Command Center Modernizataion

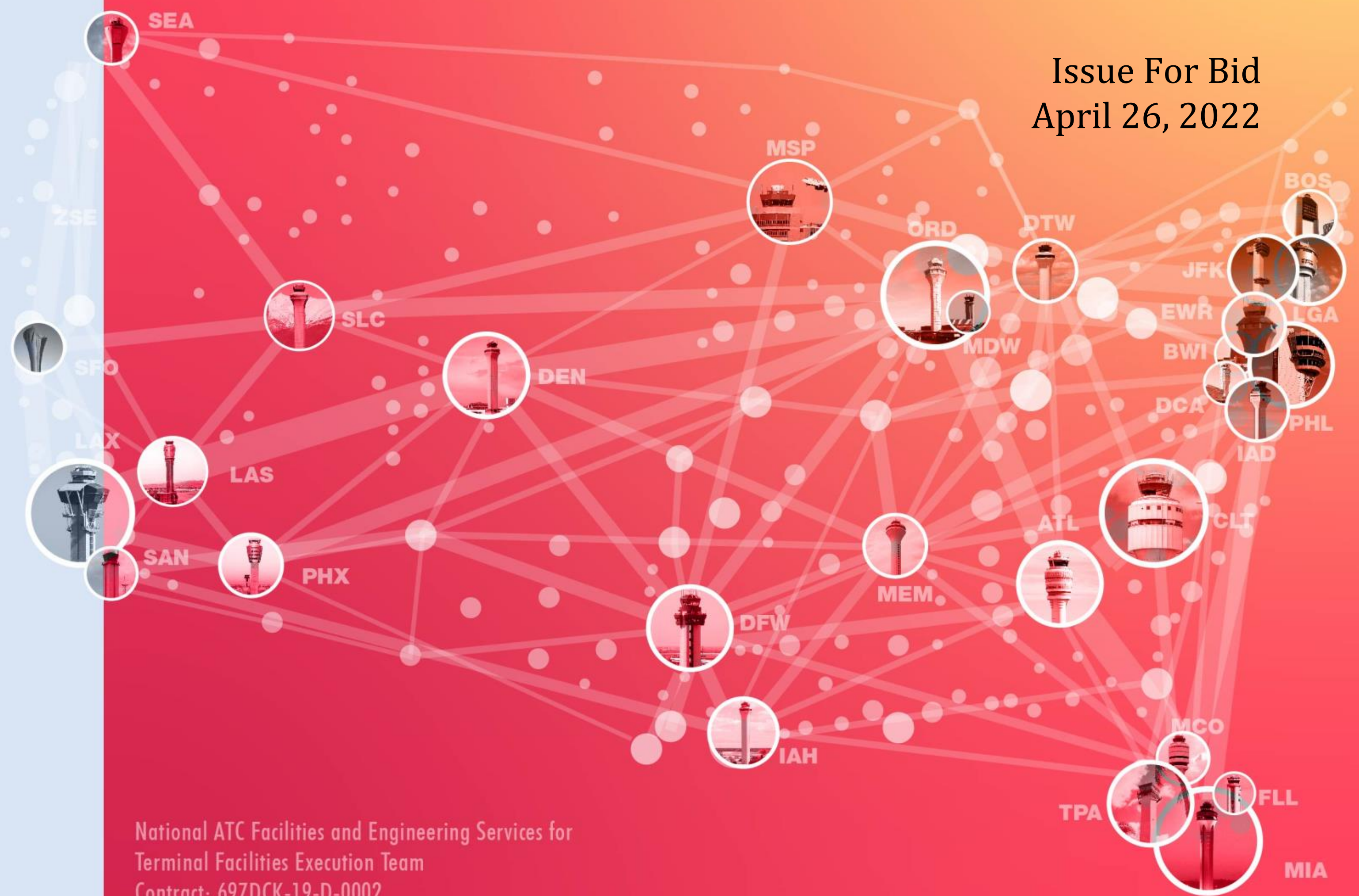
Task Order 24

Design Commissioning Plan

Warrenton Administrative Building

Warrenton, VA

Issue For Bid
April 26, 2022



National ATC Facilities and Engineering Services for
Terminal Facilities Execution Team
Contract: 697DCK-19-D-0002

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1 Introduction:

1.1 Commissioning Overview:

Commissioning is a systematic process of ensuring the building systems being commissioned perform correctly and interactively according to the design intent documents and to the FAA's and User's operational needs. A formal Commissioning Plan is used to guide the activities of all the parties involved in the construction process. The Commissioning Process continues from design to construction phase and acceptance of the building systems.

Elements of building Commissioning include:

1. Review of submittal data (concurrent review and coordinated with design/build team).
2. Incorporation of specific equipment data into Commissioning Plan.
3. Development of Pre-Functional Verification Checklists (PFVC) for new HVAC equipment and other systems being commissioned.
4. Review of any FAA/Design Engineer modifications.
5. Development of Functional Performance Tests (FPT) for HVAC, Plumbing, Lighting Control, and Building Envelope systems being commissioned. FPTs will be based on contract documents and approved submittals for HVAC systems installed. Testing and Inspection of Fire Alarm Systems, Fire Suppression Systems, Electrical Systems by the Authority Having Jurisdiction will be witnessed but no FPTs will be provided. Building Envelope functional testing will be witnessed only; testing to be performed by independent testing agency as stated in project specifications. FPTs will exclude Commissioning testing of Power, Lighting Systems, Telecommunication Systems, Public Address Systems identified in the Contract Documents. Final determination on providing FPTs / reviewing AHJ FPTs to be coordinated.
6. Completion of specific systems/equipment PFVCs.
7. Performance of FPTs.
8. Provide the FAA with an unbiased, objective view of the built systems and equipment installation, operation, and functional performance.

Certain systems and components are identified in the contract documents as requiring demonstration and training to facility users. These activities are to be accomplished and provided by the manufacturers/installers at times and locations as coordinated between the manufacturers/installers and the FAA.

1.2 Commissioning Plan:

The Commissioning Plan describes the responsibilities of various key personnel involved in the design, construction, and Commissioning process and procedures. The Commissioning Plan outlines the Commissioning Process to ensure building systems are installed according to contract documents and operate within the performance guidelines set out in the contract documents. All parties shall ensure the building systems and equipment are installed, started, tested and documented to meet the FAA's needs and to ensure that training for operations and maintenance personnel are being implemented.

1.3 Project Description:

The FAA is seeking to acquire through a purchase agreement the existing building at 3721 Macintosh Drive, in Warrenton VA, and is planning a complete tenant fit-out and reconfiguration of the entire building to relocate and consolidate 200-250 AJR personnel from 4 other FAA spaces in the greater Washington DMV area.

This Commissioning Plan addresses and provides Commissioning for:

1. Domestic Water
   a. Hot and Cold Water Piping
   b. Domestic Water Heaters and Pumps
2. Sanitary & Vent Piping
3. Storm Water Piping
4. Plumbing Fixtures
   a. Lavatories, Sinks, Drinking Fountains
5. Elevator Sump Pump
6. Plumbing Meter Reporting
7. Test, Adjust, Balance (TAB) Verification of Domestic Hot Water
8. Roof Top Units
9. Terminal Boxes
10. Exhaust Fans
11. Fan Coil Units
12. Unit Heaters
13. New DDCS Controls
14. Test, Adjust, Balance (TAB) Verification
15. Emergency Ventilation System
16. Normal Power
    a. Switchboards
    b. Panelboards
17. Emergency Power
    a. Emergency Generator
    b. Automatic Transfer Switches
18. Lighting Control
    a. Occupancy Sensors
    b. Daylight Harvesting
19. Building Envelope Systems
    a. TPO Roofing
    b. Aluminum-Framed Entrances and Storefronts
    c. Metal-Framed Skylights
20. New Fire Protection and Fire Alarm Systems

Fire Protection and Power System Start Ups / Testing will be coordinated with CxT members, as the CxA to potentially witness these particular systems. Documentation is referenced in Section 1.1.5

Building Envelope testing will be coordinated with all CxT members.

Functional performance testing will be incorporated into the overall project schedule, as referenced in Section 3.5 and 3.9

1.4 Abbreviations:

The following are common abbreviations used in this document.

- ATC – Automatic Temperature Control Contractor
- ATCT – Air Traffic Control Tower
- DDCS – Direct Digital Control System
- CxA – Commissioning Authority
- COR – Contracting Officer's Representative (FAA)
- Cx – Commissioning
- CxPD – Commissioning Plan Document
- CxT – Commissioning Team
- DDC – Direct Digital Controls
- DID – Design Intent Document
- DM – Design Project Manager
- EC – Electrical Contractor
- ESU – Environmental Support Unit Supervisor (FAA)
- GC – General Contractor
- FPTs – Functional Performance Tests
- MC – Mechanical Contractor
- NIST – National Institute of Standards and Technology
- NBS – National Bureau of Standards
- O/O – Owner/Operator (FAA)
- PFVCs – Pre-Functional Verification Checklists
- RE – Resident Engineer (FAA)
- RFI – Request for Information
- TAB – Test, Adjust and Balance
- TBD – To Be Determined

2 Roles and Responsibilities:

2.1 FAA Owner/Operator Responsibilities:

The FAA shall:

1. Define the overall vision for the use of the facility, establishes operational requirements and Commissioning objectives, defines the Commissioning Team, establishes the construction budget, and ultimately accepts and operates the finished facility.
2. Appoint the Contracting Officer's Representative (COR) as the FAA's representative for contractual issues.
3. Appoint the Resident Engineer (RE) as the FAA technical representative. Note the RE and the COR may be the same person. The RE is the primary day to day FAA point of contact. The RE is responsible for ensuring work is completed in accordance with the contract document requirements and that the FAA's design intent is met upon completion. The RE is the single point of contact for coordinating work with the FAA operations and accepting submittals, deliverables and completed work.
4. Provide facilities and qualified personnel to attend all training sessions.

2.2 Project Design Manager (DM) Responsibilities:

The design team, led by the DM, is composed of architects and engineers and prepares design documents that reflect design intent of the FAA, so the installed systems can be tested against predetermined criteria, and so that the commissioned equipment can operate as intended.

The DM's role as it relates to Commissioning during the construction phase includes submittal reviews, RFI responses and periodic site visits. The DM does not play a large role in day-to-day performance verification or quality control. The DM's role in Commissioning includes dealing with design conformance and other issues identified during the Commissioning Process.

The DM shall:

1. Translate the FAA's requirement into technical design intent.
2. Prepare thorough, accurate, and clear contract documents.
3. Develop/update a Design Intent Document (DID), which for the FAA is the Design Data Handbook (DDH), which provides narrative description of design intent and includes design calculations and major equipment manufacturer's data sheets.
4. Incorporate commissioning specifications and related information into project specs.
5. Support and advise the CxA in developing integrated tests.
6. Issue clarifications or interpretations of Design Intent as required.
7. Provide the Commissioning Authority (CxA) one copy of all approved technical submittals.
8. Provide the CxA one copy of correspondence regarding all RFI's.
9. Consult on and resolve any design related issues/problems that arise during the construction. Copy the CxA on changes relating to systems and equipment to be commissioned.
10. When requested by the CxA, witness key tests, attend Commissioning Meetings as appropriate and review test reports as appropriate.

2.3 Resident Engineer (RE) Responsibilities:

The RE is the Government representative responsible for accepting the work. The CxA will work closely with the RE regarding HVAC equipment and system performance and will make recommendations to the RE regarding acceptance.

The RE shall:

1. Assemble the Commissioning Team (CxT).
2. Attend design, construction, and commissioning related meetings.
3. Coordinate site visits and testing with the CxA.
4. Monitor/review PFVC's to ensure the results are documented as the checklists are completed.
5. Monitor controls point-to-point checks performed by the controls contractor and ensure the results are documented as the checks are completed.
6. Oversee all or part of testing of the control system and approves it for use by TAB, before TAB is executed.
7. Receive TAB plans and reports. Coordinates their review.
8. Participate at their discretion in Functional Performance Testing.
9. Coordinate training with the maintenance staff and the General Contractor and approves training plans.
10. Coordinate submission and review of the Operations and Maintenance documentation and approve Operations and Maintenance documentation.
11. Review and approve GC maintenance schedules for equipment operated by the GC prior to acceptance.
12. Review and approve the preparation of the final O&M manuals. Ensure required O&M manuals, instructions and demonstrations are provided to the FAA's designated operating staff.
13. Review equipment warranties to ensure that the FAA's responsibilities are clearly defined.

2.4 General Contractor (GC) Responsibilities:

The GC has overall responsibility and authority to ensure compliance with and coordination of the Contract Documents. This responsibility includes the following:

1. Comply with the Construction Documents.
2. Coordinate meetings, schedules, and Commissioning activities with the CxA.
3. Facilitate communications among installers and suppliers and other CxT members and foster the necessary cooperative action.
4. Involve installers in the Commissioning Process.
5. Obtain O&M documentation for updating commissioning checklists.
6. Ensure Pre-Functional Verification Checklists (PFVCs) are completed and associated work performed, prior to scheduling of FPTs.
7. Ensure Functional Performance Tests (FPTs) are performed and checklists completed.
8. Notify the RE and CxA a minimum of two weeks in advance of scheduled HVAC equipment and system start-ups, and PFVC's.
9. Implement corrective actions.
10. Coordinate specified training.
11. The GC shall coordinate with the RE and CxA. Coordination shall include, but not be limited to the following:
    a. CxA site visits,
    b. Planning,
    c. Scheduling,

d. Communication with the CxT,
e. Corrective actions, and
f. Specified training.

2.5 Commissioning Authority (CxA) Responsibilities:

The primary role of the CxA is to develop and coordinate the execution of a testing plan, document performance, and confirm proper system functionality in accordance with the DDH and with Contract Documents. The CxA facilitates the overall Commissioning process.

The CxA is not responsible for design concept, design criteria, compliance with codes, design or general construction scheduling, cost estimating, or construction management. These are responsibilities of the GC and the DM. The CxA will assist with problem solving, and resolving non-conformance, or deficiencies issues.

The Commissioning Authority (CxA) shall:

1. Develop a Commissioning Plan which describes in general the extent of the Commissioning Process to accomplish the design intent and coordinate with the construction schedule.
2. Coordinate Commissioning activities in a logical, sequential and efficient manner.
3. Kicks off the commissioning effort. Conducts an initial CxT meeting to describe the process, review roles and responsibilities, set expectations, establish communication and coordinate the work.
4. Schedule and lead commissioning meetings as needed with the Commissioning Team.
5. Develop Pre-Functional Verification Checklists (PFVCs) and Functional Performance Tests (FPTs) based on the Contract Documents, manufacturers O&M information, and accessibility requirements for O&M. Bring to the attention of the DM, GC, and RE identified deficiencies and coordination problems with systems/equipment to be commissioned.
6. Reviews completed PFVCs to ensure the results are documented properly as the checklists are completed and to evaluate any issues which are documented in the PFVCs.
7. Track testing non-conformance(s). Participate in re-testing as necessary, until satisfactory performance is achieved.
8. Compile and maintain organized and complete Commissioning records.
9. Review approved submittals applicable to the systems being commissioned to assist in development of testing checklists.
10. Review requests for information and change orders for impact on commissioning.
11. Establish test plans and schedules with the Commissioning Team.
12. Coordinate with the RE & GC to monitor Functional Performance Testing for commissioned systems and assemblies. Witness and document Functional Performance Tests performed by the Contractor for all commissioned systems and assemblies.
13. The Functional Performance Testing will include operating the system and components through each of the written sequences of operation, and other significant modes and sequences, including start-up, shutdown, unoccupied mode, manual mode, staging, miscellaneous alarms, power failure and interlocks with other systems or equipment. Sensors and actuators shall be calibrated by the installing contractors and spot-checked by the commissioning provider during Functional Performance Testing. Coordinate retesting as necessary until satisfactory performance is achieved. Tests on respective HVAC equipment shall be executed, if possible, during both the heating and cooling seasons. However, some overwriting of control values to simulate conditions may be required. Functional Performance Testing shall be done using conventional manual methods and readouts, to provide a high level of confidence in proper system function, as deemed appropriate by the FAA.

14. Maintain a master issues log and a separate record of Functional Performance Testing. Report all issues to the RE as they occur. Provide written progress reports and test results with recommended actions.
15. If requested by the CxT attend selected planning and job-site meetings to obtain information on construction progress.
16. Review the TAB execution plan.
17. As a part of the FPTs, monitors control point-to-point checks performed by the controls contractor and ensures the results are documented as the checks are completed.
18. Review FPTs and analyze data to verify performance.
19. Coordinate the resolution of design non-compliance and deficiencies identified in all phases of commissioning.
20. Recommend acceptance of tested systems and equipment commissioned to the RE.
21. Provide a final Commissioning Report that will include;

    a. An executive summary;
    b. List of participants and roles;
    c. Brief project description;
    d. Overview of Commissioning and testing scope
    e. General description of testing and verification methods.

