

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS shall form the basis of the construction phase commissioning process and procedures. The Commissioning Agent (T & M Associates, Inc.) shall add, modify, and refine the commissioning procedures, as approved by the Department of Veterans Affairs (VA), to suit field conditions and actual manufacturer's equipment, incorporate test data and procedure results, and provide detailed scheduling for all commissioning tasks.
- B. Various sections of the project specifications require equipment startup, testing, and adjusting services. Requirements for startup, testing, and adjusting services specified in the Division 7, Division 21, Division 22, Division 23, Division 26, Division 27, series sections of these specifications are intended to be provided in coordination with the commissioning services and are not intended to duplicate services. The Contractor shall coordinate the work required by individual specification sections with the commissioning services requirements specified herein.
- C. Where individual testing, adjusting, or related services are required in the project specifications and not specifically required by this commissioning requirements specification, the specified services shall be provided and copies of documentation, as required by those specifications shall be submitted to the VA and the Commissioning Agent to be indexed for future reference.
- D. Where training or educational services for VA are required and specified in other sections of the specifications, including but not limited to Division 7, Division 8, Division 21, Division 22, Division 23, Division 26, Division 27 and Division 28 series sections of the specification, these services are intended to be provided in addition to the training and educational services specified herein.
- E. Commissioning is a systematic process of verifying that the building systems perform interactively according to the construction documents and the VA's operational needs. The commissioning process shall encompass and coordinate the system documentation, equipment startup, control system calibration, testing and balancing, performance testing

and training. Commissioning during the construction, and post-occupancy phases is intended to achieve the following specific objectives according to the contract documents:

1. Verify that the applicable equipment and systems are installed in accordance with the contract documents and according to the manufacturer's recommendations.
2. Verify and document proper integrated performance of equipment and systems.
3. Verify that Operations & Maintenance documentation is complete.
4. Verify that all components requiring servicing can be accessed, serviced and removed without disturbing nearby components including ducts, piping, cabling or wiring.
5. Verify that the VA's operating personnel are adequately trained to enable them to operate, monitor, adjust, maintain, and repair building systems in an effective and energy-efficient manner.
6. Document the successful achievement of the commissioning objectives listed above.

F. The commissioning process does not take away from or reduce the responsibility of the Contractor to provide a finished and fully functioning product.

1.2 CONTRACTUAL RELATIONSHIPS

- A. For this construction project, the Department of Veterans Affairs contracts with a Contractor to provide construction services. The contracts are administered by the VA Contracting Officer and the COTR as the designated representative of the Contracting Officer. On this project, the authority to modify the contract in any way is strictly limited to the authority of the Contracting Officer and the COTR.
- B. In this structure, only two contract parties are recognized and communications on contractual issues are strictly limited to VA COTR and the Contractor. It is the practice of the VA to require that communications between other parties to the contracts (Subcontractors and Vendors) be conducted through the COTR and Contractor. It is also the practice of the VA that communications between other parties of the project (Commissioning Agent and Architect/Engineer) be conducted through the COTR.

- C. Commissioning is a process that relies upon frequent and direct communications, as well as collaboration between all parties to the construction process. By its nature, a high level of communication and cooperation between the Commissioning Agent and all other parties (Architects, Engineers, Subcontractors, Vendors, third party testing agencies, etc) is essential to the success of the Commissioning effort.
- D. With these fundamental practices in mind, the commissioning process described herein has been developed to recognize that, in the execution of the Commissioning Process, the Commissioning Agent must develop effective methods to communicate with every member of the construction team involved in delivering commissioned systems while simultaneously respecting the exclusive contract authority of the Contracting Officer and COTR. Thus, the procedures outlined in this specification must be executed within the following limitations:
1. No communications (verbal or written) from the Commissioning Agent shall be deemed to constitute direction that modifies the terms of any contract between the Department of Veterans Affairs and the Contractor.
 2. Commissioning Issues identified by the Commissioning Agent will be delivered to the COTR and copied to the designated Commissioning Representatives for the Contractor and subcontractors on the Commissioning Team for information only in order to expedite the communication process. These issues must be understood as the professional opinion of the Commissioning Agent and as suggestions for resolution.
 3. In the event that any Commissioning Issues and suggested resolutions are deemed by the COTR to require either an official interpretation of the construction documents or require a modification of the contract documents, the Contracting Officer or COTR will issue an official directive to this effect.
 4. All parties to the Commissioning Process shall be individually responsible for alerting the COTR of any issues that they deem to constitute a potential contract change prior to acting on these issues.

5. Authority for resolution or modification of design and construction issues rests solely with the Contracting Officer or COTR, with appropriate technical guidance from the Architect/Engineer and/or Commissioning Agent.

1.3 RELATED WORK

- A. Section 01 00 00 GENERAL REQUIREMENTS.
- B. Section 23 08 00 COMMISSIONING OF HVAC SYSTEMS.

1.4 SUMMARY

- A. This Section includes general requirements that apply to implementation of commissioning without regard to systems, subsystems, and equipment being commissioned.
- B. The commissioning activities have been developed to support the VA requirements to meet guidelines for Federal Leadership in Environmental, Energy, and Economic Performance.

1.5 DEFINITIONS

- A. Architect: Includes Architect identified in the Contract for Construction between the Department of Veterans Affairs and Contractor, plus consultant/design professionals responsible for design of fire suppression, plumbing, HVAC, controls for HVAC systems, electrical, communications, electronic safety and security, as well as other related systems.
- B. CxA: Commissioning Agent.
- C. Commissioning Plan: a document that is an overall plan that outlines the commissioning process, commissioning team responsibilities, schedule for commissioning activities, and commissioning documents.
- D. Commissioning Issue: a condition in the installation or function of a component, piece of equipment or system that affects the system operations, maintenance, and/or repair.
- E. Commissioning Observation: a condition in the installation or function of a component, piece of equipment or system that may not be in compliance with the Contract Documents, or may not be in compliance with the manufacturer's installation instruction, or may not be in compliance with generally accepted industry standards.
- F. Systems Functional Performance Test: a test, or tests, of the dynamic function and operation of equipment and systems using manual (direct observation) or monitoring methods. Systems Functional Performance

Testing is the dynamic testing of systems (rather than just components) under full operation. Systems are tested under various modes, such as during low cooling or heating loads, high loads, component failures, unoccupied, varying outside air temperatures, fire alarm, power failure, etc. The systems are run through all the control system's sequences of operation and components are verified to be responding as the sequences state. Traditional air or water test and balancing (TAB) is not Systems Functional Performance Testing, in the commissioning sense of the word. TAB's primary work is setting up the system flows and pressures as specified, while System Functional Performance Testing is verifying that the system has already been set up properly and is functioning in accordance with the Construction Documents. The Commissioning Agent develops the Systems Functional Performance Test Procedures in a sequential written form, coordinates, witnesses, and documents the actual testing. Systems Functional Performance Testing is performed by the Contractor. Systems Functional Performance Tests are performed after startups, control systems are complete and operational, TAB functions and Pre-Functional Checklists are complete.

- G. System: A system is defined as the entire set of components, equipment, and subsystems which must be coordinated to work together during normal operation to produce results for which the system is designed. For example, air conditioning supply air is only one component of an entire system which provides comfort conditions for a building. Other related components are return air, exhaust air, cooling coils, hot water supply, controls and electrical service, etc.
- H. Pre-Functional Checklist: a list of items provided by the Commissioning Agent to the Contractor that require inspection and elementary component tests conducted to verify proper installation of equipment. Pre-Functional Checklists are primarily static inspections and procedures to prepare the equipment or system for initial operation (e.g., belt tension, oil levels OK, labels affixed, gages in place, sensors calibrated, etc.). However, some Pre-Functional Checklist items entail simple testing of the function of a component, a piece of equipment or system. The term "Pre-Functional" refers to before Systems Functional Performance Testing. Pre-Functional Checklists

augment and are combined with the manufacturer's startup checklist and the Contractor's Quality Control checklists.

- I. Seasonal Functional Performance Testing: a test or tests that are deferred until the system will experience conditions closer to their design conditions.
- J. VA: Includes the Contracting Officer, COTR, or other authorized representative of the Department of Veterans Affairs.
- K. TAB: Testing, Adjusting, and Balancing.

