APPENDIX A – COMMISSIONING PLAN

VA Project #: 689-22-700
EHRM Infrastructure Upgrades

West Haven VA Medical Center
950 Campbell Ave
West Haven, CT 06516

December 19, 2025

DRAFT Commissioning Plan

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1. Overview

1.A. Purpose

1. The purpose of the Commissioning (Cx) Plan is to provide guidance for the commissioning process and documentation during construction, particularly with respect to participation, reporting, approvals, coordination and actual lines of communication by various team members as it relates to submittal reviews, development and performance of Pre-Functional checklists (PFCs) and Functional Performance Tests (FPTs), and scheduling of Cx activities. (Note: Commissioning Authority (CxA) does not provide official direction to other members of the Cx Team, rather, only assistance and management of the commissioning process. In addition, the Cx process is not intended to change the resolution process that is identified in the respective contracts of Cx Team members.)

   a. Provide samples of the forms to be used during the commissioning process (and referenced in this plan). These forms are listed in Appendix A of this document.
   b. This plan provides sample Pre-Functional Checklists (PFCs) and Functional Performance Test (FPTs) procedures that are not specific to this project, rather, that will be modified into draft forms based on the final design package and approved submittals. The draft forms shall then be submitted to the Cx team for review and acceptance. Final versions of the PFCs and FPTs shall incorporate Cx Team comments as well as additional details provided in the approved equipment submittals and control shop drawings.
   c. The Cx Plan has been written in concert with the Statement of Work, however, if conflicts with other contract requirements are identified, the more stringent criteria shall apply. Conflicts shall be brought to the attention of the CxA. All members of the Cx Team shall work together to fulfill their contracted responsibilities and meet the objectives of the Contract Documents.

1.B. Definition

1. Commissioning (Cx) - A systematic process of assuring by verification and documentation, from the design phase to a minimum of one year after construction, that all building facility systems perform interactively in accordance with the design documentation and intent and in accordance with the Owner's operational needs, including training of the Owner operations and maintenance personnel.

2. Pre-Functional Checklists (PFCs) – Verification checklists developed by the CxA, with input from equipment vendors, to verify that contract design requirements are met and that the system is ready for FPT. This includes checklists for general readiness, pre-functional testing, training, and other specific requirements.

3. Cx Authority (CxA) – The entity identified by the Owner who drafts the Cx Plan, witnesses and records the Functional Performance Testing, submits reports on the Cx progress and prepares the Final Cx Report.

4. Cx Plan – The document that identifies activities to be included in the project baseline schedule, PFCs and Functional Performance Test (FPT) requirements for commissioning. The Cx Plan is submitted as a Draft Plan during the Design Phase, Construction Cx Plan during Project Execution and updated after approval of equipment submittals.
5. Cx Team – Members of the project Cx team shall consist of (but not be limited to) the CxA, the COR, Owner Technical Specialists, the Executing Contractor (GC) and their Subcontractors, Equipment Vendors, and Title II (A/E).
6. Final Cx Report – The report prepared and submitted by the CxA attesting that all equipment, systems, the O&M manual and Owner training meet contract requirements.
7. Functional Performance Test (FPT) – Demonstration that each system is operating according to the documented design and contract requirements. Performance testing facilitates bringing the systems from a state of individual substantial completion to full dynamic operation.
8. Issues Log – A formal record of equipment and system non-conformance (to contract requirements) identified by the Cx Team, along with the proposed and final resolutions.
9. Owner Project Requirements (OPR) – The project functional requirements and the measurable performance criteria of how it shall be used and operated.
10. Pre-Functional Testing – Documented testing performed by the executing contractor or equipment vendor during or after start-up. This testing shall be completed prior to scheduling the FPT.
11. Start-Up – The initial starting or activating of dynamic equipment, including completing and submitting Pre-Functional Checklists (PFCs).
12. Test Procedures – A written protocol that defines methods, personnel, and expectations for tests conducted on components, equipment, assemblies, systems and interfaces among systems. Testing procedures are included in the contract specifications, approved submittals, and the Construction Cx Plan. The FPT includes the dynamic functions and operations of equipment and systems using manual or monitoring methods under full system operations. Systems shall be tested under various modes, such as during low cooling loads, high loads, component failures, unoccupied, varying outside air temperatures, fire alarm, power failure, etc. Systems shall be run through the Control System's (EMCS, SCADA) sequences of operation. Components responses shall be verified per the sequence of operation requirements.
13. Verification – The process by which specific documents, components, equipment, assemblies, systems, and interfaces among systems are documented and are in compliance with the criteria in the contract requirements.

