completed Pre-functional Construction Checklist have been completed by contractors | Before Government occupancy |
| Issues Resolution | 1 week | After Functional Testing | Before Government occupancy |
| Final Commissioning Documentation Submittal | 2 weeks | After resolution of issues log | 2 weeks after resolution of issues log |

END OF SECTION 01 91 13