1.6 SYSTEMS TO BE COMMISSIONED

- A. Commissioning of a system or systems specified for this project is part of the construction process. Documentation and testing of these systems, as well as training of the VA's Operation and Maintenance personnel, is required in cooperation with the VA and the Commissioning Agent. Also refer to commissioning charts for details.
- B. Summary of minimum Items to be commissioned:
 - 1. HVAC:
 - a. Air handling unit AC-1
 - b. Air-cooled chillers ACC-1
 - c. CAV/VAV boxes with reheat coil
 - d. Equipment, piping and duct supports
 - e. Exhaust fan EF-1
 - f. Clean steam generator
 - g. Ductwork
 - h. Steam humidifier
 - i. Grilles & diffusers
 - j. Chilled water/hot water piping & valves
 - k. DDC controls & BAS tie in
 - l. Air and water testing and balancing
 - m. Piping & equipment identification
 - n. Piping insulation
 - o. Training
 - p. Season inspection & testing
 - 2. Plumbing:
 - a. Hot water supply & return
 - b. Cold water supply

- c. Plumbing fixtures: water closets, lavatories, mop basin, counter top sink, etc.
- d. Floor and roof drains
- e. Piping material
- f. Piping insulation
- g. Piping & equipment supports
- 3. Medical Gases:
 - a. Gas piping, O2, Vac, MA, EVAC
 - b. Zone valves
 - c. Medical gas alarm panel
 - d. Medical gas outlets
 - e. Gas piping, material, size, supports, identification
- 4. Fire Protection:
 - a. Sprinkler piping, material and supports
 - b. Sprinkler heads
 - c. Pressure in piping system
- 4. Electrical:
 - a. Electrical panels LP-C, CP-C
 - b. Electrical isolation panels IPUB-111A, IPUB-111B
 - c. Equipotential grounding
 - d. Nurse call system
 - e. Power & ground module
 - f. Power receptacles - normal & critical power
 - g. Lights
 - h. Surgical lights
 - i. Tele/data outlets
 - j. Fire alarm system
 - k. Security system
 - l. Exit signs

1.7 COMMISSIONING TEAM

A. Members Appointed by Contractor:

1. Contractor: The designated person, company, or entity that plans, schedules and coordinates the commissioning activities for the construction team.
2. Contractor's Commissioning Representative(s): Individual(s), each having authority to act on behalf of the entity he or she

represents, explicitly organized to implement the commissioning process through coordinated actions. The commissioning team shall consist of, but not be limited to, representatives of Contractor, including Project Superintendent and subcontractors, installers, suppliers, and specialists deemed appropriate by the Department of Veterans Affairs (VA) and Commissioning Agent.

B. Members Appointed by VA:

1. Commissioning Agent: The designated person, company, or entity that plans, schedules, and coordinates the commissioning team to implement the commissioning process. The VA will engage the CxA under a separate contract.
2. Representatives of the facility user and operation and maintenance personnel.
3. Architect and engineering design professionals.

1.8 VA'S COMMISSIONING RESPONSIBILITIES

- A. Appoint an individual, company or firm to act as the Commissioning Agent.
- B. Assign operation and maintenance personnel and schedule them to participate in commissioning team activities including, but not limited to, the following:
 1. Coordination meetings.
 2. Training in operation and maintenance of systems, subsystems, and equipment.
 3. Testing meetings.
 4. Witness and assist in Systems Functional Performance Testing.
 5. Demonstration of operation of systems, subsystems, and equipment.
- C. Provide the Construction Documents, prepared by Architect and approved by VA, to the Commissioning Agent and for use in managing the commissioning process, developing the commissioning plan, systems manuals, and reviewing the operation and maintenance training plan.

1.9 CONTRACTOR'S COMMISSIONING RESPONSIBILITIES

- A. The Contractor shall assign a Commissioning Person to manage commissioning activities of the Contractor, and subcontractors.
- B. The Contractor shall ensure that the commissioning responsibilities outlined in these specifications are included in all subcontracts and

that subcontractors comply with the requirements of these specifications.

- C. The Contractor shall ensure that each installing subcontractor shall assign representative with expertise and authority to act on behalf of the subcontractor and schedule them to participate in and perform commissioning team activities including, but not limited to, the following:
1. Participate in commissioning coordination meetings.
 2. Conduct operation and maintenance training sessions in accordance with approved training plans.
 3. Verify that Work is complete and systems are operational according to the Contract Documents, including calibration of instrumentation and controls.
 4. Evaluate commissioning issues and commissioning observations identified in the Commissioning Issues Log, field reports, test reports or other commissioning documents. In collaboration with entity responsible for system and equipment installation, recommend corrective action.
 5. Review and comment on commissioning documentation.
 6. Participate in meetings to coordinate Systems Functional Performance Testing.
 7. Provide schedule for operation and maintenance data submittals, equipment startup, and testing to Commissioning Agent for incorporation into the commissioning plan.
 8. Provide information to the Commissioning Agent for developing commissioning plan.
 9. Participate in training sessions for VA's operation and maintenance personnel.
 10. Provide technicians who are familiar with the construction and operation of installed systems and who shall develop specific test procedures to conduct Systems Functional Performance Testing of installed systems.

1.10 COMMISSIONING AGENT'S RESPONSIBILITIES

- A. Prepare the commissioning plan.
- B. Review and comment on selected submittals from the Contractor for general conformance with the Construction Documents. Review and

comment on the ability to test and operate the system and/or equipment, including providing gages, controls and other components required to operate, maintain, and test the system. Review and comment on performance expectations of systems and equipment and interfaces between systems relating to the Construction Documents.

- C. At the beginning of the construction phase, conduct an initial construction phase coordination meeting for the purpose of reviewing the commissioning activities and establishing tentative schedules for operation and maintenance submittals; operation and maintenance training sessions; TAB Work; Pre-Functional Checklists, Systems Functional Performance Testing; and project completion.
- D. Observe construction and report progress, observations and issues. Observe systems and equipment installation for adequate accessibility for maintenance and component replacement or repair, and for general conformance with the Construction Documents.
- E. Prepare Project specific Pre-Functional Checklists and Systems Functional Performance Test procedures.
- F. Coordinate Systems Functional Performance Testing schedule with the Contractor.
- G. Witness selected systems startups.
- H. Verify selected Pre-Functional Checklists completed and submitted by the Contractor.
- I. Witness and document Systems Functional Performance Testing.
- J. Compile test data, inspection reports, and certificates and include them in the systems manual and commissioning report.
- K. Review and comment on operation and maintenance (O&M) documentation and systems manual outline for compliance with the Contract Documents.
- L. Review operation and maintenance training program developed by the Contractor. Verify training plans provide qualified instructors to conduct operation and maintenance training.
- M. Prepare commissioning Field Observation Reports.
- N. Return to the site at 10 months into the 12 month warranty period and review with facility staff the current building operation and the condition of outstanding issues related to the original and seasonal Systems Functional Performance Testing. Also interview facility staff and identify problems or concerns they have operating the building as

originally intended. Make suggestions for improvements and for recording these changes in the O&M manuals. Identify areas that may come under warranty or under the original construction contract. Assist facility staff in developing reports, documents and requests for services to remedy outstanding problems.

- O. Assemble the final commissioning documentation, including the Final Commissioning Report and Addendum to the Final Commissioning Report.

1.11 COMMISSIONING DOCUMENTATION

- A. Commissioning Plan: A document, prepared by Commissioning Agent that outlines the schedule, allocation of resources, and documentation requirements of the commissioning process, and shall include, but is not limited, to the following:
 1. Plan for delivery and review of submittals, systems manuals, and other documents and reports. Identification of the relationship of these documents to other functions and a detailed description of submittals that are required to support the commissioning processes. Submittal dates shall include the latest date approved submittals must be received without adversely affecting commissioning plan.
 2. Description of the organization, layout, and content of commissioning documentation (including systems manual) and a detailed description of documents to be provided along with identification of responsible parties.
 3. Identification of systems and equipment to be commissioned.
 4. Identification of items that must be completed before the next operation can proceed.
 5. Description of responsibilities of commissioning team members.
 6. Description of observations to be made.
 7. Description of requirements for operation and maintenance training.
 8. Schedule for commissioning activities with dates coordinated with overall construction schedule.
 9. Process and schedule for completing prestart and startup checklists for systems, subsystems, and equipment to be verified and tested.
 10. Preliminary Systems Functional Performance Test procedures.
- B. Systems Functional Performance Test Procedures: The Commissioning Agent will develop Systems Functional Performance Test Procedures for each system to be commissioned, including subsystems, or equipment and

interfaces or interlocks with other systems. The Systems Performance Test Procedure will include test procedures for each mode of operation and provide space to indicate whether the mode under test responded as required. Each System Functional Performance Test procedure, regardless of system, subsystem, or equipment being tested, shall include, but not be limited to, the following:

1. Name and identification code of tested system.
2. Test number.
3. Time and date of test.
4. Indication of whether the record is for a first test or retest following correction of a problem or issue.
5. Dated signatures of the person performing test and of the witness, if applicable.
6. Individuals present for test.
7. Observations and Issues.
8. Issue number, if any, generated as the result of test.

- C. Pre-Functional Checklists: The Commissioning Agent will prepare *Pre-Functional Checklists*. *Pre-Functional Checklists* shall be completed and signed by the Contractor, verifying that systems, subsystems, equipment, and associated controls are ready for testing. The Commissioning Agent will spot check *Pre-Functional Checklists* to verify accuracy and readiness for testing. Inaccurate or incomplete *Pre-Functional Checklists* shall be returned to the Contractor for correction and resubmission.
- D. Test and Inspection Reports: The Commissioning Agent will record test data, observations, and measurements on Systems Functional Performance Test Procedure. The report will also include recommendation for system acceptance or non-acceptance. Photographs, forms, and other means appropriate for the application shall be included with data. Commissioning Agent Will compile test and inspection reports and test and inspection certificates and include them in systems manual and commissioning report.
- E. Corrective Action Documents: The Commissioning Agent will document corrective action taken for systems and equipment that fail tests. The documentation will include any required modifications to systems and equipment and/or revisions to test procedures, if any. The

Commissioning Agent will witness and document any retesting of systems and/or equipment requiring corrective action and document retest results.