1.C. Objectives

1. Commissioning during the construction phase of this project is intended to achieve the following specific objectives of the Contract Documents:

a. Ensure applicable equipment and systems are installed properly and receive adequate operational checkout by installing contractors.
b. Verify and document proper functional performance of equipment and systems.
c. Ensure Contractor has provided O&M documentation as specified by the Owner.
d. Ensure the Owner's operating personnel is adequately trained.

1.D. Abbreviations/Acronyms

The following abbreviations are used in this Commissioning Plan:

A/E	Architect / Engineer of Record
AHJ	Authority Having Jurisdiction
AHU	Air Handling Unit
AKA	Also known as
BOD	Basis of Design
BAS	Building Automation System
Cx	Commissioning
CxA	Commissioning Authority
Cx Plan	Commissioning Plan
CxT	Commissioning Team
CC	Construction Checklist (aka PFC)
CM	Construction Manager
CO	Contracting Officer
COR	Contracting Officer Representative
DCR	Daily Commissioning Reports
DOM	Delivery Order Manager
Doc ID	Document Identifier
EC	Electrical Contractor
EPO	Emergency Power Off
EMCS	Energy Management and Control System
FAT	Factory Acceptance Test
HVAC	Heating, Ventilating and Air Conditioning
IFC	Issued For Construction
IV&V	Independent Validation and Verification Team
IST	Integrated Systems Test
OWNER	Department of Veteran's Affairs (aka Owner, and/or Client)
MC	Mechanical Contractor
NETA	National Electrical Testing Association
NFPA	National Fire Protection Association
NTP	Notice to Proceed
O&M	Operations and Maintenance Instructions
OGC	Other Owner Contractor
OPR	Owner's Project Requirements
PES	Project Execution Schedule
PFC	Pre-Functional Checklist (aka CC)
PM	Project Manager, Owner
PTN	Project Tracking Number
QA	Quality Assurance
QC	Quality Control
RE	Resident Engineer
RFI	Request For Information
RFP	Request For Proposal

FPT	Functional Performance Test	SUP	Start-up Plan
GC	General Contractor (aka Contractor)	TAB	Test, Adjust and Balance subcontractor
OFCI	Owner Furnished Contractor Installed		

2. Commissioning Team Data

2.A. Commissioning Team Information

List of Commissioning Team Members and Contact Information			
Description	**Role**	**Contact Name**	**Phone/Email**
Owner (West Haven VAMC)	Project Manager (COR)	Peter Sandor	Peter.sandor@va.gov
	VA Contracting Officer	Denise Bailey	Denise.bailey4@va.gov
	VA Resident Engineer		
Description	**Role**	**Contact Name**	**Phone/Email**
Design (Spees Design Build / WSP USA, INC / Performance Environmental)	Project Manager	James Stoddard	james@speesdb.com (504) 350-8777
	Architect (Blue Architecture)	TBD	(206) 590-2118
	Mechanical (Spees Design Build)	TBD	(206) 590-2118
	Electrical (Spees Design Build)	TBD	(206) 590-2118
	Fire Protection (Spees Design Build)	TBD	(206) 590-2118
	Civil (WSP USA, INC.)	TBD	(206) 431-2300
	Structural (WSP USA, INC.)	TBD	(206) 431-2300
	Communications (WSP USA, INC.)	TBD	(206) 431-2300
	Environmental (Performance Environmental)	TBD	(412) 616-1173
Description	**Role**	**Contact Name**	**Phone/Email**
Construction (Company Name)	Project Manager		
	Superintendent		
	Quality Assurance		
	Project Engineer		
Description	**Role (Company)**	**Contact Name**	**Phone/Email**
Sub-Contractors	Infrastructure (Company)		
	Mechanical (Company)		
	Electrical (Company)		
	Plumbing (Company)		
	Controls (Company)		