    For each piece of commissioned equipment, the report will contain the disposition of the Commissioning Authority regarding the adequacy of the equipment. Outstanding non-compliance and deficiencies shall be specifically listed. Appendices shall contain acquired documentation of all completed PFVCs, FPTs, deficiency lists, site visit reports, general findings and unresolved issues.

2.6 Subcontractors Commissioning Responsibilities:

1. Cooperate with the CxT to facilitate the successful completion of the Commissioning process.
2. Assign a representative to the CxT and submit the person's name to the RE and CxA, within one month of the Award of the Contract. The representative shall have the authority to make decisions on behalf of the contractor as they relate to the Commissioning processes. The representative shall establish communications among contractor and suppliers and all other CxT members and shall foster the necessary cooperative action.
3. Attend CxT meetings and ensure action items arising from these meetings are responded to as required to allow the Commissioning Process to proceed on schedule.
4. Ensure cooperation and participation of specialty subcontractors as applicable.
5. Ensure participation of major equipment manufacturers as appropriate in start-up, testing and training activities.
6. Notify the GC a minimum of two weeks in advance of scheduled equipment and system start-ups, and PFVC’s so the RE may witness.
7. Inspect, check and confirm that the correct and complete installation of all systems, sub-systems and component start-up for each system PFVC’s are performed. Document the results of inspections and checks on the checklists and sign them. If deficient or incomplete work is discovered, ensure corrective action is taken and re-check until the results are satisfactory, and the system is ready for safe start-up.
8. Provide all tools/equipment and personnel required to perform all checks and tests.
9. Provide Operations and Maintenance Documentation in accordance with the construction specifications.
10. Provide equipment inventory information in accordance with the specifications.
11. Develop and execute orientation and training in accordance with contract documents.

12. Provide personnel to assist the CxA during system verification and FPTs. Operate equipment and systems for FPTs in accordance with the Commissioning Plan and as directed by the CxA. If improper functionality, incomplete work, or other deficiencies affecting system performance are discovered, the CxA will stop the FPTs. Those responsible for deficient or incomplete work will be responsible to ensure corrections necessary for full and complete system operation as specified are completed.

3 Commissioning Process:

The purpose of the Commissioning Process is to provide the FAA with assurance that building systems and equipment have been installed in accordance with Contract Documents and operate within performance guidelines specified.

The Commissioning Authority will provide the FAA with an unbiased, objective view of the built systems and equipment installation, operation, and functional performance.

The Commissioning Process **does not** remove or reduce the responsibility of the installing contractor to provide a finished product, installed and fully functional in accordance with the contract documents.

Commissioning is intended to confirm and approve system start-up and aid in the orderly completion and transfer of building systems and equipment for use by the FAA. The CxA is the leader of the Commissioning Team, planning and coordinating Commissioning activities in conjunction with the RE, DM, and GC.

3.1 Commissioning Specifications:

The Design Manager (DM) has sole responsibility for the technical specifications. CxA will review the Contract Documents to ensure inclusion of information describing the GC and contractor's responsibilities related to Commissioning, and to coordinate commissioning related specifications with the DM.

The commissioning specifications include Section 013200 Construction Progress Documentation, 013300 Submittal Procedures, 017823 Operations and Maintenance Data, 019113 General Commissioning Requirements, 075423 TPO Roofing, 084113 Aluminim-Framed Entrances / Storefronts, 086300 Metal-Framed Skylights, 220800 Commissioning of Plumbing, 230800 Commissioning of HVAC, and 260800 Commissioning of Electrical. Commissioning related requirements are also included in the Contract Documents. Commissioning requirements include but are not limited to:

1. Identification of the Commissioning Authority, and its role and responsibilities.
2. A summary of the roles and responsibilities of all other team members
3. A list of all building systems, equipment and interfaces to be commissioned.
4. Sample PFVCs for each type of new system being commissioned. PFVCs will not be issued for existing equipment.
5. Sample FPT to illustrate format that will be used.
6. Commissioning responsibilities of the GC and contractors, whose scope of work includes building systems and equipment to be commissioned by the Commissioning Authority. These responsibilities apply to all sub-contractors, sub-trades and suppliers associated with work on building systems and equipment to be commissioned.
7. Requirements for training the FAA's Environmental Support Unit. This includes instruction sessions with input from equipment manufacturers and site demonstrations by applicable contractors. A site walk through will be conducted to indicate various locations of equipment and ancillary items such as shut off valves, disconnect switches, timers, special controls, etc.
8. Documentation requirements, such as submittal data, manufacturers' operations and maintenance data, and contact information for all relevant contractors and suppliers.
9. Commissioning Meetings.
10. Commissioning Issues Log.
11. Commissioning Field Reports.

12. Cross-references included in other sections of the specification where contractor or trade-specific Commissioning requirements are applicable.
13. Language assigning financial responsibilities for failed tests or tests aborted due to incomplete installation to the appropriate parties.

3.2 Review of the Commissioning Plan:

The FAA RE, DM, and GC will review the Commissioning Plan with the CxA. The approved document will be distributed to Commissioning Team members for their information and action.

3.3 Support for Commissioning:

The Commissioning Authority provides leadership by communicating goals for the Commissioning Process, including verification of roles and responsibilities of team members, and clearly defining and documenting pass/fail criteria. Each Commissioning Team member shares responsibility to support the Commissioning Process and achieve a quality installation.

3.4 Commissioning Meetings:

The CxA will coordinate through the RE and GC to schedule Commissioning Meetings during site visits as needed. Dates, times and prerequisites for upcoming Commissioning checks, start-ups, or tests will be established. Issues will be raised and problems identified with required action decided, and a date for completion determined. Commissioning Team members are responsible for attending Commissioning Meetings and for completing assigned action items by the assigned dates. Cooperation is critical to successful Commissioning.

3.5 Coordination Planning:

The sequence and timing of Commissioning activities will be incorporated into the overall project schedule. The Commissioning Authority identifies the required Commissioning activities. Coordination requires input from the RE, DM, and GC, and contractors. Cooperation among the parties facilitates integration of Commissioning into the total construction program. The RE and GC will coordinate day to day commissioning activities. The RE and CxA will coordinate CxA site visits.

3.6 Submittal Review:

Submittal reviews will be performed by the Government. The CxA will be provided copies of approved submittals as they are applicable to the systems being commissioned.

3.7 Installation Monitoring:

Contractors, sub-contractors, and suppliers are responsible for supplying materials and installation of work in accordance with standard industry practices, contract documents, and the project schedule. Commissioning is not a substitute for Quality Control.

Early planning and scheduling activities in the construction phase of the Commissioning Process are intended to create a coordinated and realistic schedule, and thus avoid delays. PFVCs in the Commissioning Plan are particularly valuable. As scheduled start-up time approaches, the checklists prioritize items for the contractor's attention. Checklists for upcoming start-ups are reviewed at Commissioning Meetings to confirm readiness, and incomplete items will become issues for tracking and resolution. It is critical that the PFVCs be complete and approved PRIOR to the related FPT to ensure deficiencies are minimized to avoid unnecessary delay in construction and acceptance.

3.8 Construction Issues Tracking:

The GC and subcontractors are responsible for the overall construction process, including the necessary scheduling and coordination. The CxA will maintain a "Commissioning Issues Log" document to ensure that issues encountered during the Commissioning process are documented, followed up, and kept visible until resolved.

It is the responsibility of the appropriate team member to address and resolve all applicable items in a timely manner, to avoid impacts on schedule and acceptance testing.

3.9 Project Schedule Updates:

The FAA, DM, GC and CxA will periodically review the updated project schedule to ensure that all required Commissioning activities are incorporated, time allowances are adequate, and installation sequences are logical and properly coordinated with other construction activities.

3.10 CxA Site Visits:

The CxA will observe the installation periodically to assess construction compliance with the Design Intent Document (DID)**,** Contract Documents and prevailing industry standards.

The first site visit will be a one day visit shortly after the GC mobilizes. The purpose of the site visit will be to assemble the CxT and conduct a kickoff meeting. The meeting will include a review of the commissioning process, commissioning requirements, roles and responsibilities and major commissioning issues and milestones. During the kickoff meeting schedule, coordination, communication and process management will be discussed. Also, any construction or design issues will be discussed.

Construction Phase Site Visits: Site visits will be coordinated with the CxT, with the scope of the meetings to potentially include: survey construction progress, attend progress/coordination meetings, conduct commissioning-specific meetings, coordinate with the site concerning Functional Performance Testing and its potential impact, and to witness Owner training.

Testing Phase Site Visits: Subsequent site visits (duration to be coordinated – each could be a full week) when various systems / equipment installation is complete. The purpose will be to direct and witness Functional Performance Tests and to verify completion of PFVC checks and startup tests.

Warranty Phase Site Visits: One (1) site visit to supervise required alternate season or deferred testing and deficiency corrections.

One (1) site visit at 10 months into the 12-month warranty period and review with facility staff the current equipment operation and condition of outstanding issues related to the original and seasonal commissioning. Also interview facility staff and identify issues or concerns they have with operation of the commissioned systems / equipment.

3.11 Pre-Functional Verification Checklists (PFVCs):

PFVCs ensure systems and equipment are installed properly, conform to the Contract Documents and are ready for safe start-up. The responsibility for carrying out these checks, as well as any corrective action, lies with the GC. The CxA will prepare PFVCs for the new equipment and issue PFVCs to the RE prior to startup of the equipment being commissioned. PFVCs will not be issued for existing equipment. Completion of checklists items does not indicate acceptance or responsibility by the CxA or FAA.

Checks developed for the project will include steps that are typically required and verification inspection checks that must be carried out and documented prior to and during start-up and performance testing. Commissioning checklists and the equipment list will be developed and updated as the design progresses, and as specific manufacturers and models of equipment are submitted by the GC and approved for installation.

Start-Up Checks:

Typically used to refer to the static testing or check out of systems or equipment to ensure proper and complete operation and readiness for FPT. Start-up checks are incorporated into the PFVCs and include items such as verifying proper voltage, motor rotation, etc. The start-up procedures and/or checks are typically obtained from manufacturers O&M manuals and Contract Documents and are performed by the authorized manufacturer's start-up representative. These are done prior to Functional Performance Testing.

3.12 Functional Performance Tests (FPTs):

After reviewing the approved submittals, and the construction documents, the CxA authors the FPTs for each system-to-be-commissioned. Both new and existing equipment that is part of the chilled water system and the condenser water system shall be tested as part of the functional performance testing. The FPTs are based upon the construction documents, specifications and submittals. FPTs should progress from individual items of equipment and sub-systems, to complete systems, to integration between other systems, depending on the scope of the Commissioning Plan. This test progression helps to isolate the cause of problems as it verifies correct operation of smaller components of the installation before moving on to tests involving larger systems or integration between systems.

The GC is responsible for operating the systems as directed by the CxA. CxA directs, witnesses and documents the results of the FPTs of building systems to be Commissioned.

The Automatic Temperature Controls (ATC) contractor may have to override normal control operation or parameters to simulate specific test conditions and set up trend-logs to provide a record of system responses to test actions. Completion of checklists items **does not** indicate acceptance or responsibility by the CxA or FAA.

3.13 Review of Test and Balance (TAB) Procedures:

Before executing their work, the TAB agency must submit to the DM, GC and CxA for review and approval a plan detailing the TAB procedures and instruments planned for use on the project. The plan shall include the formats in which results will be reported, including a preliminary TAB report representing the project's equipment design parameters on approved data sheets. The TAB agency shall also describe the operational conditions required before HVAC systems will be ready for balancing. During early construction the TAB agency provides comments from their review of contract documents pertaining to provisions for testing air and water flows, temperatures and pressures.

The TAB agency shall submit a tentative schedule for their work. The schedule includes site visits to evaluate the impacts of as-built conditions on the planned procedures and schedule, and to determine when the installation will be ready for on-site TAB work. The RE, DM and GC will review this information.

TAB Services:

The TAB agency is responsible for checking that prerequisites for the start of TAB services have been completed prior to initiating their fieldwork.

The TAB agency shall perform TAB services in accordance with the Contract Documents and the procedures submitted and approved at the beginning of the construction phase.

Where controls need to be calibrated against measured air or water flows, the ATC contractor must work with the TAB agency so that the related measurements and calibrations are coordinated, and the results documented.

TAB equipment used for testing and calibration shall be NIST/NBS traceable and calibrated with-in the preceding six-month period. Certificates of calibration must be submitted previous to any TAB testing.

TAB Report:

The TAB subcontractor shall complete and submit a preliminary TAB report to the RE. The RE will verify the TAB report both by reviewing the report and duplicating field tests. The TAB subcontractor shall provide necessary personnel and equipment to assist in verification. The TAB subcontractor shall address inconsistencies identified during verification or designer comments and resubmits the final TAB report to the RE for approval. A copy of the preliminary TAB report will be provided to the CxA prior to starting Functional Performance Tests.

3.14 HVAC Controls Installation:

The ATC contractor is responsible for documenting all aspects of the controls installation. At a minimum, the following as-built information will be included:

1. Data on all components included with the controls installation, including general description, parts lists, technical & applications data, and installation, calibration and maintenance information.
2. Schematic diagrams of the entire controls system as specified.
3. A complete points list, with records of point-to-point wiring, documented field locations and device test.
4. Complete written sequences of controls for all systems, with details of final values for all parameters and set points.
5. Clearly labeled control panels and devices as specified.

Controls Point-to-Point Checks:

The ATC contractor will carry out point-to-point control checks and document the results on checkout sheets. These checks confirm control point wiring has been correctly installed and terminated, sensors have been calibrated, and field devices operate correctly. This involves physical observation of device responses by the ATC contractor to ensure they match control system displays. The RE will verify the results reported by the ATC subcontractor, and provide this information to the CxA for inclusion in the Commissioning Report. The RE will employ sampling techniques to document verification of point-to-point checkouts. Direct monitoring of the ATC checkout process facilitates conformance with the DID.

3.15 HVAC System Start-Ups:

The mechanical contractor is responsible for starting HVAC equipment and systems in accordance with the Contract Documents. No equipment shall be started until appropriate Cx plan documentation (including completed PFVCs) has been completed and the start-up time and date has been scheduled and approved in advance.

Before starting equipment or systems, contractors must complete the relevant PFVCs. When the specification requires a manufacturer’s certified technician, the technician, using the manufacturer's start-up procedure and documentation must perform the start-up. The RE will observe major start-ups. Abnormalities occurring or corrective actions taken during start-up of equipment or systems will be noted in the Commissioning start-up documentation. Conditions not in compliance with Contract Documents or manufacturer's recommendations will preclude operation of affected systems until such conditions are corrected. RE makes final decisions regarding a system's readiness for operation.

The RE will witness selected start-ups, and document the results using the start-up checklists and other provisions in the Commissioning Plan. When the manufacturer's technician does the start-up, a copy of the manufacturer's start-up report will be attached to the PFVC.

3.16 Deficiencies and Re-Test:

The GC will ensure equipment and systems as well as subcontractors and suppliers are ready for Commissioning tests, inspections and any necessary re-testing.

Incomplete work or deficiencies discovered in PFVCs, or FPTs will be corrected by the responsible subcontractors and re-tested to produce satisfactory results prior to proceeding to the next stage of the Commissioning process. The GC is responsible for deficient or incomplete work and will be responsible to ensure corrections necessary for full and complete system operation as specified are completed.

In the event the deficiencies cannot be completed within initial test, coordination with entire CxT is necessary to develop an appropriate path to resolution.

3.17 Acceptance:

The acceptance phase immediately follows the construction phase and FPTs of specified systems/equipment and completion of documentation. During the acceptance phase the FAA O&M staff receives the documentation and training necessary for effective operations and maintenance of building systems. The DM and RE evaluate new and/or modified systems relative to the DID and suitability for occupancy. Acceptance of building by the FAA initiates specified warranties. Commissioning clarifies requirements for initiation of the warranty period. The requirements for acceptance will be defined by the FAA.

4 Commissioning Protocols:

The following Commissioning Protocols shall be followed:

1. No communication from the CxA shall be interpreted as a work directive. Commissioning Issues Log updates resulting from testing will be provided to the GC through the FAA RE, but this does not imply that it is complete or that the identified deficiencies shall be acted upon or how to resolve them.
2. Design related Commissioning issues will be referred to the GC through the RE.
3. Equipment shall not be "temporarily" started (for heating or cooling), before PFVC items and manufacturers' pre-start procedures are completed, and moisture, dust and other environmental and building integrity issues have been addressed and a maintenance schedule set in place.
4. Equipment put in service for temporary use shall have a preventive maintenance schedule in place and approved by the RE. Maintenance shall be performed in accordance with manufacturer's recommended maintenance schedule and any precautionary measures necessary to protect equipment during the construction process.
5. Equipment that is operated by the GC to support the construction effort, such as providing conditioned air, shall be commissioned in accordance with this Specification before being placed in service. Temporary operation of permanent equipment shall be coordinated with the RE

    - Maintain equipment in accordance with manufacturer's procedures and schedules. Review maintenance requirements with the RE and adjust as necessary to account for the construction environment (high dust, humidity, etc.).
    - Maintain a maintenance record of each equipment item operated prior to acceptance. Submit copies to the RE on a monthly basis.
    - Prior to acceptance, replace belts, filters, lubricants and other consumables with new and re-perform PFVCs.