- F. Commissioning Issues Log: The Commissioning Agent will prepare and maintain Commissioning Issues Log that describes Commissioning Issues and Commissioning Observations that are identified during the Commissioning process. These observations and issues include, but are not limited to, those that are at variance with the Contract Documents. The Commissioning Issues Log will identify and track issues as they are encountered, the party responsible for resolution, progress toward resolution, and document how the issue was resolved. The Master Commissioning Issues Log will also track the status of unresolved issues.
- G. Final Commissioning Report: The Commissioning Agent will document results of the commissioning process, including unresolved issues, and performance of systems, subsystems, and equipment. The Commissioning Report will indicate whether systems, subsystems, and equipment have been properly installed and are performing according to the Contract Documents. This report will be used by the Department of Veterans Affairs when determining that systems will be accepted. This report will be used to evaluate systems, subsystems, and equipment and will serve as a future reference document during VA occupancy and operation. It shall describe components and performance that exceed requirements of the Contract Documents and those that do not meet requirements of the Contract Documents. The commissioning report will include, but is not limited to, the following:
1. Lists and explanations of substitutions; compromises; variances with the Contract Documents; record of conditions; and, if appropriate, recommendations for resolution. Design Narrative documentation maintained by the Commissioning Agent.
- H. Systems Manual: The Commissioning Agent will gather required information and compile the Systems Manual. The Systems Manual will include, but is not limited to, the following:
1. Design Narrative, including system narratives, schematics, single-line diagrams, flow diagrams, equipment schedules, and changes made throughout the Project.

2. Reference to Final Commissioning Plan.
3. Reference to Final Commissioning Report.
4. Approved Operation and Maintenance Data as submitted by the Contractor.

1.12 SUBMITTALS

- A. Preliminary Commissioning Plan Submittal: The Commissioning Agent has prepared a Preliminary Commissioning Plan based on the final Construction Documents. The Preliminary Commissioning Plan will be provided by the Commissioning Agent. It will contain preliminary information about the following commissioning activities:
 1. The Commissioning Team: A list of commissioning team members by organization.
 2. Systems to be commissioned. A detailed list of systems to be commissioned for the project. This list also provides preliminary information on systems/equipment submittals to be reviewed by the Commissioning Agent; preliminary information on Pre-Functional Checklists that are to be completed; preliminary information on Systems Performance Testing, including information on testing sample size (where authorized by the VA).
 3. Commissioning Documents: A preliminary list of commissioning-related documents, include identification of the parties responsible for preparation, review, approval, and action on each document.
 4. Pre-Functional Checklists: Preliminary Pre-Functional Checklists for equipment, components, subsystems, and systems to be commissioned. These Preliminary Pre-Functional Checklists provide guidance on the level of detailed information the Contractor shall include on the final submission.
 5. Systems Functional Performance Test Procedures: Preliminary step-by-step System Functional Performance Test Procedures to be used during Systems Functional Performance Testing. These Preliminary Systems Functional Performance procedures provide information on the level of testing rigor, and the level of Contractor support required during performance of system's testing.
- B. Final Commissioning Plan Submittal: Based on the Final Construction Documents and the Contractor's project team, the Commissioning Agent will prepare the Final Commissioning Plan as described in this section.

The Commissioning Agent will submit three hard copies and three sets of electronic files of Final Commissioning Plan. The Contractor shall review the Commissioning Plan and provide any comments to the VA. The Commissioning Agent will incorporate review comments into the Final Commissioning Plan as directed by the VA.

- C. Systems Functional Performance Test Procedure: The Commissioning Agent will submit preliminary Systems Functional Performance Test Procedures to the Contractor, and the VA for review and comment. The Contractor shall return review comments to the VA and the Commissioning Agent. The VA will also return review comments to the Commissioning Agent. The Commissioning Agent will incorporate review comments into the Final Systems Functional Test Procedures to be used in Systems Functional Performance Testing.
- D. Pre-Functional Checklists: The Commissioning Agent will submit Pre-Functional Checklists to be completed by the Contractor.
- E. Test and Inspection Reports: The Commissioning Agent will submit test and inspection reports to the VA with copies to the Contractor and the Architect/Engineer.
- F. Corrective Action Documents: The Commissioning Agent will submit corrective action documents to the VA COTR with copies to the Contractor and Architect.
- G. Preliminary Commissioning Report Submittal: The Commissioning Agent will submit three electronic copies of the preliminary commissioning report. One electronic copy, with review comments, will be returned to the Commissioning Agent for preparation of the final submittal.
- H. Final Commissioning Report Submittal: The Commissioning Agent will submit four sets of electronically formatted information of the final commissioning report to the VA. The final submittal will incorporate comments as directed by the VA.
- I. Data for Commissioning:
 - 1. The Commissioning Agent will request in writing from the Contractor specific information needed about each piece of commissioned equipment or system to fulfill requirements of the Commissioning Plan.

1.13 COMMISSIONING PROCESS

- A. The Commissioning Agent will be responsible for the overall management of the commissioning process as well as coordinating scheduling of commissioning tasks with the VA and the Contractor. As directed by the VA, the Contractor shall incorporate Commissioning tasks, including, but not limited to, Systems Functional Performance Testing (including predecessors) with the Master Construction Schedule.
- B. The Contractor shall designate a specific individual as the Commissioning Representative to manage and lead the commissioning effort on behalf of the Contractor. The Commissioning Representative shall be the single point of contact and communications for all commissioning related services by the Contractor.
- C. The Contractor shall ensure that each subcontractor designates specific individuals as Commissioning Representatives (CR) to be responsible for commissioning related tasks. The Contractor shall ensure the designated Commissioning Representatives participate in the commissioning process as team members providing commissioning testing services, equipment operation, adjustments, and corrections if necessary. The Contractor shall ensure that all Commissioning Representatives shall have sufficient authority to direct their respective staff to provide the services required, and to speak on behalf of their organizations in all commissioning related contractual matters.

1.14 QUALITY ASSURANCE

- A. Instructor Qualifications: Factory authorized service representatives shall be experienced in training, operation, and maintenance procedures for installed systems, subsystems, and equipment.
- B. Test Equipment Calibration: The Contractor shall comply with test equipment manufacturer's calibration procedures and intervals. Recalibrate test instruments immediately whenever instruments have been repaired following damage or dropping. Affix calibration tags to test instruments. Instruments shall have been calibrated within six months prior to use.

1.15 COORDINATION

- A. Management: The Commissioning Agent will coordinate the commissioning activities with the VA and Contractor. The Commissioning Agent will submit commissioning documents and information to the VA. All

commissioning team members shall work together to fulfill their contracted responsibilities and meet the objectives of the contract documents.

- B. Scheduling: The Contractor will work with the Commissioning Agent and the VA to incorporate the commissioning activities into the construction schedule. The Commissioning Agent will provide sufficient information on commissioning activities to allow the Contractor and the VA to schedule commissioning activities. All parties shall address scheduling issues and make necessary notifications in a timely manner in order to expedite the project and the commissioning process. The Contractor shall update the Master Construction as directed by the VA.
- C. Initial Schedule of Commissioning Events: The Commissioning Agent will provide the initial schedule of primary commissioning events in the Commissioning Plan and at the commissioning coordination meetings. The Commissioning Plan will provide a format for this schedule. As construction progresses, more detailed schedules will be developed by the Contractor with information from the Commissioning Agent.
- D. Systems Functional Performance Testing Coordination: The Contractor shall coordinate testing activities to accommodate required quality assurance and control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting. The Contractor shall coordinate the schedule times for tests, inspections, obtaining samples, and similar activities.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

- A. The Contractor shall provide all standard and specialized testing equipment required to perform Systems Functional Performance Testing. Test equipment required for Systems Functional Performance Testing will be identified in the detailed System Functional Performance Test Procedure prepared by the Commissioning Agent.
- B. All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified in the Specifications. If not otherwise noted, the following minimum requirements apply: Temperature sensors and digital thermometers shall have a certified calibration within the past year to an accuracy of 0.5 °C (1.0 °F) and a resolution of + or - 0.1 °C (0.2 °F). Pressure sensors

shall have an accuracy of + or - 2.0% of the value range being measured (not full range of meter) and have been calibrated within the last year. All equipment shall be calibrated according to the manufacturer's recommended intervals and when dropped or damaged. Calibration tags shall be affixed or certificates readily available.