List of Commissioning Team Members and Contact Information			
Description	**Role**	**Contact Name**	**Phone/Email**
	Fire Alarm & Control (Company)		
	Security (Company)		
	Test and Balance (Company)		
Description	**Role (Company)**	**Contact Name**	**Phone/Email**
Commissioning (VA) Davenergy Solutions Inc.	Project Manager & CxA	Andrew Gaffield	(315) 663-5550 Andrew.Gaffield@davenergy.com
	Sr. Cx Engineer	Alex Boucher	(919) 635-8545 Alexander.Boucher@davenergy.com
	Field Cx Engineer	Tim Buskell	(719) 648-7207 tim.buskell@davenergy.com

2.B. 3rd Party Testing Information

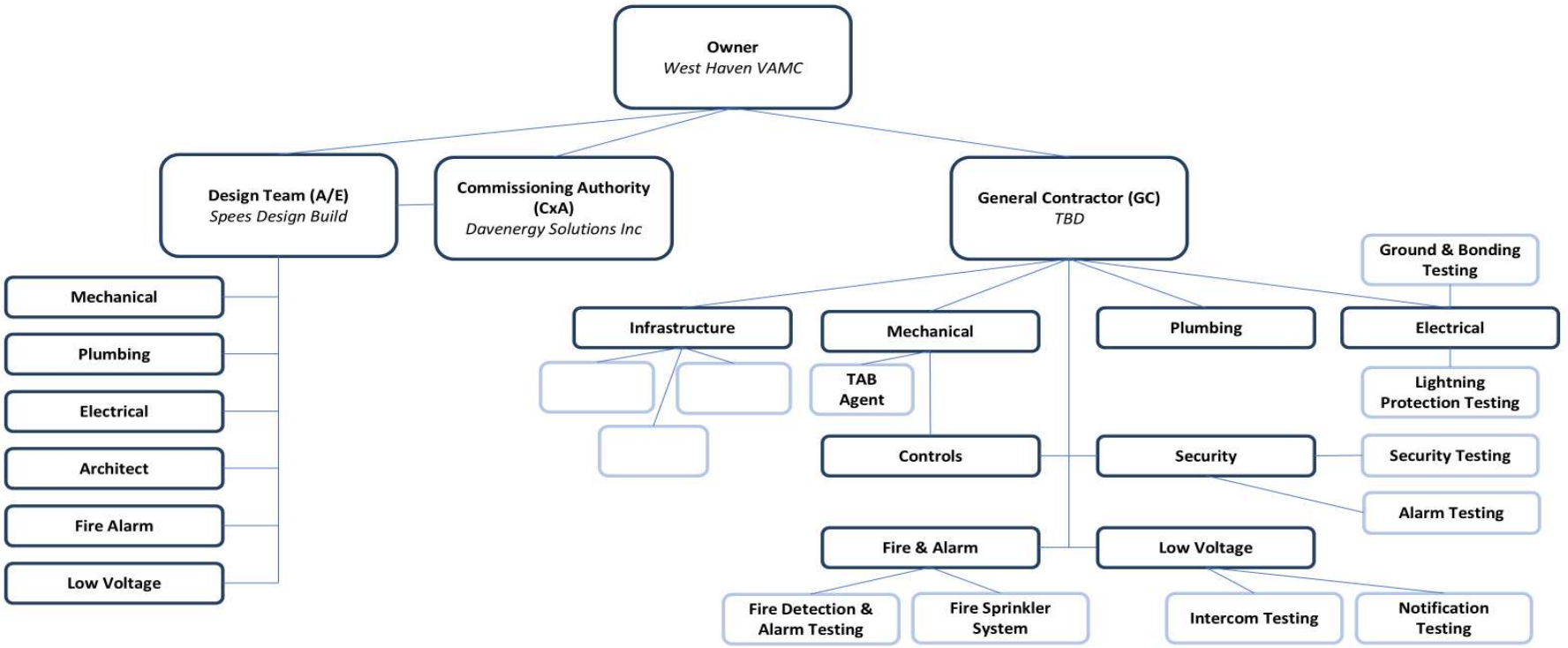
The table below outlines the list of commissioning team members who will perform the 3rd party equipment testing. The role of the CxA is to confirm the selected 3rd party testing agencies meet the qualifications called out in the division specifications. This information is normally reviewed during the submittal process. Once the equipment is installed, the CxA will also review the testing procedures to confirm their conformance to the equipment specifications and design intention.