6. The controls system and equipment it controls are not functionally tested until points have been calibrated point-to-point checks are completed, PFVCs have been completed and FPTs are completed.
7. TAB is not performed until the building envelope is completely enclosed and ceiling complete, unless return air is ducted.
8. TAB is not performed until the controls system has been tested and approved by the RE for TAB work.

APPENDIX A

Participants Involved in the Cx Process:

1. **Design Manager (DM):**

Company Name: Jacobs
Address: 1100 N. Glebe Rd
Arlington, VA 22201

Contact Person:
Phone:
Fax:
Other:
Email Address:

2. **Architect:**

Company Name: Jacobs
Address: 1100 N. Glebe Rd
Arlington, VA 22201

Contact Person:
Phone:
Fax:
Other:
Email Address:

3. **Electrical Design Engineer (EDE):**

Company Name: Jacobs
Address: 1100 N. Glebe Rd
Arlington, VA 22201

Contact Person:
Phone:
Fax:
Other:
Email Address:

4. **Mechanical Design Engineer (MDE):**

Company Name: Jacobs
Address: 1100 N. Glebe Rd
Arlington, VA 22201

Contact Person:
Phone:
Fax:
Other:

Email Address:

5. Fire Alarm Design Engineer (FADE)

Company Name: Jacobs
Address: 1100 N. Glebe Rd
Arlington, VA 22201

Contact Person:
Phone:
Fax:
Other:
Email Address:

6. Commissioning Authority (CxA):

Company Name: Jacobs
Address: 1100 N. Glebe Rd
Arlington, VA 22201

Contact Person:
Phone:
Fax:
Other:
Email Address:

7. Federal Aviation Administration (FAA)

Headquarters
Address: 800 Independence Avenue, SW
Washington, DC 20591

Contact Person:
Phone:
Fax:
Other:
Email Address:

8. Federal Aviation Administration (FAA)

FAA PIM / Regional Contact
Address:

Contact Person:

Phone:
Fax:
Other:
Email Address:

9. Federal Aviation Administration (FAA):

FAA Resident Engineer (RE)
Address:

Contact Person:
Phone:
Fax:
Other:
Email Address: @faa.gov

10. General Contractor

Company Name: TBD
Address: TBD
Contact Person: TBD
Phone: TBD
Fax: TBD
Other: TBD
Email Address: TBD

11. Electrical Contractor (EC):

Company Name: TBD
Address: TBD
Contact Person: TBD
Phone: TBD
Fax: TBD
Other: TBD
Email Address: TBD

12. Controls Contractor (CC):

Company Name: TBD
Address: TBD
Contact Person: TBD
Phone: TBD
Fax: TBD
Other: TBD
Email Address: TBD

13. Fire Alarm Contractor (FAC):

Company Name: TBD
Address: TBD
Contact Person: TBD
Phone: TBD
Fax: TBD
Other: TBD
Email Address: TBD

14. Fire Protection Contractor (FPC):

Company Name: TBD
Address: TBD
Contact Person: TBD
Phone: TBD
Fax: TBD
Other: TBD
Email Address: TBD

15. Mechanical Contractor (MC):

Company Name: TBD
Address: TBD
Contact Person: TBD
Phone: TBD
Fax: TBD
Other: TBD
Email Address: TBD

16. TAB Contractor (TAB):

Company Name: TBD
Address: TBD
Contact Person: TBD
Phone: TBD
Fax: TBD
Other: TBD
Email Address: TBD

APPENDIX B

Systems and Equipment to be Commissioned:

Plumbing Systems:

- Domestic Water
  - Hot and Cold Water Piping
  - Domestic Water Heaters and Pumps
- Sanitary & Vent Piping
- Storm Water Piping
- Plumbing Fixtures
  - Lavatories, Sinks, Drinking Fountains
- Elevator Sump Pump
- Plumbing Meter Reporting
- Test, Adjust, Balance (TAB) Verification of Domestic Hot Water

Mechanical Systems:

- Roof Top Units
- Terminal Boxes
- Exhaust Fans
- Fan Coil Units
- Unit Heaters
- New DDCS Controls
- Test, Adjust, Balance (TAB) Verification
- Emergency Ventilation System

Electrical Systems:

- Normal Power
  - Switchboards
  - Panelboards
- Emergency Power
  - Emergency Generator
  - Automatic Transfer Switches
- Lighting Control
  - Occupancy Sensors
  - Daylight Harvesting

Building Envelope Systems:

- TPO Roofing
- Aluminum-Framed Entrances and Storefronts
- Metal-Framed Skylights

Fire Protection System

Fire Alarm System

APPENDIX C

Preliminary Equipment Inventory

This appendix contains the preliminary equipment inventory for the Warrenton Command Center Modernization Project

The inventory will be used to develop individual Commissioning PFVCs and FPTs for each equipment item installed. The inventory will be updated as additional information becomes available.

WARRENTON COMMAND CENTER MODERNIZATION, WARRENTON, VA

PRELIMINARY EQUIPMENT INVENTORY

Equipment Identification	Location	Description	Size	U/M	Serves	Manufacturer	System ID	Sub-System ID	Notes
RTU-1	Roof	Roof Top Unit	6200	cfm	Level 1		Mech	HVAC	
RTU-2	Roof	Roof Top Unit	4800	cfm	Level 1		Mech	HVAC	
RTU-3	Roof	Roof Top Unit	7200	cfm	Level 2		Mech	HVAC	
RTU-4	Roof	Roof Top Unit	8500	cfm	Level 2		Mech	HVAC	
FCU-01	Rm 103	Fan Coil Unit	24	MBH	Rm 103		Mech	HVAC	
FCU-02	Stair	Fan Coil Unit	24	MBH	Stair		Mech	HVAC	
FCU-03	Rm 170 / 171	Fan Coil Unit	9	MBH	Rm 170 / 171		Mech	HVAC	
FCU-04	Rm 142 / 143	Fan Coil Unit	9	MBH	Rm 142 / 143		Mech	HVAC	
FCU-05	Stair	Fan Coil Unit	24	MBH	Stair		Mech	HVAC	
FCU-06	Rm 223	Fan Coil Unit	24	MBH	Rm 223		Mech	HVAC	
FCU-07	Rm 250 / 251	Fan Coil Unit	9	MBH	Rm 250 / 251		Mech	HVAC	
FCU-08	Rm 221	Fan Coil Unit	9	MBH	Rm 221		Mech	HVAC	
FCU-09	Rm 131	Fan Coil Unit	9	MBH	Rm 131		Mech	HVAC	
EF-1	Roof	Exhaust Fan	1400	cfm	Restroom		Mech	HVAC	
EF-2	Roof	Exhaust Fan	150	cfm	Sprinkler Room		Mech	HVAC	
EF-3	Roof	Exhaust Fan		cfm	Radon		Mech	HVAC	

WARRENTON COMMAND CENTER MODERNIZATION, WARRENTON, VA									
PRELIMINARY EQUIPMENT INVENTORY									
Equipment Identification	Location	Description	Size	U/M	Serves	Manufacturer	System ID	Sub-System ID	Notes
UH-1		Unit Heater	0.8	kW			Mech	HVAC	
UH-2		Unit Heater	0.8	kW			Mech	HVAC	
UH-3		Unit Heater	0.8	kW			Mech	HVAC	
VAV-1-01	Level 1	Air Handling Unit	315	cfm	Break Rm 907		Mech	HVAC	
VAV-1-02	Level 1	Terminal Box	155	cfm	CAB 1100		Mech	HVAC	
VAV-1-03	Level 1	Terminal Box	1240	cfm	Level 1		Mech	HVAC	
VAV-1-04	Level 1	Terminal Box	1240	cfm	Level 1		Mech	HVAC	
VAV-1-05	Level 1	Terminal Box	305	cfm	Level 1		Mech	HVAC	
VAV-1-06	Level 1	Terminal Box	2480	cfm	Level 1		Mech	HVAC	
VAV-1-07	Level 1	Terminal Box	2480	cfm	Level 1		Mech	HVAC	
VAV-1-08	Level 1	Terminal Box	1100	cfm	Level 1		Mech	HVAC	
VAV-1-09	Level 1	Terminal Box	555	cfm	Level 1		Mech	HVAC	
VAV-1-10	Level 1	Terminal Box	1075	cfm	Level 1		Mech	HVAC	
VAV-1-11	Level 1	Terminal Box	1140	cfm	Level 1		Mech	HVAC	
VAV-1-12	Level 1	Terminal Box	1215	cfm	Level 1		Mech	HVAC	
VAV-1-13	Level 1	Terminal Box	190	lb-hr	Level 1		Mech	HVAC	

WARRENTON COMMAND CENTER MODERNIZATION, WARRENTON, VA									
PRELIMINARY EQUIPMENT INVENTORY									
Equipment Identification	Location	Description	Size	U/M	Serves	Manufacturer	System ID	Sub-System ID	Notes
VAV-1-14	Level 1	Terminal Box	515	lb-hr	Level 1		Mech	HVAC	
VAV-1-15	Level 1	Terminal Box	1195	lb-hr	Level 1		Mech	HVAC	
VAV-1-16	Level 1	Terminal Box	160	lb-hr	Level 1		Mech	HVAC	
VAV-1-17	Level 1	Terminal Box	200	kW	Level 1		Mech	HVAC	
VAV-1-18	Level 1	Terminal Box	845	kW	Level 1		Mech	HVAC	
VAV-1-19	Level 1	Terminal Box	115	kBTUH	Level 1		Mech	HVAC	
VAV-1-20	Level 1	Terminal Box	700	kBTUH	Level 1		Mech	HVAC	
VAV-1-21	Level 1	Terminal Box	700	kBTUH	Level 1		Mech	HVAC	
VAV-1-22	Level 1	Terminal Box	300	kBTUH	Level 1		Mech	HVAC	
VAV-1-23	Level 1	Terminal Box	675	kBTUH	Level 1		Mech	HVAC	
VAV-1-24	Level 1	Terminal Box	305	kBTUH	Level 1		Mech	HVAC	
VAV-1-25	Level 1	Terminal Box	145	cfm	Level 1		Mech	HVAC	
VAV-1-26	Level 1	Terminal Box	140	cfm	Level 1		Mech	HVAC	
VAV-1-27	Level 1	Terminal Box	800	cfm	Level 1		Mech	HVAC	
VAV-1-28	Level 1	Terminal Box	310	cfm	Level 1		Mech	HVAC	
VAV-1-29	Level 1	Terminal Box	600	cfm	Level 1		Mech	HVAC	

WARRENTON COMMAND CENTER MODERNIZATION, WARRENTON, VA									
PRELIMINARY EQUIPMENT INVENTORY									
Equipment Identification	Location	Description	Size	U/M	Serves	Manufacturer	System ID	Sub-System ID	Notes
VAV-1-30	Level 1	Terminal Box	710	cfm	Level 1		Mech	HVAC	
VAV-1-31	Level 1	Terminal Box	125	cfm	Level 1		Mech	HVAC	
VAV-1-32	Level 1	Terminal Box	1225	cfm	Level 1		Mech	HVAC	
VAV-1-33	Level 1	Terminal Box	535	cfm	Level 1		Mech	HVAC	
VAV-1-34	Level 1	Terminal Box	1165	cfm	Level 1		Mech	HVAC	
VAV-1-35	Level 1	Terminal Box	165	cfm	Level 1		Mech	HVAC	
VAV-1-36	Level 1	Terminal Box	140	cfm	Level 1		Mech	HVAC	
VAV-1-37	Level 1	Terminal Box	100	cfm	Level 1		Mech	HVAC	
VAV-1-38	Level 1	Terminal Box	1065	cfm	Level 1		Mech	HVAC	
VAV-1-39	Level 1	Terminal Box	215	cfm	Level 1		Mech	HVAC	
VAV-2-1	Level 2	Terminal Box	1590	cfm	Level 2		Mech	HVAC	
VAV-2-2	Level 2	Terminal Box	1185	cfm	Level 2		Mech	HVAC	
VAV-2-3	Level 2	Terminal Box	1240	cfm	Level 2		Mech	HVAC	
VAV-2-4	Level 2	Terminal Box	1724	cfm	Level 2		Mech	HVAC	
VAV-2-5	Level 2	Terminal Box	1265	cfm	Level 2		Mech	HVAC	
VAV-2-6	Level 2	Terminal Box	1225	cfm	Level 2		Mech	HVAC	

WARRENTON COMMAND CENTER MODERNIZATION, WARRENTON, VA									
PRELIMINARY EQUIPMENT INVENTORY									
Equipment Identification	Location	Description	Size	U/M	Serves	Manufacturer	System ID	Sub-System ID	Notes
VAV-2-7	Level 2	Terminal Box	1420	cfm	Level 2		Mech	HVAC	
VAV-2-8	Level 2	Terminal Box	1425	cfm	Level 2		Mech	HVAC	
VAV-2-9	Level 2	Terminal Box	985	cfm	Level 2		Mech	HVAC	
VAV-2-10	Level 2	Terminal Box	1055	cfm	Level 2		Mech	HVAC	
VAV-2-11	Level 2	Terminal Box	230	cfm	Level 2		Mech	HVAC	
VAV-2-12	Level 2	Terminal Box	775	cfm	Level 2		Mech	HVAC	
VAV-2-13	Level 2	Terminal Box	800	cfm	Level 2		Mech	HVAC	
VAV-2-14	Level 2	Terminal Box	920	cfm	Level 2		Mech	HVAC	
VAV-2-15	Level 2	Terminal Box	1120	cfm	Level 2		Mech	HVAC	
VAV-2-16	Level 2	Terminal Box	305	cfm	Level 2		Mech	HVAC	
VAV-2-17	Level 2	Terminal Box	295	cfm	Level 2		Mech	HVAC	
VAV-2-18	Level 2	Terminal Box	610	cfm	Level 2		Mech	HVAC	
VAV-2-19	Level 2	Terminal Box	305	cfm	Level 2		Mech	HVAC	
VAV-2-20	Level 2	Terminal Box	320	cfm	Level 2		Mech	HVAC	
VAV-2-21	Level 2	Terminal Box	155	cfm	Level 2		Mech	HVAC	
VAV-2-22	Level 2	Terminal Box	670	cfm	Level 2		Mech	HVAC	

WARRENTON COMMAND CENTER MODERNIZATION, WARRENTON, VA									
PRELIMINARY EQUIPMENT INVENTORY									
Equipment Identification	Location	Description	Size	U/M	Serves	Manufacturer	System ID	Sub-System ID	Notes
VAV-2-23	Level 2	Terminal Box	200	cfm	Level 2		Mech	HVAC	
VAV-2-24	Level 2	Terminal Box	305	cfm	Level 2		Mech	HVAC	
VAV-2-25	Level 2	Terminal Box	110	cfm	Level 2		Mech	HVAC	
VAV-2-26	Level 2	Terminal Box	925	cfm	Level 2		Mech	HVAC	
VAV-2-27	Level 2	Terminal Box	700	cfm	Level 2		Mech	HVAC	
VAV-2-28	Level 2	Terminal Box	600	cfm	Level 2		Mech	HVAC	
VAV-2-29	Level 2	Terminal Box	160	cfm	Level 2		Mech	HVAC	
VAV-2-30	Level 2	Terminal Box	1060	cfm	Level 2		Mech	HVAC	
VAV-2-31	Level 2	Terminal Box	185	cfm	Level 2		Mech	HVAC	
DHWH-1	123	Domestic Water Heater	80	gal	Building		Plumb	Plumbing	
SP-1	Elevator Pit	Sump Pump	50	gpm	Elevator		Plumb	Plumbing	
SEDP	Rm 132	Switchboard	1200	amps			Elect	Switchboard	
NDPH	Rm 132	Normal Dist. Panelboard	800	amps	Normal Power		Elect	Switchboard	
ATS	Rm 132	Automatic Transfer Switch	600	amps	EDPH, Generator		Elect	Emerg Power	
EGEN		Emergency Generator	125	kW	ATS		Elect	Emerg Power	
GDP	Rm 132	Generator Distribution Panel	400	amps	ATS		Elect	Switchboard	