PART 3 - EXECUTION

3.1 STARTUP, INITIAL CHECKOUT, AND PRE-FUNCTIONAL CHECKLISTS

A. The following procedures shall apply to all equipment and systems to be commissioned, according to Part 1, Systems to Be Commissioned.

1. Pre-Functional Checklists are important to ensure that the equipment and systems are hooked up and operational. These ensure that Systems Functional Performance Testing may proceed without unnecessary delays. Each system to be commissioned shall have a full Pre-Functional Checklist completed by the Contractor prior to Systems Functional Performance Testing. No sampling strategies are used.
 - a. The Pre-Functional Checklist will identify the trades responsible for completing the checklist. The Contractor shall ensure the appropriate trades complete the checklists.
 - b. The Commissioning Agent will review completed Pre-Functional Checklists and field-verify the accuracy of the completed checklist using sampling techniques.
2. Startup and Initial Checkout Plan: The Contractor shall develop detailed startup plans for all new and existing equipment. The primary role of the Contractor in this process is to ensure that there is written documentation that each of the manufacturer recommended procedures have been completed. Parties responsible for startup shall be identified in the Startup Plan and in the checklist forms.
 - a. The Contractor shall develop the full startup plan by combining (or adding to) the checklists with the manufacturer's detailed startup and checkout procedures from the O&M manual data and the field checkout sheets normally used by the Contractor. The plan shall include checklists and procedures with specific boxes or lines for recording and documenting the checking and inspections of each procedure and a summary statement with a signature block at the end of the plan.

- b. The full startup plan shall at a minimum consist of the following items:
 - 1) The Pre-Functional Checklists.
 - 2) The manufacturer's standard written startup procedures copied from the installation manuals with check boxes by each procedure and a signature block added by hand at the end.
 - 3) The manufacturer's normally used field checkout sheets.
 - a) The Commissioning Agent will submit the full startup plan to the VA and Contractor for review. Final approval will be by the VA.
 - b) The Contractor shall review and evaluate the procedures and the format for documenting them, noting any procedures that need to be revised or added.
- 3. Sensor and Actuator Calibration
 - a. All field installed existing & new temperature, relative humidity, and pressure sensors and gages, and all actuators (dampers and valves) on all equipment shall be calibrated using the methods described in Division 21, Division 22, Division 23, Division 26, Division 27, and Division 28 specifications.
 - b. All procedures used shall be fully documented on the Pre-Functional Checklists or other suitable forms, clearly referencing the procedures followed and written documentation of initial, intermediate and final results.
- 4. Execution of Equipment Startup
 - a. Four weeks prior to equipment startup, the Contractor shall schedule startup and checkout with the VA and Commissioning Agent. The performance of the startup and checkout shall be directed and executed by the Contractor.
 - b. The Commissioning Agent will observe the startup procedures for selected pieces of primary equipment.
 - c. The Contractor shall execute startup and provide the VA and Commissioning Agent with a signed and dated copy of the completed startup checklists, and contractor tests.
 - d. Only individuals that have direct knowledge and witnessed that a line item task on the Startup Checklist was actually performed

shall initial or check that item off. It is not acceptable for witnessing supervisors to fill out these forms.

3.2 DEFICIENCIES, NONCONFORMANCE, AND APPROVAL IN CHECKLISTS AND STARTUP

- A. The Contractor shall clearly list any outstanding items of the initial startup and Pre-Functional Checklist procedures that were not completed successfully, at the bottom of the procedures form or on an attached sheet. The procedures form and any outstanding deficiencies shall be provided to the VA and the Commissioning Agent within two days of completion.
- B. The Commissioning Agent will review the report and submit comments to the VA. The Commissioning Agent will work with the Contractor to correct and verify deficiencies or uncompleted items. The Commissioning Agent will involve the VA and others as necessary. The Contractor shall correct all areas that are noncompliant or incomplete in the checklists in a timely manner, and shall notify the VA and Commissioning Agent as soon as outstanding items have been corrected. The Contractor shall submit an updated startup report and a Statement of Correction on the original noncompliance report. When satisfactorily completed, the Commissioning Agent will recommend approval of the checklists and startup of each system to the VA.
- C. The Contractor shall be responsible for resolution of deficiencies as directed the VA.

3.3 PHASED COMMISSIONING

- A. The project may require startup and initial checkout to be executed in phases. This phasing shall be planned and scheduled in a coordination meeting of the VA, Commissioning Agent, and the Contractor. Results will be added to the master construction schedule and the commissioning schedule.

3.4 TRENDING AND ALARMS

- A. Trending is a method of testing as a standalone method or to augment manual testing. The Contractor shall trend any and all points of the system or systems at intervals specified below.
- B. Alarms are a means to notify the system operator that abnormal conditions are present in the system. Alarms shall be structured into three tiers - Critical, Priority, and Maintenance.

1. Critical alarms are intended to be alarms that require the immediate attention of and action by the Operator. These alarms shall be displayed on the Operator Workstation in a popup style window that is graphically linked to the associated unit's graphical display.
2. Priority level alarms are to be printed to a printer which is connected to the Operator's Work Station located within the engineer's office. Additionally Priority level alarms shall be able to be monitored and viewed through an active alarm application. Priority level alarms are alarms which shall require reaction from the operator or maintenance personnel within a normal work shift, and not immediate action.
3. Maintenance alarms are intended to be minor issues which would require examination by maintenance personnel within the following shift. These alarms shall be generated in a scheduled report automatically by the DDC system at the start of each shift. The generated maintenance report will be printed to a printer located within the engineer's office. Verify existing alarms and alarm for new devices.
4. The following tables indicate the points to be trended and alarmed by system. The Operational Trend Duration column indicates the trend duration for normal operations. The Testing Trend Duration column indicates the trend duration prior to Systems Functional Performance Testing and again after Systems Functional Performance Testing. The Type column indicates point type: AI = Analog Input, AO = Analog Output, DI = Digital Input, DO = Digital Output, Calc = Calculated Point. In the Trend Interval Column, COV = Change of Value. The Alarm Type indicates the alarm priority; C = Critical, P = Priority, and M = Maintenance. The Alarm Range column indicates when the point is considered in the alarm state. The Alarm Delay column indicates the length of time the point must remain in an alarm state before the alarm is recorded in the DDC. The intent is to allow minor, short-duration events to be corrected by the DDC system prior to recording an alarm. Many of these alarms points may be existing in the existing Building Automation System. Test these and new alarms.

Dual-Path Air Handling Unit Trending and Alarms							
Point	Type	Trend Interval	Operational Trend Duration	Testing Trend Duration	Alarm Type	Alarm Range	Alarm Delay
RA Temperature	AI	15 Min	24 hours	3 days	N/A		
RA Humidity	AI	15 Min	24 hours	3 days	P	>60% RH	10 min
Mixed Air Temp	AI	None	None	None	N/A		
SA Temp	AI	15 Min	24 hours	3 days	C	±5°F from SP	10 min
Supply Fan Speed	AI	15 Min	24 hours	3 days	N/A		
RA Pre-Filter Status	AI	None	None	None	N/A		
After Filter Status	AI	None	None	None	N/A		
SA Flow	AI	15 Min	24 hours	3 days	C	±10% from SP	10 min
OA Supply Temp	AI	15 Min	24 hours	3 days	P	±5°F from SP	10 min
RA Supply Temp	AI	15 Min	24 hours	3 days	N/A		
RA Dx Valve Position	AI	15 Min	24 hours	3 days	N/A		
OA Valve Position	AI	15 Min	24 hours	3 days	N/A		
OA Steam Valve Position	AI	15 Min	24 hours	3 days	N/A		
OA Flow	AI	15 Min	24 hours	3 days	P	±10% from SP	5 min
RA Flow	AI	15 Min	24 hours	3 days	P	±10% from SP	5 min
Duct Pressure	AI	15 Min	24 hours	3 days	C	±25% from SP	6 min
Supply Fan Status	DI	COV	24 hours	3 days	C	Status <> Command	10 min
High Static Status	DI	COV	24 hours	3 days	P	True	1 min
Fire Alarm Status	DI	COV	24 hours	3 days	C	True	5 min
Freeze Stat Level 1	DI	COV	24 hours	3 days	C	True	10 min

Dual-Path Air Handling Unit Trending and Alarms							
Point	Type	Trend Interval	Operational Trend Duration	Testing Trend Duration	Alarm Type	Alarm Range	Alarm Delay
Emergency AHU Shutdown	DI	COV	24 hours	3 days	P	True	1 min

Terminal Unit (VAV, CAV, etc.) Trending and Alarms							
Point	Type	Trend Interval	Operational Trend Duration	Testing Trend Duration	Alarm Type	Alarm Range	Alarm Delay
Space Temperature	AI	15 Min	12 hours	3 days	P	±5°F from SP	10 min
Air Flow	AI	15 Min	12 hours	3 days	P	±5°F from SP	10 min
SA Temperature	AI	15 Min	12 hours	3 days	P	±5°F from SP	10 min
Local Set-point	AI	15 Min	12 hours	3 days	M	±10°F from SP	60 min
Damper Position	AO	15 Minutes	12 hours	3 days	N/A		
Heating coil Valve Position	AO	15 Minutes	12 hours	3 days	N/A		

C. The Contractor shall provide the following information prior to Systems Functional Performance Testing. Any documentation that is modified after submission shall be recorded and resubmitted to the COTR and Commissioning Agent.