List of Commissioning Team Members and Contact Information			
Role	**Description (Company)**	**Contact Name**	**Phone/Email**
3rd Party Testing Agents	Grounding & Bonding System Testing Agent (Company)	TBD	TBD
	Electrical Power Monitoring System Testing Agent (Company)	TBD	TBD

2.C. Commissioning Organization Chart

The organization chart below highlights the key members associated with the commissioning process. For specific contact names and information, refer to section 2A and 2B above. The commissioning agent (Davenergy) works for the Owner (VA) and does not have any authority over the other jurisdictions.

Figure 1: Commissioning Organization Chart



3. Systems to be Commissioned

3.A. Project Description

The overall intent of this project is to upgrade and improve the Electronic Health Record Modernization (EHRM) infrastructure of the West Haven VA Healthcare campus in West Haven, Connecticut as part of the ongoing national VA EHRM initiative. Per the SOW and the VA-provided HEFP Readiness Assessment, sixty (60) Telecommunications Rooms (TRs) and 1 Data Center (DC) of the West Haven VAMC are within the scope of this project. Commissioning will include FPT of the mechanical systems within the scope of this project. Commissioning of electrical and telecommunication systems will consist of submittal and report review, as well as site observations and spot checks.

3.B. Systems

The following systems shall be commissioned as part of this project. All general references to equipment in this document refer only to the equipment that is specified to be commissioned.

Systems To Be Commissioned				
Building System	**System Component**	**Equipment**	**Quantity**	**Test Sample**
Mechanical and HVAC Systems	HVAC Air Distribution	VRF Units	84	50% (5)
		Ductless Split System	15	100%
		Air Cooled Condensing Units	2	100%
		Data Center CRAC Systems	2	100%
		Blast Suppression Damper	5	100%
		Exhaust Fans	7	100%
		Supply Fan	1	100%
		Transfer Fan	6	100%
		Roof Hood	4	100%
		Electric Unit Heater	1	100%
		ERV	1	100%
		Dehumidifier	2	100%
		Air–Cooled Condensing Unit	2	100%
	Steam Systems	Clean Steam Generator	1	100%
	Emergency Power	Generator Fuel Tank	2	100%
		Fuel Transfer/Polishing System	1	100%
		Fuel Oil Pump Skid	1	100%
		Generator	1	100%
	Building Automation System (BAS)	Graphical User Interface	Included	(1)
		Building Controllers and Programming	Included	(1)
		Sequence of Operations	Included	100% (1)

Systems To Be Commissioned				
Misc. Systems	Fiber Feeds	Fiber feeds and IT layouts	Included	(3)
	Rack Sensors	Rack Temperature Sensors	Included	(1)
Electrical and Power Systems	Integrated Systems	UPS Monitoring	Included	(3)
		Panelboards	TBD	100% (2)
		Transformer	TBD	100% (2)
		ATS	TBD	100% (2)
		UPS Systems	Included	(3)
		Low Voltage System Testing (telecom)	Included	(3)
		Emergency Power Verification	Included	(2)
Table / Scope Notes	Note (1)	The programming operation of the controllers, sensors, and actuators are all verified during testing of the respective equipment.		
	Note (2)	Testing is limited to systems added/modified as part of the project.		
	Note (3)	Verification consists of submittal & report review, as well as site observations		
	Note (4)	TAB validation will be reviewed via provided TAB report and only investigated if FPT issues arise.		
	Note (5)	Testing may exceed 50% of units to ensure all Independent Units which do not have redundancy support are tested		