WARRENTON COMMAND CENTER MODERNIZATION, WARRENTON, VA									
PRELIMINARY EQUIPMENT INVENTORY									
Equipment Identification	Location	Description	Size	U/M	Serves	Manufacturer	System ID	Sub-System ID	Notes
EDPH	Rm 132	Essential Dist. Panelboard	800	amps	EPH		Elect	Panelboard	
EPH1	Rm 132	Panelboard	250	amps			Elect	Panelboard	
EPH2	Rm 132	Panelboard	250	amps			Elect	Panelboard	
T-EDPL	Rm 132	Transformer	112.5	kVA	EDPL		Elect	Transformer	
EDPL	Rm 132	Panelboard	400	amps	EPL		Elect	Panelboard	
EPL 1-1	Rm 132	Panelboard	250	amps			Elect	Panelboard	
EPL 1-2	Rm 171	Panelboard	100	amps			Elect	Panelboard	
EPL 1-3	Rm 143	Panelboard	250	amps			Elect	Panelboard	
EPL 1-4	Rm 251	Panelboard	250	amps			Elect	Panelboard	
EPL 1-5	Rm 223	Panelboard	100	amps			Elect	Panelboard	
NPH 1	Rm 170	Panelboard	250	amps			Elect	Panelboard	
NPH 2	Rm 142	Panelboard	250	amps			Elect	Panelboard	
NPH 3	Rm 250	Panelboard	250	amps			Elect	Panelboard	
NPH 4	Rm 221	Panelboard	250	amps			Elect	Panelboard	
T-NPL 1		Transformer	75	kVA	NPL 1		Elect	Transformer	
T-NPL 2		Transformer	75	kVA	NPL 2		Elect	Transformer	

WARRENTON COMMAND CENTER MODERNIZATION, WARRENTON, VA

PRELIMINARY EQUIPMENT INVENTORY

Equipment Identification	Location	Description	Size	U/M	Serves	Manufacturer	System ID	Sub-System ID	Notes
T-NPL 3		Transformer	75	kVA	NPL 3		Elect	Transformer	
NPL 1-1	Rm 170	Panelboard	250	amps			Elect	Panelboard	
NPL 1-2	Rm 170	Panelboard	100	amps			Elect	Panelboard	
NPL 1-3	Rm 170	Panelboard	100	amps			Elect	Panelboard	
NPL 2-1	Rm 142	Panelboard	250	amps			Elect	Panelboard	
NPL 2-2	Rm 142	Panelboard	100	amps			Elect	Panelboard	
NPL 2-3	Rm 142	Panelboard	100	amps			Elect	Panelboard	
NPL 3-1	Rm 250	Panelboard	250	amps			Elect	Panelboard	
NPL 3-2	Rm 250	Panelboard	100	amps			Elect	Panelboard	
NPL 3-3	Rm 250	Panelboard	100	amps			Elect	Panelboard	
NPL 4-1	Rm 221	Panelboard	250	amps			Elect	Panelboard	
NPL 4-2	Rm 221	Panelboard	100	amps			Elect	Panelboard	
NPL 4-3	Rm 221	Panelboard	100	amps			Elect	Panelboard	

APPENDIX D

Pre-Functional Verification Checklists (PFVCs) - Samples

This appendix contains **samples** of system/equipment PFVCs similar the equipment anticipated to be installed.

The sample PFVCs indicate the level of detail that is required to commission this project. **As specific equipment is approved and installation and start up information obtained, checklists shall be developed that include actual manufacturer's requirements.** The checklists include steps that are typically required, and verification inspection checks that must be carried out and documented prior to and during start-up and performance testing.

NOTE: During Commissioning Kick-Off Meeting, the PFVCs will be distributed for Contractor review and use.

The following sample checklists contained in this Cx Plan:

Mechanical Systems:

Roof Top Unit - VAV Unit
Exhaust Fan
Terminal Boxes w Electric Reheat

Plumbing Systems:

Domestic Water Heater

Roof Top Unit

Pre-Functional Verification Checklist

Jacobs
120 St. James Ave, 5th Floor
Boston, MA 02116
Tel: (508) 864-4170

FAA Warrenton Command Center (WCC) Modernization
Warrenton, VA

Task No.	Task Description	Contractor	Contractor Initial and Date
1	**Equipment Delivery and Acceptance Verifications**		
1.1	**Note:** Record actual Name Plate Data and confirm unit is as specified in the contract documents: Manufacturer: ____ Model Number: ____ Serial Number: ____ Volts/Phase/Hz: ____ CFM: ___________; Cooling BTUH: ___________; Heating BTUH: ______________ Motor FLA: ______________________Amps; Motor HP: _____________________	MC	
1.2	Verify RTU configuration is as specified in the contract documents.	MC	
1.3	Verify date of manufacture. (Verify by date tag or serial number. If date exceeds 16 weeks notify RE and CxA).	MC	
1.4	Verify unit is free of physical damage (dents, holes, etc.).	MC	
1.5	Verify unit is stored on a flat surface in a safe and dry environment.	MC	
1.6	Verify packing list has been checked and non mounted parts inventoried and confirmed.	MC	
2	**Basic Installation**		
2.1	Verify unit is installed in the proper location per the contract documents.	MC	
2.2	Verify shipping blocks and brackets, etc. have been removed.	MC	
2.3	Verify roof curb is in good condition and is of sufficient height to allow for proper drainage of condensate.	MC	
2.4	Verify sufficient access and clearance has been provided to and around equipment for servicing. (Access is defined as sufficient space for a middle aged man of average size and health to be able to perform necessary maintenance and repairs.)	MC	
2.5	Verify there is sufficient space on one side of the unit equal to the width of the RTU for removal of the coils and fan assemblies.	MC	
2.6	Verify sufficient space clearance has been provided for the electrical power and control access points and that minimum clearances have been provided per electric code.	MC	
2.7	Verify the unit is level.	MC	
2.8	Verify that vibration and sound isolation equipment is installed per contract documents.	MC	
2.9	Verify all sensor locations are appropriate and away from causes of erratic operation.	MC	
2.10	Verify the following dampers have been installed: -Outdoor Air Damper______; -Return Air Damper______ -Exhaust Air Damper _______	MC	
2.11	Verify Air Flow Measuring Station has been installed in the outdoor air duct in accordance with manufacturer's distance requirements and instructions.	MC	
2.12	Verify duct access doors have been installed at each damper location and any other locations called out in the contract documents.	MC	

Roof Top Unit

Pre-Functional Verification Checklist

120 St. James Ave, 5th Floor
Boston, MA 02116
Tel: (508) 864-4170

FAA Warrenton Command Center (WCC) Modernization
Warrenton, VA

Task No.	Task Description	Contractor	Contractor Initial and Date
2.13	Verify unit to duct flex connectors are installed tight and undamaged.	MC	
2.14	Verify damper linkages at each damper are tight.	MC	
2.15	Verify end of damper shaft at each damper has a score mark indicating damper position.	MC	
2.16	Verify all access doors close tightly, are gasketed and are air tight.	MC	
2.17	Verify door latches maintain a good tight seal when secured.	MC	
2.18	Verify the correct filters are installed and fit tight in the filter racks.	MC	
2.19	Verify all penetrations through unit panels and unit enclosure are sealed.	MC	
2.20	Verify caulked seams and air seals are intact.	MC	
2.21	Verify the unit is clean and free of damage, both inside and outside.	MC	
2.22	Verify equipment ID labels for the unit and associated sensors are correct and permanently affixed.	MC	
3	**Coils, Piping and Valves**		
3.1	Verify piping installation is complete and properly supported.	MC	
3.2	Verify piping pressure testing has been completed.	MC	
3.3	Verify piping has been flushed and flushing has been properly documented per specifications.	MC	
3.4	Verify piping connections have been completed and are connected to the appropriate inlet/outlet points on the RTU. Confirm that flexible connections have been used as indicated in the contract documents.	MC	
3.5	Refrigerant piping sizes and routing approved by Manufacturer	MC	
3.6	Refrigerant piping safety vent properly vented to atmosphere	MC	
3.7	Verify gas train for gas heater installed with no leaks	MC	
3.8	Verify isolation valve for natural gas piping is installed and operational	MC	
3.9	Verify gas burner installed	MC	
3.10	Verify the coils are clean, the fins are not damaged and there are no leaks.	MC	
3.11	Verify coil piping connections are tight and are not leaking.	MC	
3.12	Verify valves have been installed facing in the correct direction, based on the direction of water flow.	MC	
3.13	Verify strainers are clean.	MC	
3.14	Verify valves and pipes are properly insulated.	MC	
3.15	Verify valves are labeled.	MC	
3.16	Verify piping has been properly labeled.	MC	
3.17	Verify a condensate pan has been installed under the cooling coil.	MC	
3.18	Verify the condensate pan is clean.	MC	
3.19	Verify water in the condensate pan flows towards the associated drain connection.	MC	
3.20	Verify RTU condensate drain has been installed per mechanical detail in the contract documents.	MC	
4	**Electrical**		
	Supply Fan		
4.1	Verify unit mounted safety disconnect switch is installed and labeled.	EC	

Roof Top Unit

Pre-Functional Verification Checklist

120 St. James Ave, 5th Floor
Boston, MA 02116
Tel: (508) 864-4170

FAA Warrenton Command Center (WCC) Modernization
Warrenton, VA

Task No.	Task Description	Contractor	Contractor Initial and Date
4.2	Verify motor is labeled for use with a Variable Frequency Drive (VFD).	EC	
4.3	Verify VFD has been provided with Hand/Off/Auto selection settings through a switch or the VFD keypad.	EC	
4.4	Verify VFD has been provided with Local/Remote speed selection settings through a switch or the VFD keypad.	EC	
4.5	Verify VFD has been provided with a three contactor, Line Bypass selection switch to bypass the VFD and operate the fan using line voltage.	EC	
4.6	Verify properly sized and adjusted electrical motor protection with manufacturer's rating plate and record. Motor FLA Amperage ________. Protection Device (FLA _______X 125%) Amperage ________ .	EC	
4.7	Verify all electrical connections are tight and enclosed.	EC	
4.8	Verify adequate breaker or fuse size and note. ________ Amps.	EC	
4.9	Verify proper grounding installed for each component.	EC	
4.10	Verify grounding has been tested.	EC	
4.11	Verify supplied voltage and phase are the same as printed on rating label.	EC	
4.12	Switch off local disconnect switch and verify no power to fan is present.	EC	
	Return Fan		
4.13	Verify unit mounted safety disconnect switch is installed and labeled.	EC	
4.14	Verify motor is labeled for use with a Variable Frequency Drive (VFD).	EC	
4.15	Verify VFD has been provided with Hand/Off/Auto selection settings through a switch or the VFD keypad.	EC	
4.16	Verify VFD has been provided with Local/Remote speed selection settings through a switch or the VFD keypad.	EC	
4.17	Verify VFD has been provided with a three contactor, Line Bypass selection switch to bypass the VFD and operate the fan using line voltage.	EC	
4.18	Verify properly sized and adjusted electrical motor protection with manufacturer's rating plate and record. Motor FLA Amperage ________. Protection Device (FLA _______X 125%) Amperage ________ .	EC	
4.19	Verify all electrical connections are tight and enclosed.	EC	
4.20	Verify adequate breaker or fuse size and note. ________ Amps.	EC	
4.21	Verify proper grounding installed for each component.	EC	
4.22	Verify grounding has been tested.	EC	
4.23	Verify supplied voltage and phase are the same as printed on rating label.	EC	
4.24	Switch off local disconnect switch and verify no power to fan is present.	EC	
4.25	Verify all RTU control devices are labeled.	EC	
5	**Pre Start-Up Verification**		
5.1	Verify ductwork, dampers and any other equipment that could obstruct airflow are complete.	MC	
5.2	Verify Fire Alarm System components (Addressable Control Devices, Duct Smoke Detectors, Safety Interlocks) associated with the unit are installed, functional and have been tested.	FAC	
5.3	Verify Direct Digital Control System (DDCS) controls associated with the unit are installed, functional and have been tested.	TCC	

Roof Top Unit

Pre-Functional Verification Checklist

120 St. James Ave, 5th Floor
Boston, MA 02116
Tel: (508) 864-4170

FAA Warrenton Command Center (WCC) Modernization
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Task No.	Task Description	Contractor	Contractor Initial and Date
5.4	Verify DDCS control devices and Direct Digital Control Panels (DDCP) are labeled.	TCC	
5.5	Confirm that Air Flow Measuring Station has been started up by manufacturer's certified representative and associated controls have been tested. (Start-up documentation must be pre-approved by CxA)	TCC	
5.6	Verify clean air filters are in place.	MC	
	Supply Fan		
5.7	Verify fan assembly bearings and locking collars are properly tightened.	MC	
5.8	Verify fan wheel is properly aligned, tight on the shaft and freely moving.	MC	
5.9	Verify fan bearings are properly lubricated	MC	
5.10	Verify fan sheaves are properly aligned and tight on the shaft.	MC	
5.11	Verify belt tensions are correctly adjusted and record. Initial Tension Reading ft-lbs _______ (After 8 hrs run time reading ft-lbs _______), (After 16 hrs run time, Reading ft-lbs _______), (After 24 hrs run time, Reading ft-lbs _______). Note: Correct belt tension information is located on the blower housing. Belt should not squeal on start-up.	MC	
5.12	Verify motor mounting bolts and adjustable motor base bolts are tight.	MC	
5.13	Confirm that VFD has been started up by VFD manufacturer's certified representative and associated controls have been tested. (Start-up documentation must be pre-approved by CxA)	EC	
5.14	Verify and record actual line voltage to VFD and fan motor with VFD set at 100% fan speed. VFD Ph A-B _______ Ph A-C ________ Ph B-C _________ Motor Ph A-B _______ Ph A-C ________ Ph B-C _________	EC	
5.15	Verify and record actual motor amperage with VFD set at 100% fan speed. Motor Ph A _______ Ph B ________ Ph C _________	EC	
5.16	Verify proper fan rotation.	EC	
5.17	Verify no unusual vibration or noise at any normal operating frequency.	MC	
	Return Fan		
5.18	Verify fan assembly bearings and locking collars are properly tightened.	MC	
5.19	Verify fan wheel is properly aligned, tight on the shaft and freely moving.	MC	
5.20	Verify fan bearings are properly lubricated	MC	
5.21	Verify fan sheaves are properly aligned and tight on the shaft.	MC	
5.22	Verify belt tensions are correctly adjusted and record. Initial Tension Reading ft-lbs _______ (After 8 hrs run time reading ft-lbs _______), (After 16 hrs run time, Reading ft-lbs _______), (After 24 hrs run time, Reading ft-lbs _______). Note: Correct belt tension information is located on the blower housing. Belt should not squeal on start-up.	MC	
5.23	Verify motor mounting bolts and adjustable motor base bolts are tight.	MC	
5.24	Confirm that VFD has been started up by VFD manufacturer's certified representative and associated controls have been tested. (Start-up documentation must be pre-approved by CxA)	EC	
5.25	Verify and record actual line voltage to VFD and fan motor with VFD set at 100% fan speed. VFD Ph A-B _______ Ph A-C ________ Ph B-C _________ Motor Ph A-B _______ Ph A-C ________ Ph B-C _________	EC	
5.26	Verify and record actual motor amperage with VFD set at 100% fan speed. Motor Ph A _______ Ph B ________ Ph C _________	EC	

Roof Top Unit
Pre-Functional Verification Checklist

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FAA Warrenton Command Center (WCC) Modernization
Warrenton, VA

Task No.	Task Description	Contractor	Contractor Initial and Date
5.27	Verify proper fan rotation.	EC	
5.28	Verify no unusual vibration or noise at any normal operating frequency.	MC	
5.29	Verify no obvious audible air leaks.	MC	
5.30	Verify Refrigerant charged	MC	
5.31	Verify DX Compressor operation and staging	MC	
5.32	Verify gas heater operation		
5.33	Confirm fan is ready for the Test and Balancing (TAB) contractor. (TAB to be complete before FPT occurs.)	MC	
5.34	Certify fan is ready for Functional Performance Testing (FPT).	GC	
	Stipulate, if any outstanding item(s) preclude safe or reliable Functional Performance Testing.		
Notes			

Checklist items have been initialed by parties having direct knowledge of the event. Completion of checklist items <u>does not</u> indicate acceptance or responsibility by the FAA.