1. Point-to-Point checkout documentation;
2. Sensor field calibration documentation including system name, sensor/point name, measured value, DDC value, and Correction Factor.

3. A sensor calibration table listing the referencing the location of procedures to following in the O&M manuals, and the frequency at which calibration should be performed for all sensors, separated by system, subsystem, and type. The calibration requirements shall be submitted both in the O&M manuals and separately in a standalone document containing all sensors for inclusion in the commissioning documentation.

3.5 SYSTEMS FUNCTIONAL PERFORMANCE TESTING

- A. This paragraph applies to Systems Functional Performance Testing of systems for all referenced specification Divisions.
- B. Objectives and Scope: The objective of Systems Functional Performance Testing is to demonstrate that each system is operating according to the Contract Documents. Systems Functional Performance Testing facilitates bringing the systems from a state of substantial completion to full dynamic operation. Additionally, during the testing process, areas of noncompliant performance are identified and corrected, thereby improving the operation and functioning of the systems. In general, each system shall be operated through all modes of operation (seasonal, occupied, unoccupied, warm-up, cool-down, part- and full-load, fire alarm and emergency power) where there is a specified system response. The Contractor shall verify each sequence in the sequences of operation. Proper responses to such modes and conditions as power failure, freeze condition, low oil pressure, no flow, equipment failure, etc. shall also be tested.
- C. Development of Systems Functional Performance Test Procedures: Before Systems Functional Performance Test procedures are written, the Contractor shall submit all requested documentation and a current list of change orders affecting equipment or systems, including an updated points list, program code, control sequences and parameters. Using the testing parameters and requirements found in the Contract Documents and approved submittals and shop drawings, the Commissioning Agent will develop specific Systems Functional Test Procedures to verify and document proper operation of each piece of equipment and system to be commissioned. The Contractor shall assist the Commissioning Agent in developing the Systems Functional Performance Test procedures as requested by the Commissioning Agent i.e. by answering questions about

equipment, operation, sequences, etc. Prior to execution, the Commissioning Agent will provide a copy of the Systems Functional Performance Test procedures to the VA, the Architect/Engineer, and the Contractor, who shall review the tests for feasibility, safety, equipment and warranty protection.

- D. Purpose of Test Procedures: The purpose of each specific Systems including air handling unit AC-1 Functional Performance Test is to verify and document compliance with the stated criteria of acceptance given on the test form. The test procedure forms developed by the Commissioning Agent will include, but not be limited to, the following information:
1. System and equipment or component name(s)
 2. Equipment location and ID number
 3. Unique test ID number, and reference to unique Pre-Functional Checklists and startup documentation, and ID numbers for the piece of equipment.
 4. Date
 5. Project name
 6. Participating parties
 7. A copy of the specification section describing the test requirements
 8. A copy of the specific sequence of operations or other specified parameters being verified
 9. Instructions for setting up the test.
 10. Special cautions, alarm limits, etc.
 11. Signatures and date block for the Commissioning Agent. A place for the Contractor to initial to signify attendance at the test.
- E. Test Methods: Systems Functional Performance Testing shall be achieved by manual testing (i.e. persons manipulate the equipment and observe performance) and/or by monitoring the performance and analyzing the results using the control system's trend log capabilities or by standalone data loggers. The Contractor and Commissioning Agent shall determine which method is most appropriate for tests that do not have a method specified.
1. Overwritten Values: Overwriting sensor values to simulate a condition, such as overwriting the outside air temperature reading in a control system to be something other than it really is, shall

be allowed, but shall be used with caution and avoided when possible. Such testing methods often can only test a part of a system, as the interactions and responses of other systems will be erroneous or not applicable. Simulating a condition is preferable. e.g., for the above case, by heating the outside air sensor with a hair blower rather than overwriting the value or by altering the appropriate setpoint to see the desired response. Before simulating conditions or overwriting values, sensors, transducers and devices shall have been calibrated.

2. Indirect Indicators: Relying on indirect indicators for responses or performance shall be allowed only after visually and directly verifying and documenting, over the range of the tested parameters, that the indirect readings through the control system represent actual conditions and responses. Much of this verification shall be completed during systems startup and initial checkout.

F. Setup: Each function and test shall be performed under conditions that simulate actual conditions as closely as is practically possible. The Contractor shall provide all necessary materials, system modifications, etc. to produce the necessary flows, pressures, temperatures, etc. necessary to execute the test according to the specified conditions. At completion of the test, the Contractor shall return all affected building equipment and systems, due to these temporary modifications, to their pretest condition.

G. Sampling: No sampling is allowed in completing Pre-Functional Checklists. Sampling is allowed for Systems Functional Performance Test Procedures execution. The Commissioning Agent will determine the sampling rate. If at any point, frequent failures are occurring and testing is becoming more troubleshooting than verification, the Commissioning Agent may stop the testing and require the Contractor to perform and document a checkout of the remaining units, prior to continuing with Systems Functional Performance Testing of the remaining units.

H. Cost of Retesting: The cost associated with expanded sample System Functional Performance Tests shall be solely the responsibility of the Contractor. Any required retesting by the Contractor shall not be

considered a justified reason for a claim of delay or for a time extension by the Contractor.

- I. Coordination and Scheduling: The Contractor shall provide a minimum of 7 days notice to the Commissioning Agent and the VA regarding the completion schedule for the Pre-Functional Checklists and startup of all equipment and systems. The Commissioning Agent will schedule Systems Functional Performance Tests with the Contractor and VA. The Commissioning Agent will witness and document the Systems Functional Performance Testing of systems. The Contractor shall execute the tests in accordance with the Systems Functional Performance Test Procedure.
- J. Testing Prerequisites: In general, Systems Functional Performance Testing will be conducted only after Pre-Functional Checklists have been satisfactorily completed. The control system shall be sufficiently tested and approved by the Commissioning Agent and the VA before it is used to verify performance of other components or systems. The air balancing and water balancing shall be completed before Systems Functional Performance Testing of air-related equipment or systems are scheduled. Systems Functional Performance Testing will proceed from components to subsystems to systems. When the proper performance of all interacting individual systems has been achieved, the interface or coordinated responses between systems will be checked.
- K. Problem Solving: The Commissioning Agent will recommend solutions to problems found, however the burden of responsibility to solve, correct and retest problems is with the Contractor.

3.6 DOCUMENTATION, NONCONFORMANCE AND APPROVAL OF TESTS

- A. Documentation: The Commissioning Agent will witness, and document the results of all Systems Functional Performance Tests using the specific procedural forms developed by the Commissioning Agent for that purpose. Prior to testing, the Commissioning Agent will provide these forms to the VA and the Contractor for review and approval. The Contractor shall include the filled out forms with the O&M manual data.
- B. Nonconformance: The Commissioning Agent will record the results of the Systems Functional Performance Tests on the procedure or test form. All items of nonconformance issues will be noted and reported to the VA on Commissioning Field Reports and/or the Commissioning Master Issues Log.

1. Corrections of minor items of noncompliance identified may be made during the tests. In such cases, the item of noncompliance and resolution shall be documented on the Systems Functional Test Procedure.
2. Every effort shall be made to expedite the systems functional Performance Testing process and minimize unnecessary delays, while not compromising the integrity of the procedures. However, the Commissioning Agent shall not be pressured into overlooking noncompliant work or loosening acceptance criteria to satisfy scheduling or cost issues, unless there is an overriding reason to do so by direction from the VA.
3. As the Systems Functional Performance Tests progresses and an item of noncompliance is identified, the Commissioning Agent shall discuss the issue with the Contractor and the VA.
4. When there is no dispute on an item of noncompliance, and the Contractor accepts responsibility to correct it:
 - a. The Commissioning Agent will document the item of noncompliance and the Contractor's response and/or intentions. The Systems Functional Performance Test then continues or proceeds to another test or sequence. After the day's work is complete, the Commissioning Agent will submit a Commissioning Field Report to the VA. The Commissioning Agent will also note items of noncompliance and the Contractor's response in the Master Commissioning Issues Log. The Contractor shall correct the item of noncompliance and report completion to the VA and the Commissioning Agent.
 - b. The need for retesting will be determined by the Commissioning Agent. If retesting is required, the Commissioning Agent and the Contractor shall reschedule the test and the test shall be repeated.
5. If there is a dispute about item of noncompliance, regarding whether it is an item of noncompliance, or who is responsible:
 - a. The item of noncompliance shall be documented on the test form with the Contractor's response. The item of noncompliance with the Contractor's response shall also be reported on a

Commissioning Field Report and on the Master Commissioning Issues Log.