General Contractor's Signature____ Date _________

Mechanical Contractor's Signature____ Date _________

Electrical Contractor's Signature____ Date _________

Resident Engineer's Signature ____ Date _________

Exhaust Fan

Pre-Functional Verification Checklist

Jacobs
120 St. James Ave, 5th Floor
Boston, MA 02116
Tel: (508) 864-4170

FAA Warrenton Command Center (WCC) Modernization
Warrenton, VA

Task No.	Task Description	Contractor	Contractor Initial and Date
1	**Equipment Delivery and Acceptance Verifications**		
1.1	Note: Record actual Name Plate Data and confirm fan is as specified in the contract documents: Manufacturer: ____ Model Number: ____ Serial Number: ____ Volts/Phase/Hz: ____ Motor FLA: ___________Amps; Motor HP: ____________; CFM: _____________	MC	
1.2	Verify date of manufacture. (Verify by date tag or serial number. If date exceeds 16 weeks notify RE and CxA).	MC	
1.3	Verify fan is free of physical damage (dents, holes, etc.).	MC	
1.4	Verify fan is stored in a safe and dry environment.	MC	
2	**Basic Installation**		
2.1	Verify fan is installed in the proper location per contract documents.	MC	
2.2	Verify fan is securely mounted per manufacturers recommendations.	MC	
2.3	Verify vibration and sound isolation equipment is installed as per contract documents.	MC	
2.4	Verify shipping blocks and brackets, etc. have been removed.	MC	
2.5	Verify fan is level.	MC	
2.6	Verify all fasteners are tight.	MC	
2.7	Verify sufficient space clearance has been provided for the electrical power and control access points and that minimum clearances have been provided per electric code.	MC	
2.8	Verify sufficient access and clearance to and around fan for servicing. (Access is defined as sufficient space for a middle aged man of average size and health to be able to perform necessary maintenance and repairs.)	MC	
2.9	Verify the following dampers have been installed: -Isolation Damper______	MC	
2.10	Verify duct access doors have been installed at each damper location and any other locations called out in the contract documents.	MC	
2.11	Verify damper linkages are tight.	MC	
2.12	Verify end of damper shaft has a score mark indicating damper position.	MC	
2.13	Verify fan to duct flex connectors are installed tight and undamaged.	MC	
2.14	Verify access doors close tightly and gaskets are not damaged.	MC	
2.15	Verify fan is clean and free of damage, both inside and outside.	MC	
2.16	Verify permanent equipment ID label for the fan is correct and permanently affixed.	MC	
3	**Electrical**		
3.1	Verify safety disconnect switch is installed within line of sight of fan and labeled.	EC	
3.2	Verify Hand/Off/Auto switch is installed at electrical disconnect switch and permanent labels are affixed.	EC	

Exhaust Fan

Pre-Functional Verification Checklist

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FAA Warrenton Command Center (WCC) Modernization
Warrenton, VA

Task No.	Task Description	Contractor	Contractor Initial and Date
3.3	Verify properly sized and adjusted electrical motor protection with manufacturer's rating plate and record. Motor FLA Amperage ________. Protection Device (FLA _______X 125%) Amperage ________ .	EC	
3.4	Verify all electrical connections are tight and enclosed.	EC	
3.5	Verify adequate breaker or fuse size and note. ________ Amps.	EC	
3.6	Verify proper grounding installed for each component.	EC	
3.7	Verify grounding has been tested.	EC	
3.8	Verify supplied voltage and phase are the same as printed on rating label.	EC	
3.9	Switch off local disconnect switch and verify no power to fan is present.	EC	
3.10	Verify control devices are labeled.	EC	
4	**Pre Start-Up Verification**		
4.1	Verify ductwork, dampers and any other equipment that could obstruct airflow are complete.	MC	
4.2	Verify Direct Digital Control System (DDCS) controls associated with the unit are installed, functional and have been tested.	TCC	
4.3	Verify DDCS control devices and Direct Digital Control Panels (DDCP) are labeled.	TCC	
4.4	Verify fan assembly bearings and locking collars are properly tightened.	MC	
4.5	Verify fan wheel is properly aligned, tight on the shaft and freely moving.	MC	
4.6	Verify fan bearings are properly lubricated	MC	
4.7	Verify fan sheaves are properly aligned and tight on the shaft.	MC	
4.8	Verify belt tensions are correctly adjusted and record. Initial Tension Reading ft-lbs _______ (After 8 hrs run time reading ft-lbs _______), (After 16 hrs run time, Reading ft-lbs _______), (After 24 hrs run time, Reading ft-lbs _______). Note: Correct belt tension information is located on the blower housing. Belt should not squeal on start-up.	MC	
4.9	Verify motor mounting bolts and adjustable motor base bolts are tight.	MC	
4.10	Verify proper line voltage to fan and record. L - G __________	EC	
4.11	Verify and record fan motor amperage. Motor Amps: _________	EC	
4.12	Verify isolation damper is hard wire interlocked with the fan electrical disconnect switch. (Damper shall open when fan is activated in Hand or Auto. Fan shall remain off until damper is proven open through hard wire interlock with damper position switch.)	TCC	
4.13	Verify power for isolation damper hard wire interlocks is provided from the electrical disconnect switch.	TCC	
4.14	Verify proper fan rotation.	EC	
4.15	Verify no unusual vibration or noise.	EC	
4.16	Confirm fan is ready for the Test and Balancing (TAB) contractor. (TAB to be complete before FPT occurs.)	MC	
4.17	Certify fan is ready for Functional Performance Testing (FPT).	GC	
	Stipulate, if any outstanding item(s) preclude safe or reliable functional performance testing.		

Exhaust Fan

Pre-Functional Verification Checklist

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FAA Warrenton Command Center (WCC) Modernization
Warrenton, VA

Task No.	Task Description	Contractor	Contractor Initial and Date
Notes			
	Checklist items have been initialed by parties having direct knowledge of the event. Completion of checklist items do not indicate acceptance or responsibility by the FAA.		
	General Contractor's Signature______________________________ Date _________		
	Mechanical Contractor's Signature______________________________ Date _________		
	Electrical Contractor's Signature______________________________ Date _________		
	Resident Engineer's Signature ______________________________ Date _________		

Terminal Box w/ Elec Rht

Pre-Functional Verification Checklist

120 St. James Ave, 5th Floor
Boston, MA 02116
Tel: (508) 864-4170

FAA Warrenton Command Center (WCC) Modernization
Warrenton, VA

Task No.	Task Description	Contractor	Contractor Initial and Date
1	**Equipment Delivery and Acceptance Verifications**		
1.1	**Note:** Record actual Name Plate Data and confirm unit is as specified in the contract documents: Manufacturer: ____ Model Number: ___________________________; Size: ______________________ Serial Number: ____ CFM (MIN/MAX): ____ Elec. Reheat KW: ____________; Amps: _____________; Elec. Reheat Stages: ______; Heater Voltage/Phase: _____________	MC	
1.2	Verify date of manufacture. (Verify by date tag or serial number. If date exceeds 16 weeks notify RE and CxA).	MC	
1.3	Verify terminal unit is free of physical damage (dents, holes, etc.).	MC	
1.4	Verify terminal unit is stored in a safe and dry environment.	MC	
2	**Basic Installation**		
2.1	Verify terminal unit is installed in the proper location per contract documents.	MC	
2.2	Verify terminal unit is securely mounted per manufacturers recommendations.	MC	
2.3	Verify vibration and sound isolation equipment is installed as per contract documents.	MC	
2.4	Verify terminal unit does not contact other obstacles which could cause noise or vibration transmission.	MC	
2.5	Verify terminal unit is level.	MC	
2.6	Verify terminal unit has free access to the control components.	MC	
2.7	Verify sufficient space clearance has been provided for the electrical power and control access points and that minimum clearances have been provided per electric code.	MC	
2.8	Verify sufficient access and clearance to and around terminal unit for servicing. (Access is defined as sufficient space for a middle aged man of average size and health to be able to perform necessary maintenance and repairs.)	MC	
2.9	Verify that a minimum of three duct diameters of straight inlet duct, the same size as the terminal unit inlet, is installed.	MC	
2.10	Verify terminal unit to duct discharge flex connector is installed and undamaged.	MC	
2.11	Verify discharge ductwork is connected.	MC	
2.12	Verify damper linkages are tight.	MC	
2.13	Verify end of damper shaft has score mark indicating damper position.	MC	
2.14	Verify all packing material is removed from inside of the terminal unit.	MC	
2.15	Verify all penetrations through terminal unit panels and enclosure are sealed.	MC	
2.16	Verify access doors close tightly and gaskets are not damaged.	MC	
2.17	Verify terminal unit is clean and free of damage, both inside and outside.	MC	
2.18	Verify electric heating coil is installed per manufacturers recommendations.	MC	
2.19	Verify all air balancing devices are installed per contract documents.	MC	
2.20	Verify all sensor locations are appropriate and away from causes of erratic operation.	MC	

Terminal Box w/ Elec Rht

Pre-Functional Verification Checklist

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FAA Warrenton Command Center (WCC) Modernization
Warrenton, VA

Task No.	Task Description	Contractor	Contractor Initial and Date
2.21	Verify permanent equipment ID labels for the terminal unit and associated space mounted sensors are correct and permanently affixed.	MC	
3	**Electrical**		
3.1	Verify safety disconnect switch is installed and labeled for electric reheat coil.	MC	
3.2	Verify incoming electrical connections match the unit name plate data.	MC	
3.3	Verify all electrical connections are tight and enclosed.	MC	
3.4	Verify proper grounding installed for each component.	MC	
3.5	Verify proper line voltage to electric reheat coil and record voltage. L - G __________ L - L ___________	MC	
3.6	Verify adequate breaker or fuse size and note. ________ Amps.	MC	
4	**Pre Start-Up Verification**		
4.1	Verify Direct Digital Control System (DDCS) controls associated with the terminal unit are installed, functional and have been tested.	TCC	
4.2	Verify damper control will move freely between minimum and maximum control range.	TCC	
4.3	Verify DDCS control devices and Direct Digital Control Panels (DDCP) are labeled.	TCC	
4.4	Verify ductwork, diffusers, dampers and any other equipment that could obstruct airflow are complete.	MC	
4.5	Verify associated Air Handling Unit (AHU) has been started and is providing the minimum airflow required to allow operation of the terminal unit.	MC	
4.6	Verify no obvious audible air leaks.	MC	
4.7	Verify no unusual vibration or noise.	MC	
4.8	Verify proper voltage with all heater elements energized and record. L - G __________ L - L ___________	MC	
4.9	Verify proper amperage with all heater elements energized and record. Heater Amps ______	MC	
4.10	Confirm unit is ready for the Test and Balancing (TAB) contractor. (TAB to be complete before FPT occurs.)	MC	
4.11	Certify unit is ready for Functional Performance Testing (FPT).	GC	
4	**Stipulate, if any outstanding item(s) preclude safe or reliable functional performance testing.**		
Notes			

Terminal Box w/ Elec Rht

Pre-Functional Verification Checklist

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Task No.	Task Description	Contractor	Contractor Initial and Date
	Checklist items have been initialed by parties having direct knowledge of the event. Completion of checklist items do not indicate acceptance or responsibility by the FAA.		
	General Contractor's Signature____ Date _________		
	Mechanical Contractor's Signature____ Date _________		
	Electrical Contractor's Signature____ Date _________		
	Resident Engineer's Signature ____ Date _________		

Domestic Water Heater

Pre-Functional Verification Checklist

120 St. James Ave, 5th Floor
Boston, MA 02116
Tel: (508) 864-4170

FAA Warrenton Command Center (WCC) Modernization
Warrenton, VA

Task No.	Task Description	Contractor	Contractor Initial and Date
1	**Equipment Delivery and Acceptance Verifications**		
1.1	**Note:** Record actual Name Plate Data and confirm unit is as specified in the contract documents: Manufacturer: ____________________ Model Number: ____________________ Serial Number: ____________________ Volts/Phase/Hz: ____________________ Storage (gal):____________________ Recovery at 100F (GPH):____________________	PC	
1.2	All related submittals approved by A/E	PC	
1.3	Equipment thoroughly inspected for physical damage	PC	
1.4	Concrete housekeeping pad properly sized and located	PC	
1.5	Piping connections sealed and protected	PC	
1.6	Domestic Water heater delivered and stored in a clean, dry location.	PC	
1.7	Recirculation pump delivered and stored in a clean, dry location.	PC	
2	**Basic Installation**		
2.1	All quality assurance testing complete and reports submitted	PC	
2.2	O&M and warranty data provided to Cx Authority	PC	
2.3	Water heater unit installed level and plumb	PC	
2.4	Proper maintenance access provided for devices that need service	PC	
2.5	Domestic water heater power supply energized and properly identified	EC	
2.6	All shipping blocks removed	PC	
2.7	Recirculation pump installed and piped per drawing details	PC	
2.8	Relief valve outlet properly piped to floor drain.	PC	
2.9	Relief valves properly piped for safe discharge	PC	
2.10	Piping accessories installed per drawing details and specifications	PC	
2.11	Permanent labels attached	PC	
3	**Equipment Start-up**		
3.1	Cx Authority has been notified of start-up	MC	
3.2	Manufacturers Rep on site for start-up	MC	
3.3	Water heaters filled with water and compression tanks charged with air	MC	
3.4	All dust and construction debris removed.	MC	
3.5	All piping and components insulated	MC	
3.6	Control system operational, all equipment interlocks confirmed	MC	
3.7	Sequence of operations including all interlocks, safeties and alarms are functional per Basis of Design	MC	
3.8	Point-to-point verifications have been completed	MC	
3.9	Control interface with BAS completed	MC	

Domestic Water Heater
Pre-Functional Verification Checklist

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FAA Warrenton Command Center (WCC) Modernization
Warrenton, VA

Task No.	Task Description	Contractor	Contractor Initial and Date
3.10	All alarm setpoints adjusted for proper operation	MC	
3.11	O&M and warranty data provided to Cx Authority	MC	
3.12	Recirculation pump start up procedures have been completed.	MC	
3.13	Confirm domestic water heater system is ready for the Test and Balancing (TAB) contractor. (TAB to be complete before FPT occurs.)	MC	
3.14	Certify domestic water heater system is ready for Functional Performance Testing (FPT).	MC	
	Stipulate, if any outstanding item(s) preclude safe or reliable Functional Performance Testing.		
Notes			
	Checklist items have been initialed by parties having direct knowledge of the event. Completion of checklist items <u>does not</u> indicate acceptance or responsibility by the FAA.		
	General Contractor's Signature________________________ Date _________		
	Mechanical Contractor's Signature________________________ Date _________		
	Plumbing Contractor's Signature________________________ Date _________		
	Electrical Contractor's Signature________________________ Date _________		
	Resident Engineer's Signature ________________________ Date _________		

APPENDIX E

Functional Performance Tests - Samples

This appendix contains the sample Functional Performance Tests similar to the equipment anticipated to be installed.

The sample Functional Performance Tests are intended to illustrate a level of detail that is appropriate in commissioning practice and to convey the planned format. The tests include steps that are typically required, and verification inspection checks that must be carried out by the contractors, witnessed by the CxA and documented by the CxA.

The CxA will create FPTs based on final design documents and specific equipment installed according to approved submittals.

Sample FPTs:

- **Roof Top Unit**
- **Fan Coil Unit**
- **Exhaust Fan**
- **VAV Box**
- **Sump Pump**

RTU-1 - Functional Test Procedure

			FTP (by Jacobs CxA)		
Task No.	**Task Description**	**Contractor**	**Checked**	**Ok**	**Deficiency Comment #**
1	**Basic Installation Functional Verification Checklist**				
1.1	Verify start-up and pre-functional testing of Roof Top Unit RTU-1 and associated components have been completed. Record RTU commissioning start-up date: ____________	CC			
1.2	Verify the Direct Digital Control System (DDCS) is operational. This includes confirming that communications with the existing building Direct Digital Controllers (DDC) and Operator Work Station (OWS) is operational; that the DDCS has been programmed, powered up, and all sensor/end device connections have been completed; and the graphic screens have been installed on the OWS.	CC			
1.3	Verify control components (sensors, valves, and dampers etc.) are the correct series, model, type, capacity, configuration and options are as specified in submittal and contract documents.	CC			
1.4	**Confirm Sensor/End Device Functionality - Confirm points included in the control system design have been provided, are connected to the correct sensor or end device, and are reading/operating correctly. Confirm that valves stroke fully open and closed and that dampers open completely and close completely.**				
1.4.1	Supply Fan Start/Stop Command	CC			
1.4.2	Supply Fan Run Status	CC			
1.4.3	Supply Fan VFD Bypass Status	CC			
1.4.4	Supply Fan VFD Speed Command	CC			
1.4.5	Supply Fan VFD Feedback	CC			
1.4.6	Supply Fan VFD Fault Status	CC			
1.4.7	Supply Air Temperature	CC			
1.4.8	High Duct Static Pressure Alarm	CC			
1.4.9	Supply Air Damper Status	CC			
1.4.10	Humidifier Control	CC			
1.4.11	Humidifier Command	CC			
1.4.12	Humidifer Status	CC			
1.4.13	Supply Air Humidity	CC			
1.4.14	Supply Air Static Pressure	CC			
1.4.15	Crossover Damper Command	CC			
1.4.16	Crossover Damper Position	CC			
1.4.17	Return Air Temperature	CC			
1.4.18	Return Air Humidity	CC			
1.4.19	Outdoor Air Flow	CC			
1.4.20	Freezestat Alarm	CC			
1.4.21	Mixed Air Damper Control	CC			
1.4.22	Mixed Air Damper Feedback	CC			
1.4.23	Dirty Filter Alarm	CC			
1.4.24	Pre-Heat Hot Water Valve Control (N.O.)	CC			
1.4.25	Pre-Heat Hot Water Valve Feedback	CC			
1.4.26	Chilled Water Valve Control (N.C.)	CC			