- b. Resolutions shall be made at the lowest management level possible. Other parties are brought into the discussions as needed. Final interpretive and acceptance authority is with the Department of Veterans Affairs.
 - c. The Commissioning Agent will document the resolution process.
 - d. Once the interpretation and resolution have been decided, the Contractor shall correct the item of noncompliance, report it to the Commissioning Agent. The requirement for retesting will be determined by the Commissioning Agent. If retesting is required, the Commissioning Agent and the Contractor shall reschedule the test. Retesting shall be repeated until satisfactory performance is achieved.
- C. Cost of Retesting: The cost to retest a System Functional Performance Test shall be solely the responsibility of the Contractor. Any required retesting by the Contractor shall not be considered a justified reason for a claim of delay or for a time extension by the Contractor.
- D. Failure Due to Manufacturer Defect: If 10% is greater, of identical pieces (size alone does not constitute a difference) of equipment fail to perform in compliance with the Contract Documents (mechanically or substantively) due to manufacturing defect, not allowing it to meet its submitted performance specifications, all identical units may be considered unacceptable by the VA. In such case, the Contractor shall provide the VA with the following:
- 1. Within one week of notification from the VA, the Contractor shall examine all other identical units making a record of the findings. The findings shall be provided to the VA within two weeks of the original notice.
 - 2. Within two weeks of the original notification, the Contractor shall provide a signed and dated, written explanation of the problem, cause of failures, etc. and all proposed solutions which shall include full equipment submittals. The proposed solutions shall not significantly exceed the specification requirements of the original installation.

3. The VA shall determine whether a replacement of all identical units or a repair is acceptable.
 4. Two examples of the proposed solution shall be installed by the Contractor and the VA shall be allowed to test the installations for up to one week, upon which the VA will decide whether to accept the solution.
 5. Upon acceptance, the Contractor shall replace or repair all identical items, at their expense and extend the warranty accordingly, if the original equipment warranty had begun. The replacement/repair work shall proceed with reasonable speed beginning within one week from when parts can be obtained.
- E. Approval: The Commissioning Agent will note each satisfactorily demonstrated function on the test form. Formal approval of the Systems Functional Performance Test shall be made later after review by the Commissioning Agent and by the VA. The Commissioning Agent will evaluate each test and report to the VA using a standard form. The VA will give final approval on each test using the same form, and provide signed copies to the Commissioning Agent and the Contractor.

3.7 DEFERRED TESTING

- A. Unforeseen Deferred Systems Functional Performance Tests: If any Systems Functional Performance Test cannot be completed due to the building structure, required occupancy condition or other conditions, execution of the Systems Functional Performance Testing may be delayed upon approval of the VA. These Systems Functional Performance Tests shall be conducted in the same manner as the seasonal tests as soon as possible. Services of the Contractor to conduct these unforeseen Deferred Systems Functional Performance Tests shall be negotiated between the VA and the Contractor.
- B. Deferred Seasonal Testing: Deferred Seasonal Systems Functional Performance Tests are those that must be deferred until weather conditions are closer to the systems design parameters. The Commissioning Agent will review systems parameters and recommend which Systems Functional Performance Tests should be deferred until weather conditions more closely match systems parameters. The Contractor shall review and comment on the proposed schedule for Deferred Seasonal Testing. The VA will review and approve the schedule for Deferred

Seasonal Testing. Deferred Seasonal Systems Functional Performances Tests shall be witnessed and documented by the Commissioning Agent. Deferred Seasonal Systems Functional Performance Tests shall be executed by the Contractor in accordance with these specifications.

3.8 OPERATION AND MAINTENANCE TRAINING REQUIREMENTS

- A. Training Preparation Conference: Before operation and maintenance training, the Commissioning Agent will convene a training preparation conference to include VA's COTR, VA's Operations and Maintenance personnel, and the Contractor. The purpose of this conference will be to discuss and plan for Training and Demonstration of VA Operations and Maintenance personnel.
- B. The Contractor shall provide training and demonstration as required by other Division 21, Division 22, Division 23, Division 26, Division 27 and Division 28 sections. The Training and Demonstration shall include, but is not limited to, the following:
1. Review the Contract Documents.
 2. Review installed systems, subsystems, and equipment.
 3. Review instructor qualifications.
 4. Review instructional methods and procedures.
 5. Review training module outlines and contents.
 6. Review course materials (including operation and maintenance manuals).
 7. Review and finalize training schedule and verify availability of educational materials, instructors, and facilities needed to avoid delays.
- C. Training Module Submittals: The Contractor shall submit the following information to the VA and the Commissioning Agent:
1. Instruction Program: Submit two copies of outline of instructional program for demonstration and training, including a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module. At completion of training, submit two complete training manuals for VA's use.
 2. Qualification Data: Submit qualifications for instructor.
 3. Attendance Record: For each training module, submit list of participants and length of instruction time.

4. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.
5. Transcript: Prepared on 8-1/2-by-11-inch paper, punched and bound in heavy-duty, 3-ring, vinyl-covered binders. Mark appropriate identification on front and spine of each binder.

D. QUALITY ASSURANCE

1. Instructor Qualifications: A factory authorized service representative, complying with requirements in Division 01 Section "Quality Requirements," experienced in operation and maintenance procedures and training.

E. COORDINATION

1. Coordinate instruction schedule with VA's operations. Adjust schedule as required to minimize disrupting VA's operations.
2. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.
3. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by the VA.

F. INSTRUCTION PROGRAM

1. Program Structure: Develop an instruction program that includes individual training modules for each system and equipment not part of a system, as required by individual Specification Sections, and as follows:
 - a. Fire protection systems, including fire alarm, and fire suppression systems.
 - b. Intrusion detection systems.
 - c. HVAC systems, air distribution systems, and terminal equipment and devices.
 - d. Panelboards.
 - e. Lighting equipment and controls.
 - f. Communication systems, including intercommunication, public address, and voice and data.

- G. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and

knowledge that participants are expected to master. For each module, include instruction for the following:

1. Basis of System Design, Operational Requirements, and Criteria:

Include the following:

- a. System, subsystem, and equipment descriptions.
- b. Performance and design criteria if Contractor is delegated design responsibility.
- c. Operating standards.
- d. Regulatory requirements.
- e. Equipment function.
- f. Operating characteristics.
- g. Limiting conditions.
- h. Performance curves.

2. Documentation: Review the following items in detail:

- a. Emergency manuals.
- b. Operations manuals.
- c. Maintenance manuals.
- d. Project Record Documents.
- e. Identification systems.
- f. Warranties and bonds.
- g. Maintenance service agreements and similar continuing commitments.

3. Emergencies: Include the following, as applicable:

- a. Instructions on meaning of warnings, trouble indications, and error messages.
- b. Instructions on stopping.
- c. Shutdown instructions for each type of emergency.
- d. Operating instructions for conditions outside of normal operating limits.
- e. Sequences for electric or electronic systems.
- f. Special operating instructions and procedures.

4. Operations: Include the following, as applicable:

- a. Startup procedures.
- b. Equipment or system break-in procedures.
- c. Routine and normal operating instructions.
- d. Regulation and control procedures.

- e. Control sequences.
 - f. Safety procedures.
 - g. Instructions on stopping.
 - h. Normal shutdown instructions.
 - i. Operating procedures for emergencies.
 - j. Operating procedures for system, subsystem, or equipment failure.
 - k. Seasonal and weekend operating instructions.
 - l. Required sequences for electric or electronic systems.
 - m. Special operating instructions and procedures.
5. Adjustments: Include the following:
- a. Alignments.
 - b. Checking adjustments.
 - c. Noise and vibration adjustments.
 - d. Economy and efficiency adjustments.
6. Troubleshooting: Include the following:
- a. Diagnostic instructions.
 - b. Test and inspection procedures.
7. Maintenance: Include the following:
- a. Inspection procedures.
 - b. Types of cleaning agents to be used and methods of cleaning.
 - c. List of cleaning agents and methods of cleaning detrimental to product.
 - d. Procedures for routine cleaning
 - e. Procedures for preventive maintenance.
 - f. Procedures for routine maintenance.
 - g. Instruction on use of special tools.
8. Repairs: Include the following:
- a. Diagnosis instructions.
 - b. Repair instructions.
 - c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - d. Instructions for identifying parts and components.
 - e. Review of spare parts needed for operation and maintenance.
- H. Training Execution:
1. Preparation: Assemble educational materials necessary for instruction, including documentation and training module. Assemble

training modules into a combined training manual. Set up instructional equipment at instruction location.

2. Instruction:

a. Instructor: Qualified instructors shall instruct VA's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.

1) The Commissioning Agent will furnish an instructor to describe basis of system design, operational requirements, criteria, and regulatory requirements.

2) The VA will furnish an instructor to describe VA's operational philosophy.

3) The VA will furnish the Contractor with names and positions of participants.

3. Scheduling: Provide instruction at mutually agreed times. For equipment that requires seasonal operation, provide similar instruction at start of each season. Schedule training with the VA and the Commissioning Agent with at least seven days' advance notice.

4. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of **an oral, or a written**, performance-based test.

5. Cleanup: Collect used and leftover educational materials and remove from Project site. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

I. Demonstration and Training Recording:

1. General: Record each training module separately. At beginning of each training module, record each chart containing learning objective and lesson outline.

Anderson Mikos Architects, Ltd.

RENOVATE CARDIOLOGY DEPARTMENT, BLDG 200
EDWARD HINES, JR. V.A. HOSPITAL
HINES, ILLINOIS

Amendment No. 5 3-15-2013

SECTION 01 91 00

GENERAL COMMISSIONING REQUIREMENTS

COMMISSIONING CHARTS

AIR HANDLING UNIT PRE-FUNCTIONAL CHECKLIST – AC-1 Hines VA – 1st Floor Cardiology Suite Renovation Commissioning		
Date:		
Unit #:		
Area Served:		
Location:		
Model Verification		
1		1=specified
Manufacturer		2=installed
2		
1		
Model		
2		
serial #		
1		
SF Electrical		
2		
1		
SF Starter		
2		
1		
Pre-filters		
2		
General		Comp. Y/N
Equipment cleaned and properly labeled		
Inspection and access doors are operable		
Any damage to coil tubing or fins has been repaired.		
Filters		Comp. Y/N
Disposable filters clean and in place.		
No gaps to allow air bypass around filters.		
Unit		Comp. Y/N
Condensate drainage is unobstructed		
Unit controlled via BAS		
Dampers are operational.		
Piping		Comp. Y/N
Chilled water piping: existing supply, shutoff valve, strainer w/blowdown, union, thermometer, pressure gauge, flex, coil with air vent, flex, pressure gauge, thermometer, union, control valve, flow control device		
Hot water piping: existing supply, shutoff valve, strainer w/blowdown, union, thermometer, pressure gauge, flex, coil with air vent, flex, pressure gauge, thermometer, union, control valve, flow control device		
Insulation and Labeling		Comp. Y/N
Chilled water piping is insulated		
Hot water piping is insulated		
Condensate piping is insulated		
All piping properly color coded per existing and labeled.		

ROOF TOP UNIT PRE-FUNCTIONAL CHECKLIST – AC-1 <i>Hines VA – 1st Floor Cardiology Suite Renovation Commissioning</i>	
Date:	
Electrical	Comp. Y/N
Power available to unit control panel	
Proper motor rotation verified	
Verify that power disconnect is located within sight of the unit controls and labeled	
Check for voltage & color coding of conductor	
Installation Inspection and testing	Comp. Y/N
Installation of system and balancing devices allowed balancing to be completed following accepted procedures and contract documents	
Miscellaneous Checks	Comp. Y/N
The HOA switch properly activates and deactivates the unit	
Fans rotation verified correct , belts tightness	
No unusual noise or vibration	
No leaking apparent around fittings	
Sequences of operation and operating schedules have been implemented	
Point-to-point checks have been completed for this system	
Startup report includes written certification from contractor that all specified features, controls and safeties are functioning properly and that the application comply with the manufacturer's recommendations.	
Notes	

AIR HANDLING UNIT FUNCTIONAL PERFORMANCE TEST – AC-1 <i>Hines VA – 1st Floor Cardiology Suite Renovation Commissioning</i>		
Unit #: AC-1		
Area Served: Cath Lab, Exam Rooms, etc.		
Location: Roof		
Pre-test setpoints		
Parameter	Pretest Value	Returned to pretest setpoint
CHW valve	auto	
SAT	52	
Dirty Filter Stpt	Pre=0.5"; Final=1.2"	

Mode	Test Procedure	Expected response	Comp, Y/N
Fan Off	The unit is commanded off by the BAS	Verify by visual response that:	
		1. Interlocked primary RF-1 thru RF-4 stop	
		2. Supply fans stops	
		3. Outside air dampers closed	
		4. CHW valves are closed	
		5. Hot water Preheat valve closed , open if OAT<35	
		6. HVAC Control system & graphic updates to indicate condition	
Fan Start	The unit is commanded on by the BAS	Verify by visual response that:	
		Supply Fan HOA is in auto	
		1. Interlocked 1-RF-1 thru RF-4 (inside AC-1)	
		2. Outside air dampers open	
		3. Supply fan SF-1 thru SF-6 starts (in AC-1)	
		4. CHW valves modulate to maintain SA temperature	
		5. Heating coil valves modulate to control SA temperature	
		6. Alarms/sensors (freeze, filter, etc.) operational	
OA damper failure	Disable the OA damper	Verify by visual response that:	
		1. Unit shuts down	
		2. Unit requires reset at the operator's terminal	
		3. HVAC Control graphic updates to indicate each condition	
SA fan control	Vary the static pressure sensor setpoint	Verify by visual response that:	
		1. Supply Fan VFD modulates fan speed as required to maintain static pressure sensor setpoint.	
		2. Final supply air quantity, SP, RPM.	
		3. HVAC Control system & graphic updates to indicate each condition	
SAT control - summer	1. Record SAT setpoint 2. Vary the SAT setpoint	Verify by visual response that:	
		1. Chilled water valves modulate to maintain setpoint within +/- 0.5%. Setpt = _____ Actual= _____	
		2. SAT is limited by a SA low limit	
		3. Setpoint changed to _____ Actual= _____	
		4. Time from adjustment to steady state at new setpoint	
		5. HVAC Control system & graphic updates to indicate each condition	

AIR HANDLING UNIT FUNCTIONAL PERFORMANCE TEST – AC-1 <i>Hines VA – 1st Floor Cardiology Suite Renovation Commissioning</i>			
Unit #: Area Served: Location:			
Mode	Test Procedure	Expected response	Comp, Y/N
Preheat coil control OAT>35	1. Vary the SAT by changing the set-points.	Verify by visual response that:	
		1. Preheat coil valves modulates to maintain setpoint within +/- 0.5%. Setpt = _____ Actual= _____	
		2. SAT is limited by a SA high limit	
		3. Setpoint changed to _____ Actual= _____	
		4. Time from adjustment to steady state at new setpoint	
		5. Check steam & condensate return flow is proper	
		6. HVAC Control system & graphic updates to indicate each condition	
Freezestat	DDC Controls	Verify by visual response that:	
		1. Unit shuts down	
		2. Unit requires reset at the operator's terminal	
		3. HVAC Control graphic updates to indicate each condition	
Fan Status	1. Shutdown RF-1 thru RF-4 2. Restart RF-1 thru RF-4	Verify by visual response that:	
		1. BAS indicates all fans off via DP sensors or current sensing relays	
		2. BAS indicates fans on via DP sensors or current sensing relays	
		3. Return air quantity, fan SP, RPM voltage	
		4. VFD modulates fans speed	
		5. HVAC Control graphic updates to indicate each condition	
Pre -Filter Alarm operation	Override the value of 1. the "dirty" setpt to initiate alarm. 2. Reset setpt to normal.	Verify by visual response that:	
		1. An alarm is initiated in the BAS	
		2. Alarm automatically clears	
		3. HVAC Control graphic updates to indicate each condition	
Supply or return smoke detected	1. Alarm in zone or SA	Verify by visual response that:	
		1. Supply fans shuts down	
		2. OA damper closes	
		3. Return fan operates	
		4. Exhaust damper opens	
		5. Return air damper closes	
		5. HVAC Control graphic updates to indicate each condition	
Comments:			

COMMISSIONING CHARTS FOR MISCELLANEOUS ITEMS:

I. HVAC:

- 1.
- VAV Boxes
- : CA will select six (6) VAV boxes to be tested.

	Meets Criteria: Y/N						Remarks:
	#1	#2	#3	#4	#5	#6	
A. VAV box size per design	Y/N	Y/N	Y/N	Y/N	Y/N	Y/N	
B. Inlet size per design	Y/N	Y/N	Y/N	Y/N	Y/N	Y/N	
C. Rated CFM per design	Y/N	Y/N	Y/N	Y/N	Y/N	Y/N	
D. Minimum air flow setting per design	Y/N	Y/N	Y/N	Y/N	Y/N	Y/N	
E. Controller operation per design	Y/N	Y/N	Y/N	Y/N	Y/N	Y/N	
F. Thermostat operation per design	Y/N	Y/N	Y/N	Y/N	Y/N	Y/N	
G. Controls from BAS	Y/N	Y/N	Y/N	Y/N	Y/N	Y/N	
H. VAV box supported properly	Y/N	Y/N	Y/N	Y/N	Y/N	Y/N	
I. Is there adequate access to VAV box	Y/N	Y/N	Y/N	Y/N	Y/N	Y/N	

- 2.
- Supply Air Diffusers
- : CA will select six (6) supply diffusers.

A. Supply air quantity (CFM) as designed	Y/N	Y/N	Y/N	Y/N	Y/N	Y/N	
B. Noise per design	Y/N	Y/N	Y/N	Y/N	Y/N	Y/N	

- 3.
- Return Air Grille
- : CA will select five (5) grilles.