RTU-1 - Functional Test Procedure

			FTP (by Jacobs CxA)		
Task No.	**Task Description**	**Contractor**	**Checked**	**Ok**	**Deficiency Comment #**
1.4.27	Chilled Water Valve Feedback	CC			
1.4.28	RTU Drain Pan Alarm	CC			
1.4.29	UPS Fault Status	CC			
1.4.30	UPS Power Status	CC			
2	**<u>Function Performance Testing - Simulate the Sequences of Operation:</u> Confirm the control functionality, described in each statement below, occurs. When a control function does not respond as described in the statement, record the deficiency.**				
2.1	**Adjust the time schedule for the RTU to place the unit in the Unoccupied Mode of operation. (Assumes that RTU is in the Occupied Mode at the beginning of testing.) Do this by changing the start of the Unoccupied time period in the schedule to 3 minutes later than the current controller time.**				
2.1.1	Does the controller transition from the Occupied Mode to the Unoccupied Mode after 3 minutes pass?	CC			
2.1.2	Does the supply fan stop?	CC			
2.1.3	Does the supply air damper close?	CC			
2.1.4	Does the outdoor air damper close?	CC			
2.1.5	Does the heating hot water valve close?	CC			
2.1.6	Does the chilled water valve close?	CC			
2.1.7	Does the humidifier disable?	CC			
2.1.8	Does the return air damper fully open?	CC			
2.1.9	Does the DDCS command the supply fan speed to zero?	CC			
2.2	**Unoccupied Heating - A representative sample of two VAV boxes associated with the RTU shall be used to test this functionality. Additional VAV boxes will be used if testing reveals there are problems with meeting the required control functionality.**				
2.2.1	**Unoccupied Heating Mode Control - Note VAVs used in this test VAV-___(initial) & VAV-__ (secondary)**				
2.2.1.1	Are the space temperature sensors for the associated VAV boxes being used to control the operation of the supply fan during unoccupied heating mode? (If not, note variation)	CC			
2.2.1.2	Note the current unoccupied mode space temperature heating setpoint: _60F+5F___________________ (Value noted in Sequence of Operations is < 60°F + 5°F)	CC			
2.2.1.3	Override the initial VAV-_____ space temperature sensor and simulate a drop in the zone's temperature below the unoccupied heating set point. Does the unit's supply air damper open?	CC			
2.2.1.4	Once the damper's end switch makes, does the unit's supply fan start?	CC			
2.2.1.5	Does the outdoor air damper remain closed?	CC			
2.2.1.6	Does the return air damper remain open?	CC			
2.2.1.7	Does VFD speed control begin to operate as required in the "Supply Fan VFD Speed Control" sequences? (Sequence to be tested as part of Occupied Control testing.)	CC			

RTU-1 - Functional Test Procedure

			FTP (by Jacobs CxA)		
Task No.	**Task Description**	**Contractor**	**Checked**	**Ok**	**Deficiency Comment #**
2.2.1.8	Does the supply air temperature set point remain fixed at 75°F? Is the supply air temperature set point reset disabled?	CC			
2.2.1.9	Does the hot water valve modulate to maintain the supply air temperature set point?	CC			
2.2.1.10	Does the chilled water valve remain closed?	CC			
2.2.1.11	Override the initial VAV space temperature sensor and simulate a rise in the zone's temperature to a value above the unoccupied heating mode enable set point but within the deadband. Does the unit continue to operate in the unoccupied heating mode?	CC			
2.2.1.12	Override the secondary VAV space temperature sensor and simulate a drop in the zone's temperature below the unoccupied heating set point. Override the initial VAV space temperature sensor and simulate a rise in the zone's temperature above the unoccupied heating mode disable set point. Does the Roof Top Unit continue to operate in the unoccupied heating mode?	CC			
2.2.1.13	Override the secondary VAV space temperature sensor and simulate a rise in the zone's temperature to a value above the unoccupied heating mode enable set point but within the deadband. Does the unit's fan remain enabled?	CC			
2.2.1.14	Does the supply air temperature set point remain fixed at 75°F? Is the supply air temperature set point reset disabled?	CC			
2.2.1.15	Does the hot water valve modulate to maintain the supply air temperature set point?	CC			
2.2.1.16	Does the chilled water valve remain closed?	CC			
2.2.1.17	Override the secondary VAV space temperature sensor and simulate a rise in the zone's temperature above the unoccupied heating mode disable set point. Does the unit's fan stop and the isolation damper closes?	CC			
2.2.1.18	Does the DDCS command the supply fan speed to zero?	CC			
2.2.1.19	Does the heating hot water valve modulate closed?	CC			
2.2.1.20	Does the chilled water valve remain closed?	CC			
2.2.1.21	Does the humidifier remain de-energized?	CC			
2.2.1.22	Does the outdoor air damper remain closed?	CC			
2.2.1.23	Does the return air damper remain open?	CC			
2.2.1.24	Place control functions and points back into automatic operation and return set points to design settings.	CC			
2.3	**Unoccupied Cooling - A representative sample of two VAV boxes associated with the RTU shall be used to test this functionality. Additional VAV boxes will be used if testing reveals there are problems with meeting the required control functionality.**				
2.3.1	**Unoccupied Cooling Mode Control - Note VAVs used in this test VAV-___ (initial) & VAV-____ (secondary)**				

RTU-1 - Functional Test Procedure

Task No.	Task Description	Contractor	FTP (by Jacobs CxA) Checked	Ok	Deficiency Comment #
2.3.1.1	Are the space temperature sensors for the associated VAV boxes being used to control the operation of the supply fan during unoccupied cooling mode? (If not, note variation)	CC			
2.3.1.2	Note the current unoccupied mode space temperature cooling setpoint: _72F - 5F___________________ (Value noted in Sequence of Operations is > 85°F - 5°F)	CC			
2.3.1.3	Override the initial VAV space temperature sensor and simulate a rise in the zone's temperature above the unoccupied cooling set point. Does the unit's supply air damper open?	CC			
2.3.1.4	Once the damper's end switch makes, does the unit's supply fan start?	CC			
2.3.1.5	Does the outdoor air damper remain closed?	CC			
2.3.1.6	Does the return air damper remain open?	CC			
2.3.1.7	Does VFD speed control begin to operate as required in the "Supply Fan VFD Speed Control" sequences? (Sequence to be tested as part of Occupied Control testing.)	CC			
2.3.1.8	Does the supply air temperature set point remain fixed at 55°F? Is the supply air temperature set point reset disabled?	CC			
2.3.1.9	Does the chilled water valve modulate to maintain the supply air temperature set point?	CC			
2.3.1.10	Does the hot water valve remain closed?	CC			
2.3.1.11	Override the initial VAV space temperature sensor and simulate a drop in the zone's temperature to a value below the unoccupied cooling mode enable set point but within the deadband. Does the unit continue to operate in the unoccupied cooling mode?	CC			
2.3.1.12	Override the secondary VAV space temperature sensor and simulate a rise in the zone's temperature above the unoccupied cooling set point. Override the initial VAV space temperature sensor and simulate a drop in the zone's temperature below the unoccupied cooling mode disable set point. Does the Roof Top Unit continue to operate in the unoccupied cooling mode?	CC			
2.3.1.13	Override the secondary VAV space temperature sensor and simulate a drop in the zone's temperature to a value below the unoccupied cooling mode enable set point but within the deadband. Does the unit continue to operate in the unoccupied cooling mode?	CC			
2.3.1.14	Does the supply air temperature set point remain fixed at 55°F? Is the supply air temperature set point reset disabled?	CC			
2.3.1.15	Does the chilled water valve modulate to maintain the supply air temperature set point?	CC			
2.3.1.16	Does the hot water valve remain closed?	CC			
2.3.1.17	Override the secondary VAV space temperature sensor and simulate a drop in the zone's temperature below the unoccupied cooling mode disable set point. Does the unit's fan stop and the isolation damper closes?	CC			

RTU-1 - Functional Test Procedure

			FTP (by Jacobs CxA)		
Task No.	**Task Description**	**Contractor**	**Checked**	**Ok**	**Deficiency Comment #**
2.3.1.18	Does the DDCS command the supply fan speed to zero?	CC			
2.3.1.19	Does the heating hot water valve remain closed?	CC			
2.3.1.20	Does the chilled water valve modulate closed?	CC			
2.3.1.21	Does the humidifier remain de-energized?	CC			
2.3.1.22	Does the outdoor air damper remain closed?	CC			
2.3.1.23	Does the return air damper remain open?	CC			
2.3.1.24	Place control functions and points back into automatic operation and return set points to design settings.	CC			
2.4	**Morning Warm Up Control - Adjust the time schedule for RTU so that the occupied start time is 20 minutes later than the current time in the controller.**				
2.4.1	Are the space temperature sensors (average) for the associated VAV boxes being used to control the operation of the supply fan during morning warm up mode? (If not, note variation)	CC			
2.4.2	Note the current morning warm up mode enable space temperature setpoint: ____________________ (Value noted in Sequence of Operations is 72°F)	CC			
2.4.3	Simulate average space temperature below the morning warm up mode enable set point. Adjust the time schedule for the RTU so that the occupied start time is 20 minutes later than the current time in the controller. Does the unit's supply air damper open?	CC			
2.4.4	Once the damper's end switch makes, does the unit's supply fan start?	CC			
2.4.5	Does the outdoor air damper remain closed?	CC			
2.4.6	Does the return air damper remain open?	CC			
2.4.7	Does VFD speed control begin to operate as required in the "Supply Fan VFD Speed Control" sequences? (Sequence to be tested as part of Occupied Control testing.)	CC			
2.4.8	Does the supply air temperature set point remain fixed at 75°F? Is the supply air temperature set point reset disabled?	CC			
2.4.9	Does the pre-heat hot water valve modulate to maintain the supply air temperature set point?	CC			
2.4.10	Does the chilled water valve remain closed?	CC			
2.4.11	Simulate average space temperature that rises above the occupancy setpoint, does the Roof Top Unit exit Optimal Start Mode and enter the Occupied Mode of operation before the occupancy time clock enables occupied mode?	CC			
2.4.12	Place all control functions and points back into automatic operation and return set points to design settings. Change the time schedule to make the current time fall inside the Unoccupied Mode of Operation.	CC			
2.5	**Morning Cool Down Control**				
2.5.1	Are the space temperature sensors (average) for the associated VAV boxes being used to control the operation of the supply fan during morning cool down mode? (If not, note variation)	CC			

RTU-1 - Functional Test Procedure

			FTP (by Jacobs CxA)		
Task No.	**Task Description**	**Contractor**	**Checked**	**Ok**	**Deficiency Comment #**
2.5.2	Note the current morning cool down mode enable space temperature setpoint: __________ (Value noted in Sequence of Operations is > 72°F)	CC			
2.5.3	Simulate average space temperature above the morning cool down mode enable set point. Adjust the time schedule for the RTU so that the occupied start time is 20 minutes later than the current time in the controller. Does the unit's supply air damper open?	CC			
2.5.4	Once the damper's end switch makes, does the unit's supply fan start?	CC			
2.5.5	Does the outdoor air damper remain closed?	CC			
2.5.6	Does the return air damper remain open?	CC			
2.5.7	Does VFD speed control begin to operate as required in the "Supply Fan VFD Speed Control" sequences? (Sequence to be tested as part of Occupied Control testing.)	CC			
2.5.8	Does the supply air temperature set point remain fixed at 55°F? Is the supply air temperature set point reset disabled?	CC			
2.5.9	Does the chilled water valve modulate to maintain the supply air temperature set point?	CC			
2.5.10	Does the heating hot water valve remain closed?	CC			
2.5.11	Simulate average space temperature that drops below the occupancy enable setpoint, does the Roof Top Unit exit Cool-Down Mode and enter the Occupied Mode of operation before the occupancy time clock enables occupied mode?	CC			
2.5.12	Place all control functions and points back into automatic operation and return set points to design settings.	CC			
2.6	**Adjust the time schedule for the RTU to place the unit in the Occupied mode of operation.**				
2.6.1	Does the controller transition from the Unoccupied Mode to the Occupied Mode?	CC			
2.6.2	Does the supply air damper modulate open?	CC			
2.6.3	Once the damper endswitch proves, does the supply fan start?	CC			
2.6.4	Does the DDCS begin to operate the unit according to the Occupied Mode control sequences?	CC			
2.7	**Minimum Outdoor Air Control**				
2.7.1	Override the minimum outdoor air flow set point and input a value greater than the current air flow setting. Does the minimum outdoor air damper modulate towards the open position?	CC			
2.7.2	Does the return air damper remain in previous position?	CC			
2.7.3	Does the air flow measured at the minimum outdoor air flow measuring station increase and stabilize at the minimum outdoor air flow set point?	CC			
2.7.4	Override the minimum outdoor air flow set point higher than previous revision. Does the minimum outdoor air damper modulate to 100% open?	CC			

RTU-1 - Functional Test Procedure

			FTP (by Jacobs CxA)		
Task No.	**Task Description**	**Contractor**	**Checked**	**Ok**	**Deficiency Comment #**
2.7.5	Once outdoor air damper is at 100% open and airflow remains below set point, does the return air damper begin to modulate closed, subject to a minimum damper position?	CC			
2.7.6	Override the minimum outdoor air flow set point and input a value lower than the current air flow setting. Does the return air damper modulate toward 100% open?	CC			
2.7.7	Once return air is 100% open and airflow is greater than set point, does the outdoor air damper begin to modulate closed?	CC			
2.7.8	Does the air flow measured at the minimum outdoor air flow measuring station decrease and stabilize at the minimum outdoor air flow set point?	CC			
2.7.9	Place all control functions and points back into automatic operation. Do the minimum outdoor air damper and return air damper modulate to maintain the minimum air flow set point calculated by the DDCS?	CC			
2.8	**Supply Air Static Pressure Set Point Control**				
2.8.1	Confirm linear reset of static pressure limits based upon box damper position. Design is 0.25" - 1.5"; VAV threshold of 95%. Note limits (SP range and damper position threshold: 0.5"-1.5" 95%	CC			
2.8.2	Under current conditions, note current active static pressure set point and number of VAVs with dampers > 95%:	CC			
2.8.3	Take more than 2 VAVs and override damper position > 95%. Note which VAVs:	CC			
2.8.4	Does the active static pressure increase?	CC			
2.8.5	Does the supply fan speed increase to meet the revised set point?	CC			
2.8.6	Does the supply fan speed stabilize?	CC			
2.8.7	Release one VAV. (Note which VAV:) Once box damper <95%, does the active static pressure decrease?	CC			
2.8.8	Does the supply fan speed decrease to meet the revised set point?	CC			
2.8.9	Does the supply fan speed stabilize?	CC			
2.8.10	Override all VAV dampers below 95%. Note which VAVs effected if need be:	CC			
2.8.11	Does the active static pressure decrease to minimum value?	CC			
2.8.12	Does the supply fan speed decrease to meet the revised set point?	CC			
2.8.13	Does the supply fan speed stabilize?	CC			
2.8.14	Override all VAV dampers above 95%. Note which VAVs effected if need be:	CC			
2.8.15	Does the active static pressure increase to maximum?	CC			
2.8.16	Does the supply fan speed increase to meet the revised set point?	CC			
2.8.17	Does the supply fan speed stabilize? Note speed:	CC			
2.8.18	Place all control functions and points back into automatic operation and return set points to design settings. Do the VAV boxes and the unit return to normal operation?	CC			

RTU-1 - Functional Test Procedure

			FTP (by Jacobs CxA)		
Task No.	**Task Description**	**Contractor**	**Checked**	**Ok**	**Deficiency Comment #**
2.9	**Supply Air Temperature Set Point Reset Control**				
2.9.1	Confirm reset of DAT based upon highest cooling demand. Design is +25 to +75; DAT 60F-53F Note limits:	CC			
2.9.2	Under current conditions, note current active DAT set point and max cooling load:	CC			
2.9.3	Override maximum cooling load to be +50. Does the DAT temperature set point reset to the middle of the range	CC			
2.9.4	Does the chilled water valve modulate with (but independent of) hot water valve to maintain the new set point?	CC			
2.9.5	Does the unit stabilize at the new revised set point?	CC			
2.9.6	Override maximum cooling load to be at minimum (+25). Does the DAT temperature set point reset to the maximum of the range?	CC			
2.9.7	Does the chilled water valve modulate closed?	CC			
2.9.8	Does the pre-heat hot water valve start to modulate open once the chilled water valve is completely closed (not before)?	CC			
2.9.9	Does the unit stabilize at the new revised set point?	CC			
2.9.10	Override maximum cooling load to be at maximum (+75 design). Does the DAT temperature set point reset to the minimum of the range?	CC			
2.9.11	Does the pre-heat hot water valve modulate closed?	CC			
2.9.12	Does the chilled water valve start to modulate open once the chilled water valve is completely closed (not before)?	CC			
2.9.13	Does the unit stabilize at the new revised set point?	CC			
2.9.14	Place all control functions and points back into automatic operation and return set points to design settings. Do the VAV boxes and the unit return to normal operation?	CC			
2.10	**Humidifier Control**				
2.10.1	Is the return air relative humidity set point being used to control the humidifier? (If not, note variation)	CC			
2.10.2	Note the humidity set point: _______________ (Value noted in Sequence of Operations: 40% RH)	CC			
2.10.3	Is the supply air relative humidity sensor being used as a humidity high limit control? (If not, note variation)	CC			
2.10.4	Note the supply air humidity high limit set point: _______________ (Value noted in Sequence of Operations: 85% RH)	CC			
2.10.5	Override humidity levels below set point. Does the humidifier activate and increase the humidity output to maintain the set point?	CC			
2.10.6	Override the supply air humidity high limit set point below the current supply air humidity level. Does the humidifier deactivate?	CC			
2.10.7	Release override of supply air humidity. Confirm humidifer returns to operation.	CC			

RTU-1 - Functional Test Procedure

			FTP (by Jacobs CxA)		
Task No.	**Task Description**	**Contractor**	**Checked**	**Ok**	**Deficiency Comment #**
2.10.8	Adjust the return air humidity set point to a value lower than the return air humidity level. Does the humidifier decrease the humidity output to maintain the set point?	CC			
2.10.9	Release all overrides. Does the unit return to normal operation?	CC			
2.11	**Bypass Control**				
2.11.1	With the unit operating in normal occupied mode, override the unit into bypass mode	CC			
2.11.2	Does the supply fan operate at full speed?	CC			
2.11.3	Are all of the associated VAV boxes dampers commanded to 100%?	CC			
2.11.4	Release the bypass override. Does the unit return to normal operation?	CC			
2.11.5	Do the associated VAV boxes' damper positions reset to the normal values?	CC			
2.12	**Freezestat Alarm**				
2.12.1	Manually trip the Freezestat, does an alarm generate at the DDCS?	CC			
2.12.2	Does the supply fan stop?	CC			
2.12.3	Does the outdoor air damper fully close?	CC			
2.12.4	Does the return air damper fully open?	CC			
2.12.5	Does the chilled water control valve open fully?	CC			
2.12.6	Does the heating hot water control valve open fully?	CC			
2.12.7	Place the Supply Fan Hand-Off-Auto selector in the "Hand" position. Does the fan remain off?	CC			
2.12.8	Place the Supply Fan Normal/Bypass selector switch in the "Bypass" position. Does the fan remain off?	CC			
2.12.9	Place the Supply Fan Hand-Off-Auto selector back in the "Auto" position. Does the fan remain off?	CC			
2.12.10	Place the Supply Fan Normal/Bypass selector switch back in the "Normal" position. Does the fan remain off?	CC			
2.12.11	Reset the freezestat. Does the unit restart and return to normal operation?	CC			
2.13	**Duct High Static Pressure Alarm**				
2.13.1	Manually trip the High Static Pressure Switch, does an alarm generate at the DDCS?	CC			
2.13.2	Does the supply fan stop?	CC			
2.13.3	Does the supply air damper fully close?	CC			
2.13.4	Place the Supply Fan Hand-Off-Auto selector in the "Hand" position. Does the fan remain off?	CC			
2.13.5	Place the Supply Fan Normal/Bypass selector switch in the "Bypass" position. Does the fan remain off?	CC			
2.13.6	Place the Supply Fan Hand-Off-Auto selector back in the "Auto" position. Does the fan remain off?	CC			
2.13.7	Place the Supply Fan Normal/Bypass selector switch back in the "Normal" position. Does the fan remain off?	CC			

RTU-1 - Functional Test Procedure

Task No.	Task Description	Contractor	FTP (by Jacobs CxA) Checked	Ok	Deficiency Comment #
2.13.8	Reset the High Static Pressure Switch. Does the unit restart and return to normal operation?	CC			
2.14	**Filter Monitoring**				
2.14.1	Increase the differential pressure across the differential pressure switch above the set point for the filter. Does the DDCS registers a maintenance alarm?	CC			
2.14.2	Decrease the differential pressure across the differential pressure below the set point for the filter. Does the DDCS filter maintenance alarm return to normal?	CC			
2.15	**RTU Drain Pan Alarm**				
2.15.1	Simulate an alarm condition in the drain pan associated with the RTU. Does an alarm register at the DDCS?	CC			
2.15.2	Does the supply fan stop?	CC			
2.15.3	Does the supply air damper fully close?	CC			
2.15.4	Place the Supply Fan Hand-Off-Auto selector in the "Hand" position. Does the fan remain off?	CC			
2.15.5	Place the Supply Fan Normal/Bypass selector switch in the "Bypass" position. Does the fan remain off?	CC			
2.15.6	Place the Supply Fan Hand-Off-Auto selector back in the "Auto" position. Does the fan remain off?	CC			
2.15.7	Place the Supply Fan Normal/Bypass selector switch back in the "Normal" position. Does the fan remain off?	CC			
2.15.8	Reset the High Static Pressure Switch. Does the unit restart and return to normal operation?	CC			
2.16	**Fire Alarm System/Duct Smoke Shutdown - To be tested if applicable (If devices are hardwired to starter then N/A)**				
2.14.1	With the unit on, smoke test the supply air duct smoke detector. Does the supply fan stop?	CC			
2.14.2	Does the supply air damper close fully?	CC			
2.14.3	Does the return air damper open fully?	CC			
2.14.4	Does the outside air damper close fully?	CC			
2.14.5	Does the supply air damper close fully?	CC			
2.14.6	Does the humidifier disable?	CC			
2.14.7	Does the pre-heat hot water valve close?	CC			
2.14.8	Does the chilled water valve close?	CC			
2.14.9	Does the crossover damper remain closed?	CC			
2.14.10	Place the Supply Fan Hand-Off-Auto selector in the "Hand" position. Does the fan remain off?	CC			
2.14.11	Place the Supply Fan Normal/Bypass selector switch in the "Bypass" position. Does the fan remain off?	CC			
2.14.12	Place the Supply Fan Hand-Off-Auto selector back in the "Auto" position. Does the fan remain off?	CC			

RTU-1 - Functional Test Procedure

Task No.	Task Description	Contractor	FTP (by Jacobs CxA) Checked	Ok	Deficiency Comment #
2.14.13	Place the Supply Fan Normal/Bypass selector switch back in the "Normal" position. Does the fan remain off?	CC			
2.14.14	Reset the supply air duct smoke detector/fire alarm system and restart the Roof Top Unit.	CC			
2.15	**Power Failure Fan Restart**				
2.15.1	While operating in the "Auto" mode of operation, manually turn off power to the Roof Top Unit using the disconnect switch at the supply fan VFD. Does the unit stop?	CC			
2.15.2	Does the supply air damper close?	CC			
2.15.3	Does the heating hot water valve close?	CC			
2.15.4	Does the chilled water valve close?	CC			
2.15.5	Does the return air damper fully open?	CC			
2.15.6	Does the outdoor air damper fully close?	CC			
2.15.7	Does the humidifier deactivate?	CC			
2.15.8	After 60 seconds pass, does the control system register that the supply fan status does not match the command and generate an alarm? Does the DDCS cancel the start command?	CC			
2.15.9	Does crossover damper open?	CC			
2.15.10	When the crossover damper is fully open, does the speed of the operating RTU fan VFD slowly ramp up to a speed which maintains the calculated average duct static pressure at set point?	CC			
2.15.11	Override the average static pressure calculation and input a value less than the current supply air static pressure. Does the speed of the operating RTU supply fan increase?	CC			
2.15.12	Override the average static pressure calculation and input a value greater than the current supply air static pressure. Does the speed of the operating RTU supply fan decrease?	CC			
2.15.13	Release override of average static pressure calculation. Does the speed of the operating RTU supply fan stabilize and maintain a constant supply air static pressure?	CC			
2.15.14	Reset the start command in the DDCS and use the disconnect switch at the supply fan VFD to turn power back on for the failed RTU. Does the unit restart after a time delay has elapsed?	CC			
2.15.15	Once both units are operational, does crossover damper close?	CC			
2.15.16	Do units return to maintain their own static pressure?	CC			
2.15.17	Do automatic control functions return to normal?	CC			
3	**Failure Condition Testing - Simulates loss of control signal from the unit's controller and loss of power to the controller.**				
3.1	**With the RTU operating, simulate a loss of communication to the devices.**				
3.1.1	Does the loss of communication alarm register at the DDCS?	CC			
3.1.2	Does the unit continue to operate according to the last commanded state?	CC			

RTU-1 - Functional Test Procedure

			FTP (by Jacobs CxA)		
Task No.	**Task Description**	**Contractor**	**Checked**	**Ok**	**Deficiency Comment #**
3.1.3	Restore communications and confirm the alarm is cleared at DDCS.	CC			
3.1.4	Unit resumes normal operation at DDCS.	CC			
3.2	**With the RTU operating in the occupied mode, turn off power to the unit's controller from the associated electrical panel.**				
3.2.1	Did the supply fan stop?	CC			
3.2.2	Does the loss of communication alarm register at the DDCS?	CC			
3.2.3	Does the supply air damper close?	CC			
3.2.4	Did the heating hot water valve fail to the open position?	CC			
3.2.5	Did the chilled water valve fail to the open position?	CC			
3.2.6	Did the return air damper fail to the open position?	CC			
3.2.7	Did the outdoor air damper fail to the closed position?	CC			
3.2.8	Did the humidifier fail off?	CC			
3.3	**At the supply fan, switch the fan HOA to "Hand".**				
3.3.1	Does the supply air damper open?	CC			
3.3.2	Once the damper's end switch makes, does the unit's supply fan start?	CC			
3.3.3	Did the unit's dampers and valves remain in their failure positions?	CC			
3.4	**At the supply fan, switch the fan HOA to "Off".**				
3.4.1	Did the supply fan stop?	CC			
3.4.2	Does the supply air damper close?	CC			
3.4.3	Did the unit's dampers and valves remain in their failure positions?	CC			
3.5	**At the supply fan place the bypass switch in the "Bypass" position.**				
3.5.1	Does the supply air damper open?	CC			
3.5.2	Once the damper's end switch makes, does the unit's supply fan start?	CC			
3.5.3	Does the fan run at full speed?	CC			
3.5.4	Did the unit's dampers and valves remain in their failure positions?	CC			
3.6	**At the supply fan place the bypass switch in the "Normal" position.**				
3.6.1	Did the supply fan stop?	CC			
3.6.2	Does the supply damper close?	CC			
3.6.3	Did the unit's dampers and valves remain in their failure positions?	CC			

RTU-1 - Functional Test Procedure

			FTP (by Jacobs CxA)		
Task No.	**Task Description**	**Contractor**	**Checked**	**Ok**	**Deficiency Comment #**
3.7	**With the supply fan off, restore power to the unit's controller.**				
3.7.1	At the supply fan, switch the fan HOA to "Auto".				
3.7.2	Confirm that the controller restarts RTU and that automatic control functions return to normal.	CC			
	Functional Testing plan has been signed by parties having direct knowledge of the event. Successful completion of these procedures does NOT yield the acceptance of the equipment by the FAA				
	Temperature Controls Contractor - Signature and Date:				
	Commissioning Agent - Signature and Date:				
	Resident Engineer - Signature and Date:				
Deficiency Record					
1					
2					
3					
4					
5					

2 Pipe Fan Coil Unit FCU-_____
Functional Test Procedure

			FTP (by Jacobs CxA)		
Task No.	**Task Description**	**Contractor**	**Checked**	**Ok**	**Deficiency Comment #**
1	**Basic Installation Functional Verification Checklist**				
1.1	Verify start-up and pre-functional testing of Fan Coil Unit FCU-____ and associated components have been completed. FCU serves Room _____. Record FCU commissioning start-up date. ___________	CC			
1.2	Verify programmable thermostat is operational. This includes confirming that the programmable thermostat has been programmed, stat is powered up, and all end device connections have been completed.	CC			
1.3	Verify control components (programmable thermostat) are the correct series, model, type, configuration and options are as specified in submittal and contract documents.	CC			
1.4	**Confirmation of Control Component Functionality - Confirm thermostat included in the control system design has been provided, is correctly installed and is reading/operating correctly. Confirm that valve strokes fully open and closed. (NOTE: In some locations the average temperature from multiple thermostats is used to control the FCUs in the room. Make note in testing docs if the average temperature is used.)**				
1.4.1	Fan Command	CC			
1.4.2	Valve Open Command	CC			
1.4.3	Valve Closed Command	CC			
1.4.4	AquaStat	CC			
1.4.5	Space Temperature	CC			
2	**Functional Performance Testing - Simulate the Sequences of Operation:** **Confirm the control functionality, described in each statement below, occurs. When a control function does not respond as described in the statement, record the deficiency.**				
2.1	**Occupied Cooling Mode - Set time schedule so that the FCU is currently in Occupied mode.**				
2.1.1	Is cooling mode determined by the aquastat associated with the FCU? (If not, note variation)	CC			
2.1.2	Simulate chilled water at the aquastat. Does the unit enter cooling mode?	CC			
2.1.3	Is the cooling space temperature setpoint being used to control the DT water valve? (If not, note variation)	CC			
2.1.4	Note the current cooling space temperature setpoint: __________ (Value noted in sequence of operations is 75°F)	CC			
2.1.5	Override the current space temperature 3°F above the cooling space temperature setpoint. Does the fan energize and DT water valve modulate open to maintain the room temperature setpoint?	CC			
2.1.6	Override the current space temperature 6°F above the cooling space temperature setpoint. Does the DT water valve modulate fully open?	CC			
2.1.7	Override the current space temperature 1°F below the cooling space temperature setpoint. Does the DT water valve modulate fully closed to maintain the room temperature setpoint, does the fan continue to run?	CC			

2 Pipe Fan Coil Unit FCU-_____
Functional Test Procedure

			FTP (by Jacobs CxA)		
Task No.	**Task Description**	**Contractor**	**Checked**	**Ok**	**Deficiency Comment #**
2.1.8	Override the current space temperature 3°F below the cooling space temperature setpoint. Does the fan de-energize?	CC			
2.1.9	Release all overrides. Confirm the DT water valve returns to normal operation.	CC			
2.2	**Occupied Heating Mode**				
2.2.1	Is heating mode determined by the aquastat associated with the FCU? (If not, note variation)	CC			
2.2.2	Simulate heating hot water at the aquastat. Does the unit enter heating mode?	CC			
2.2.3	Is the heating space temperature setpoint being used to control the DT water valve? (If not, note variation)	CC			
2.2.4	Note the current heating space temperature setpoint: __________ (Value noted in sequence of operations is 70°F)	CC			
2.2.5	Override the current space temperature 3°F below the heating space temperature setpoint. Does the fan energize and DT water valve modulate open to meet the room temperature setpoint?	CC			
2.2.6	Override the current space temperature 6°F below the heating space temperature setpoint. Does the DT water valve fully open?	CC			
2.2.7	Override the current space temperature 1°F above the heating space temperature setpoint. Does the DT water valve modulate fully closed and the fan continue to run?	CC			
2.2.8	Override the current space temperature 3°F above the heating space temperature setpoint. Does the fan de-energize?	CC			
2.2.9	Release all overrides. Confirm the DT water valve returns to normal operation.	CC			
2.3	**Local Control**				
2.3.1	With the FCU operating in automatic control, increase the local temperature set point 4 degrees.	CC			
2.3.2	Does the DDCS register the change in temperature set point?	CC			
2.3.3	Does FCU begin to maintain the new room temperature set point?	CC			
2.3.4	Decrease the local temperature set point 4 degrees.	CC			
2.3.5	Does the DDCS register the change in temperature set point?	CC			
2.3.6	Does FCU begin to maintain the new room temperature set point?	CC			
2.3.7	Is the 5 degree deadband from heating to cooling maintained during the manual change of temperature set point?	CC			
2.3.8	Return the FCU fan speed to auto.	CC			
3	**Failure Condition Testing - Simulates loss of control signal and loss of power from the associated control panel.**				
3.1	**With the fan coil unit operating in the occupied mode, disconnect communications to the associated panel.**				
3.1.1	Does the loss of communication alarm register at the DDCS?	CC			

2 Pipe Fan Coil Unit FCU-_____
Functional Test Procedure

Task No.	Task Description	Contractor	FTP (by Jacobs CxA) Checked	Ok	Deficiency Comment #
3.1.2	Does the unit continue to operate according to the last commanded state?	CC			
3.1.3	Restore communications and confirm the alarm is cleared at DDCS.	CC			
3.1.4	Unit resumes normal operation at DDCS.	CC			
3.2	**With the fan coil unit operating in the occupied mode, disconnect power to the associated panel.**				
3.2.1	Does a Loss of Communication Alarm register at DDCS for panel?	CC			
3.2.2	Does the fan stop?	CC			
3.2.3	Does the DT water valve go to its failure position?	CC			
3.3	**Reconnect power to the associated panel.**				
3.3.1	Confirm that the fan coil unit restarts and the associated panel resumes control functions.	CC			
	Functional Testing plan has been signed by parties having direct knowledge of the event. Successful completion of these procedures does NOT yield the acceptance of the equipment by the FAA				
	Temperature Controls Contractor - Signature and Date:				
	Commissioning Agent - Signature and Date:				
	Resident Engineer - Signature and Date:				
	Deficiency Record				
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EF-202 - Functional Test Procedure