A. Return air quantity (CFM) per design	Y/N	Y/N	Y/N	Y/N	Y/N	
B. Noise per design	Y/N	Y/N	Y/N	Y/N	Y/N	

- 4.
- Exhaust Air Grille
- : CA will select three (3) grilles.

A. Exhaust air quantity meets design	Y/N	Y/N	Y/N	
B. Noise meets design	Y/N	Y/N	Y/N	

5. Air-cooled Chiller:

Meets Criteria: Remarks:

A. Capacity shown per plan	Y/N	
B. Flow GPM per design	Y/N	
C. Chilled water supply temp. per design	Y/N	_____ deg. F
D. Chilled water return temp. per design	Y/N	_____ deg. F
E. Chilled water pressure entering per design	Y/N	_____ PSI
F. Chilled water return pressure per design	Y/N	_____ PSI
G. Condenser fans functioning properly	Y/N	
H. Sound level per design	Y/N	
I. Chiller identified with name plate	Y/N	
J. Chiller properly supported on roof	Y/N	
K. DDC control panel functional & tied to BAS	Y/N	

6. Steam to Steam Generator:

Remarks:

A. Steam flow per design in/out	Y/N	
B. Steam press per design	Y/N	
C. Control valve functioning properly	Y/N	
D. All gauges & thermostats installed	Y/N	
E. Steam pressure leaving & controls tied to BAS	Y/N	

7. Exhaust Fans:

Meets Criteria: Remarks:

	EF-1	
A. Backdraft damper installed	Y/N	
B. Does fan run continuously?	Y/N	
C. Is fan noisy?	Y/N	
D. Is exhaust fan supported properly	Y/N	

8. Identification:

Meets Criteria: Y/N Remarks:

A. Chilled water piping identified	Y/N	
B. Steam piping identified	Y/N	
C. Condensate return piping identified	Y/N	
D. Hot water piping identified	Y/N	
E. Supply duct identified	Y/N	
F. Return duct identified	Y/N	
G. Exhaust duct identified	Y/N	

9. Insulation:

	Meets Criteria: Y/N			Remarks:
A. Chilled water piping insulated	Y/N	----	----	
B. Steam piping insulated	Y/N	----	----	
C. Condensate return piping insulated	Y/N	----	----	
D. Hot water piping insulated	Y/N	----	----	
E. Supply air duct insulated	Y/N	----	----	

10. Supports/Hangers:

	Meets Criteria:	Remarks:
A. Chilled water piping supported properly inside and outside building	Y/N	
B. Is steam & condensate return piping supported properly	Y/N	
C. Is hot water piping supported properly	Y/N	
D. Is supply & return air duct supported properly	Y/N	

II. Plumbing:1. Plumbing Fixtures:

Meets Criteria: Y/N

	WC-1	L-1	S-1	S-2	MB-1
A. Flow adequate	Y/N	Y/N	Y/N	Y/N	Y/N
B. Pressure adequate	Y/N	Y/N	Y/N	Y/N	Y/N
C. Valves open & close easily	Y/N	Y/N	Y/N	Y/N	Y/N
D. Is unit supported per design	Y/N	Y/N	Y/N	Y/N	Y/N
Remarks:					

2. Floor Drains:

Meets Criteria: Remarks:

A. Does water run through floor drain easily?	Y/N	
---	-----	--

3. Cold Water:

Meets Criteria: Remarks:

A. Temperature per design	Y/N	
---------------------------	-----	--

4. Hot Water:

Meets Criteria: Remarks:

A. Temperature per design	Y/N	
---------------------------	-----	--

5. Identification:

Meets Criteria: Remarks:

A. Cold water piping identified	Y/N	
B. Hot water supply identified	Y/N	
C. Hot water return identified	Y/N	

6. Insulation Piping:

Meets Criteria: Remarks:

A. Cold water supply insulated	Y/N	
B. Hot water supply insulated	Y/N	
C. Domestic hot water supply insulated	Y/N	
D. Hot water return insulated	Y/N	

7. Piping Supports & Hangers:

Meets Criteria: Remarks:

A. Is cold water piping supported properly	Y/N	
B. Is hot water supply & return supported properly	Y/N	

Anderson Mikos Architects, Ltd.

RENOVATE CARDIOLOGY DEPARTMENT, BLDG 200
EDWARD HINES, JR. V.A. HOSPITAL
HINES, ILLINOIS

Amendment No. 5 3-15-2013
SECTION 01 91 00
GENERAL COMMISSIONING REQUIREMENTS

III. Fire Suppression System:

	Meets Criteria:	Remarks:
A. Sprinkler heads as specified	Y/N	
B. Are zone valves functioning properly	Y/N	
C. Is piping supported properly	Y/N	

IV. Medical Gases:

Meets Criteria: Remarks:

	O2	VAC	MA	
A. Zone valves properly installed & identified	Y/N	Y/N	Y/N	
B. Medical gas outlets properly installed & identified	Y/N	Y/N	Y/N	
C. Gas piping material as specified	Y/N	Y/N	Y/N	
D. Pipe sizes are per plan	Y/N	Y/N	Y/N	
E. Medical gas alarm panel operative & at right location	Y/N	Y/N	Y/N	
F. All piping is identified	Y/N	Y/N	Y/N	
Remarks:				

V. Electrical:1. Electrical Panels:

Meets Criteria: Y/N

	LP-C	CP-C								
A. Panelboard identified	Y/N	Y/N								
B. Panelboard has typed directory	Y/N	Y/N								
C. Panelboard door in door type	Y/N	Y/N								
D. Amp/voltage/phase identified	Y/N	Y/N								
E. Incoming breaker size per spec in MDP										
F. Is panel properly anchored to work										
G. Proper access in front of panel										
H. Feeders are of right size & color coded										
Remarks:										

2. Electrical Isolation Panels:

Meets Criteria: Y/N

	IPUB-111A	IPUB-111B								
A. Panels identified	Y/N	Y/N								
B. Panel has typed directory	Y/N	Y/N								
C. Power from emergency generator	Y/N	Y/N								
D. Amp/voltage/phase identified per plan	Y/N	Y/N								
E. Incoming breaker size ok	Y/N	Y/N								
F. Panel location ok	Y/N	Y/N								
G. Feeder sizes are per plans	Y/N	Y/N								
H. Proper access to panel	Y/N	Y/N								
Remarks:										

3. Light Switches/Fixtures:

Meets Criteria: Remarks:

A. All switches functioning properly	Y/N	
B. Light fixtures installed per design	Y/N	
C. No. of lamps per design	Y/N	
D. All fixtures functioning properly	Y/N	
E. Battery backup in 50% EM lighting in Cath Lab	Y/N	

4. Exit Signs:

Meets Criteria: Remarks:

A. Have proper direction sign	Y/N	
B. All are lit	Y/N	
C. Are they powered from EM life safety panel?	Y/N	

5. Identification:

Meets Criteria: Remarks:

A. All equipment and electrical panels are identified	Y/N	
B. All receptacles are identified with circuit no. & panel they are served from	Y/N	
C. All tele/data cables are identified per VA standards	Y/N	

6. Variable Frequency Drive:

Meets Criteria: Remarks:

A. Is it of right capacity voltage	Y/N	
B. Does it have manual bypass	Y/N	
C. Supported properly on wall or unistruts and in weatherproof enclosure	Y/N	

7. Disconnect Switches:

Meets Criteria: Remarks:

A. Disconnect switch identified	Y/N	
B. Disconnect switch properly mounted and installed	Y/N	
C. Proper ON/OFF position identified	Y/N	
D. Does disconnect switch have proper working clearances	Y/N	
E. Does disconnect switch have proper NEMA rating for indoor/outdoor application	Y/N	

VI. TELE/DATA COMMUNICATION SYSTEM:

	Meets Criteria:	Remarks:
A. Is wiring Cat 6 for data & 5e for voice	Y/N	
B. Are wiring for voice & data different color	Y/N	
C. Are tele/data outlets identified	Y/N	
D. Is wiring in conduit and properly supported	Y/N	
E. Is tele/data outlet loose	Y/N	
F. Conduit size ok	Y/N	
G. Cable tray anchored properly	Y/N	If wiring is on cable tray
H. Cable tray has proper access to install cables in the future	Y/N	

VII. Fire Alarm:

	Meets Criteria:	Remarks:
A. Fire alarm devices installed at proper location & height	Y/N	
B. Pull stations installed near exit doors	Y/N	
C. Fire alarm voice system functions properly	Y/N	
D. Smoke detectors are tied to fire alarm system	Y/N	
E. Junction boxes are color coded & identified	Y/N	
F. Conduit painted per VA standards	Y/N	

VIII. Security Card Reader & Paging System:

Meets Criteria:		Remarks:
A. Card reader at the location shown on plan	Y/N	
B. Does card reader work	Y/N	
C. Is it tied to security desk	Y/N	
D. Is paging system per VA standards	Y/N	
E. Are speakers installed in proper locations per design	Y/N	

END OF SECTION 019100

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