Task No.	Task Description	Contractor	FTP (By Jacobs CxA)		
			Checked	**Ok**	**Deficiency Comment #**
1	**Basic Installation Functional Verification Checklist**				
1.1	Verify start-up and pre-functional testing of Exhaust Fan EF-202 and associated components have been completed. Record exhaust fan commissioning date:	CC			
1.2	Verify the Direct Digital Control System (DDCS) is operational. This includes confirming that communications with the existing building Direct Digital Controllers (DDC) and Front End Personal Computers (FEPC) is	CC			
1.3	Verify control components (sensors, valves, etc.) are the correct series, model, type, capacity, configuration and options are as specified in submittal and contract documents.	CC			
1.4	**Confirm Sensor/End Device Functionality - Confirm points included in the control system design have been provided, are connected to the correct sensor or end device, and are reading/operating correctly.**				
1.4.1	Exhaust Fan Start/Stop	CC			
1.4.2	Exhaust Fan Status	CC			
1.4.3	Mechanical Room Temperature	CC			
1.4.4	Exhaust Fan Isolation Damper Command	CC			
2	**Function Performance Testing - Simulate the Sequences of Operation: Confirm the control functionality, described in each statement below, occurs. When a control function does not respond as described in the statement, record the deficiency.**				
2.1	**Normal Operation - Confirm that the HOA switch is in the AUTO position.**				
2.1.1	Verify the EF runs based on the room temperature (note any variance) and record the current space temperature setpoint: ___________(design calls for 85°F)	CC			
2.1.2	Decrease the space temperature setpoint below the current space temperature. Do the outdoor intake and isolation damper open?	CC			
2.1.3	Does the exhaust fan start only after the isolation damper end switch has proven open?	CC			
2.1.4	Adjust the space temperature setpoint 3 degrees above the current space temperature. Does the fan continue to run and the dampers remain open?	CC			
2.1.4	Adjust the space temperature setpoint 5 degrees above the current space temperature. Does the fan de-energize?	CC			
2.1.5	Do the outdoor intake and isolation damper close?	CC			
2.1.6	Release the override to the space temperature setpoint. Does the fan resume normal operation?	CC			
2.2	**Power Failure Restart**				
2.2.1	While operating in the "Auto", manually turn off power to the exhaust fan using the disconnect switch at the fan electrical disconnect. Does the fan stop?	CC			
2.2.2	Do the intake and isolation damper close?	CC			
2.2.3	After 60 seconds pass, does the control system register that the exhaust fan status does not match the command and generate an alarm?	CC			

EF-202 - Functional Test Procedure

			FTP (By Jacobs CxA)		
Task No.	**Task Description**	**Contractor**	**Checked**	**Ok**	**Deficiency Comment #**
2.2.4	Use the disconnect switch at the exhaust fan electrical disconnect to turn power back on for the fan. Do the intake and isolation damper open?	CC			
2.2.5	Does the exhaust fan start only after the isolation damper end switch has proven open?	CC			
2.2.6	Do automatic control functions return to normal?	CC			
3	**<u>Failure Condition Testing</u> - Simulates loss of control signal from the exhaust fan's controller and loss of power to the controller.**				
3.1	**With the exhaust fan operating, simulate a loss of communication to the device.**				
3.1.1	Does the loss of communication alarm register at the DDCS?	CC			
3.1.2	Does the unit continue to operate according to the last commanded state?	CC			
3.1.3	Restore communications and confirm the alarm is cleared at DDCS.	CC			
3.1.4	Unit resumes normal operation at DDCS.	CC			
3.2	**With the exhaust fan operating, turn off power to the exhaust fan's controller from the associated electrical panel.**				
3.2.1	Does the exhaust fan stop?	CC			
3.2.2	Do the intake and isolation damper close?	CC			
3.2.3	Does the loss of communication alarm register at the DDCS?	CC			
3.3	**At the exhaust fan disconnect, switch the fan HOA to "Hand".**				
3.3.1	Does the isolation damper open?	CC			
3.3.2	Does the intake damper open?	CC			
3.3.3	Does the exhaust fan start only after the isolation damper end switch has proven open?	CC			
3.4	**At the exhaust fan disconnect switch the fan HOA to "Off".**				
3.4.1	Did the exhaust fan stop?	CC			
3.4.2	Does the isolation damper close?	CC			
3.4.3	Does the intake damper close?	CC			
3.5	**With the exhaust fan off, restore power to the DDCP.**				
3.5.1	At the electrical disconnect, switch the fan HOA to the "Auto" position.	CC			
3.5.2	Does the DDCS restart the exhaust fan and resume normal operation?	CC			
	Functional Testing plan has been signed by parties having direct knowledge of the event. Successful completion of these procedures does NOT yield the acceptance of the equipment by the FAA				
	Temperature Controls Contractor - Signature and Date:				
	Commissioning Agent - Signature and Date:				
	Resident Engineer - Signature and Date:				
Deficiency Record					
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VAV Terminal Boxes w/EH Re-Heat
Functional Test Procedure

			FTP (By Jacobs CxA)		
Task No.	**Task Description**	**Contractor**	**Checked**	**Ok**	**Deficiency Comment #**
1	**Basic Installation Functional Verification Checklist**				
1.1	Verify start-up and pre-functional testing of VAV Box VAV-_____ and associated components have been completed. Record VAV Box start-up date: ______________	CC			
1.2	Verify the Direct Digital Control System (DDCS) is operational. This includes confirming that communications with the existing building Direct Digital Controllers (DDC) and Front End Personal Computers (FEPC) is operational; that the DDCS has been programmed, powered up, and all sensor/end device connections have been completed; and the graphic screens have been installed on the FEPCs.	CC			
1.3	Verify control components (sensors, valves, and dampers etc.) are the correct series, model, type, capacity, configuration and options are as specified in submittal and contract documents.	CC			
1.4	**Confirm Sensor/End Device Functionality - Confirm points included in the control system design have been provided, are connected to the correct sensor or end device, and are reading/operating correctly. Confirm that valves stroke fully open and closed and that dampers open completely and close completely.**				
1.4.1	Space Temperature	CC			
1.4.2	Air Flow	CC			
1.4.3	Damper Position	CC			
1.4.4	Electric Re-Heat Command	CC			
1.4.5	Supply Air Temperature	CC			
2	**Function Performance Testing - Simulate the Sequences of Operation: Confirm the functionality, described in each statement below, occurs. When a function does not respond as described in the statement, record the deficiency.**				
2.1	**Unoccupied Control - Through the DDCS, stop the associated air handling unit by placing it in the Unoccupied Mode of operation. (Assumes that the air handling unit is operating at the beginning of testing.)**				
2.1.1	Once the AHU's supply fan status point indicates that the unit is off, Does the VAV Box electric heat de-energize?	CC			
2.1.2	Simulate a fall in space temperature below 60°F. Does the associated AHU start?	CC			
2.1.3	Does the VAV box damper modulate to maintain the scheduled heating air flow?	CC			
2.1.4	Does the electric heating energize to maintain unoccupied set point?	CC			
2.1.5	Simulate a rise in space temperature to 64°F. Does the electric heating continue to maintain the unoccupied heating set point (65°F)?	CC			
2.1.6	Does the VAV box damper continue to maintain the scheduled heating air flow?	CC			
2.1.7	Simulate a rise in space temperature above 65°F. Does the associated AHU stop?	CC			
2.1.8	Does the electric heating de-energize?	CC			

VAV Terminal Boxes w/EH Re-Heat
Functional Test Procedure

			FTP (By Jacobs CxA)		
Task No.	**Task Description**	**Contractor**	**Checked**	**Ok**	**Deficiency Comment #**
2.1.9	Simulate a rise in space temperature above 85°F. Does the associated AHU start?	CC			
2.1.10	Does the VAV box damper modulate to maintain the scheduled maximum air flow?	CC			
2.1.11	Does the electric heating remain de-energized?	CC			
2.1.12	Simulate a fall in space temperature to 81°F. Does the VAV box damper begin to modulate closed to maintain the unoccupied cooling set point (80°F)?	CC			
2.1.13	Does the electric heating remain de-energized?	CC			
2.1.14	Simulate a fall in space temperature below 80°F. Does the associated AHU stop?	CC			
2.1.15	Does the electric heating remain de-energized?	CC			
2.1.16	Return the VAV Box space temperature sensor to automatic control. Does the VAV box return to normal operation?	CC			
2.2	**Manual Damper Override**				
2.2.1	With the associated AHU off in unoccupied mode, command all the VAV dampers full open through the on screen graphic button.	CC			
2.2.1	Is there a written caution beside the button for the damper overide?	CC			
2.2.1	Do all the VAV dampers fully open?	CC			
2.2.1	Command all the VAV dampers fully closed through the on screen graphic button.	CC			
2.2.1	Is there a written caution beside the button for the damper overide?	CC			
2.2.1	Do all the VAV dampers fully close?	CC			
2.2.1	Release all overrides, does the AHU remain off and dampers go back to normal unoccupied operation?	CC			
2.3	**Through the DDCS, start the associated air handling unit by placing it in the Occupied Mode of operation.**				
2.3.1	Once the AHU's supply fan status point indicates that the unit is on, does the VAV box controller begin to modulate the VAV box damper, and the electric heating to maintain the space temperature at the occupied set points?	CC			
2.4	**VAV Box Space Temperature Control (Cooling Set Point 74°F; Heating Set Point 72°F)**				
2.4.1	Override the space temperature sensor and input a value of 78°F. Does the VAV box damper modulate open to the maximum air flow position? Record monitored air flow and compare to scheduled maximum air flow. Scheduled Air Flow: _______CFM; Actual Air Flow: _______CFM	CC			
2.4.2	Does the electric heating remain de-energized?	CC			
2.4.3	Input a space temperature value of 72°F. Does the VAV box damper modulate to the minimum air flow position? Record monitored air flow and compare to scheduled minimum air flow. Scheduled Air Flow: _______CFM; Actual Air Flow: _______CFM	CC			
2.4.4	Does the electric heating remain de-energized?	CC			

VAV Terminal Boxes w/EH Re-Heat
Functional Test Procedure

			FTP (By Jacobs CxA)		
Task No.	**Task Description**	**Contractor**	**Checked**	**Ok**	**Deficiency Comment #**
2.4.5	Input a space temperature value of 68°F. Does the VAV box damper modulate to the heating air flow position? Record monitored air flow and compare to scheduled heating air flow. Scheduled Air Flow: _______CFM; Actual Air Flow: _______CFM	CC			
2.4.6	Does the electric heating energize to maintain the set point?	CC			
2.4.7	Input a space temperature value of 73°F. Does the electric heat de-energize?	CC			
2.4.8	Does the VAV box damper modulate to maintain the scheduled minimum air flow?	CC			
2.4.9	Input a space temperature value of 76°F. Does the VAV box damper begin to modulate open to maintain the scheduled maximum air flow?	CC			
2.4.10	Does the electric heating remain de-energized?	CC			
2.4.11	Return the VAV Box space temperature sensor to automatic control. Does the VAV box return to normal operation?	CC			
2.4.12	Verify the room temperature setpoint can be adjusted through the room thermostat.	CC			
2.5	**Bypass Mode Operation - Caution must be observed in this mode, as ductwork static pressure control is no longer possible and excessive static pressure may result in system damage.**				
2.5.1	With the AHU operating in the "Auto" mode of operation, manually turn the unit into Bypass mode or simulate the bypass condition for the specific VAV unit.	CC			
2.5.2	Does the VAV damper fully open and the electric re-heat maintain room temperature?	CC			
2.5.3	Increase the room temperature set point 3F above the current room temperature, does the damper remain fully open and the electric re-heat energize to maintain the new setpoint?	CC			
2.5.4	Decrease the room temperature set point 3F below the current room temperature, does the damper remain fully open and the electric re-heat de-energize to maintain the new setpoint?	CC			
2.5.5	At the AHU return the bypass switch to the normal position or release the simulation for this VAV. Does the alarm clear the DDCS? Does the VAV return to normal control?	CC			
3	**Failure Condition Testing - Simulates loss of control signal from the VAV box controller and loss of power to the VAV box controller.**				
3.1	**With the VAV box operating, simulate a loss of communication to the device.**				
3.1.1	Does the loss of communication alarm register at the DDCS?	CC			
3.1.2	Does the unit continue to operate according to the last commanded state?	CC			
3.1.3	Restore communications and confirm the alarm is cleared at DDCS.	CC			
3.1.4	Unit resumes normal operation at DDCS.	CC			
3.2	**With the VAV box in operation, override both the VAV Box damper and the hot water valve to 50% open. Turn off power to the VAV box controller.**				

VAV Terminal Boxes w/EH Re-Heat
Functional Test Procedure

			FTP (By Jacobs CxA)		
Task No.	**Task Description**	**Contractor**	**Checked**	**Ok**	**Deficiency Comment #**
3.2.1	Does a Loss of Communication Alarm register at DDCS for panel?	CC			
3.2.2	Did the VAV box damper fail in it's last commanded state?	CC			
3.2.3	Did the electric re-heat coil fail off?	CC			
3.3	**Restore power to the VAV box controller.**				
3.3.1	Release the overridden points in the DDCS and confirm that the VAV box controller restarts and that automatic control functions return to normal.	CC			
	Functional Testing plan has been signed by parties having direct knowledge of the event. Successful completion of these procedures does NOT yield the acceptance of the equipment by the FAA				
	Temperature Controls Contractor - Signature and Date:				
	Commissioning Agent - Signature and Date:				
	Resident Engineer - Signature and Date:				

Deficiency Record	
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Elevator Pit Sump Pump - Functional Test Procedure

			FTP (by Jacobs CxA)		
Task No.	**Task Description**	**Contractor**	**Checked**	**Ok**	**Deficiency Comment #**
1	**<u>Basic Installation Functional Verification Checklist</u>**				
1.1	Verify start-up and pre-functional testing of elevator pit Sump Pump SP-1 and associated components have been completed. Record Sump Pump commissioning start-up date. ______________	MC			
1.2	Verify controls are operational. This includes confirming that the water level switch has been set, the oil minder system is powered up, and all end device connections have been completed.	MC			
1.3	Verify control components are the correct series, model, type, configuration and options are as specified in submittal and contract documents.	MC			
1.4	**<u>Confirmation of Control Component Functionality</u> - Confirm controls have been provided, are correctly installed and are operating correctly.**				
1.4.1	Sump Pump Start/Stop	MC			
1.4.2	Water Level Switch	MC			
1.4.3	Oil Minder Sensor	MC			
1.4.4	Oil Minder Alarm	MC			
2	**<u>Function Performance Testing</u> - Simulates Sequences of Operation: Confirm the functionality, described in each statement below, occurs. When a function does not respond as described in the statement, record the deficiency.**				
2.1	**Start/Stop Control (Assumes water level in elevator pit is such that sump pump is off at the start of testing.)**				
2.1.1	Fill elevator pit with water. Does the sump pump start once the water level rises above the high water limit setting?	MC			
2.1.2	Stop filling the elevator pit with water. Does the sump pump remove the water from the elevator pit?	MC			
2.1.3	Does the sump pump stop operating once the water level in the elevator pit falls below the low water limit setting?	MC			
2.2	**Oil Minder Alarm and Safety Interlock**				
2.2.1	Fill elevator pit with water. Does the sump pump start once the water level rises above the high water limit setting?	MC			
2.2.2	Activate the Oil Minder System Alarm by simulating a condition where oil is present in the elevator pit. Do this by exposing the tip of the probe to oil. Do the audible and visual alarms at the Oil Minder control panel activate?	MC			
2.2.3	Does the sump pump stop? Stop filling the elevator pit with water.	MC			
2.2.4	Press the silence switch at the Oil Minder control panel. Does this silence the alarm?	MC			
2.2.5	Deactivate the Oil Minder Alarm by clearing the condition used to simulate the presence of oil. Press the reset switch at the Oil Minder control panel. Does the alarm at the Oil Minder control panel deactivate?	MC			
2.2.6	Does the sump pump start?	MC			

Elevator Pit Sump Pump - Functional Test Procedure

			FTP (by Jacobs CxA)		
Task No.	**Task Description**	**Contractor**	**Checked**	**Ok**	**Deficiency Comment #**
2.2.7	Does the sump pump stop operating once the water level in the elevator pit falls below the low water limit setting?	MC			
	Functional Testing plan has been signed by parties having direct knowledge of the event. Successful completion of these procedures does NOT yield the acceptance of the equipment by the FAA				
	Temperature Controls Contractor - Signature and Date:				
	Commissioning Agent - Signature and Date:				
	Resident Engineer - Signature and Date:				
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