4. Roles and Responsibilities

1. The Cx Team consists of Owner Representatives, Facility Staff, Design Engineer of Record, Construction Manager, General Contractor, Subcontractors of the General Contractor, and the Cx Authority.
2. Listed below are general roles and responsibilities for the Construction and Acceptance Phase, refer to the project specifications for additional responsibilities and further clarifications.
3. Unless otherwise agreed upon by the Commissioning Team (CxT) members, the standard review/comment and response periods for all documents shall be two (2) weeks. The CxA shall provide a Cx Comment Form to log and track comments and responses from all team members.
4. Owner
   a. The COR is responsible for approving, resolving, and providing direction to Contractors throughout the course of this project. This shall include reviewing and approving transmittal of documents and comments among Cx Team members through the use of the approved document control application.
   b. Owner tasks include:
      i. Facilitate the coordination of the commissioning work by the CxA.

ii. With the GC and CxA, ensure commissioning activities are being included into the Contractor's master schedule with appropriate durations and linking of predecessor and successor activities.
iii. Provide the CxA with a copy of the OPR and BOD documentation prepared by the A/E during the design phase.
iv. Review and approve the Final Commissioning Plan.
v. Participate in the Cx Kick-Off meeting and other Cx Team meetings.
vi. Provide the CxA with copies of all construction documents, addenda, change orders, approved submittals and shop drawings relating to commissioned equipment.
vii. Review and approve Pre-Functional Checklists (PFCs) and Functional Performance Tests (FPTs) submitted by the CxA, prior to testing.
viii. Review commissioning progress and deficiency reports.
ix. Arrange for facility operating and maintenance personnel to participate in various commissioning team activities (e.g., commissioning testing and training sessions).
x. Assist CxA in coordinating the training of Owner personnel by the Executing Contractor and Equipment Vendors.

5. Commissioning Authority (CxA)

a. The CxA is not responsible for design concept, design criteria, compliance with codes, design or general construction scheduling, cost estimating or construction management. The CxA may assist with problem solving, non-conformance or deficiencies, but ultimately that responsibility resides with the COR, GC, or A/E.
b. The primary role of the CxA during the construction phase is to develop, coordinate, oversee and supervise the execution (by contractors) of the commissioning process as described by the Commissioning Plan and required by the specifications, observe and document systems are functioning and performing in accordance with the Contract Documents, assure proper project documentation is provided to the Owner and assure proper training of Owner's operations personnel is provided.
c. Commissioning Authority tasks include the following:

i. Provide all commissioning documentation electronically to the Owner in source format (e.g., Word, Excel, or PDF).
ii. Work with the GC and the Owner to help integrate commissioning activities into the master schedule.
iii. Revise the Cx Plan with input from the Cx Team, as necessary.
iv. Provide responses to comments received on CxA work products (e.g., Cx Plan, PFCs, FPTs, and IST's) by other Cx Team members.
v. Document, track and update the status of all comments generated by the Cx Team, and as approved by the COR, in the Cx Issues Log (or other document-specific consolidated comment log, which would be maintained separately from the Cx Issues Log) for resolution.

vi. Conduct a Cx Kick-Off Meeting with the Cx Team.
vii. Conduct and document periodic Cx Coordination Meetings. Cx Coordination Meetings are generally held more frequently prior to and during the testing phase of the Cx process.
viii. Review and comment on all construction documents, addenda, change orders, approved submittals and shop drawings relating to systems being commissioned for compliance with commissioning requirements.
ix. Review and comment on Construction Meeting Minutes relating to the Cx process and assist in the resolution of any issues.
x. Review, comment and recommend approval (to the COR) of Contractor submittals applicable to systems being commissioned.
xi. Develop system level Pre-Functional Checklists (PFCs) using information provided by the Contractors (i.e. submittals and checkout procedures) and distribute for Contractor use.
xii. Develop FPTs using approved submittals (i.e. equipment submittals, control shop drawings) with input from the Cx Team (including Contractors).
xiii. Conduct periodic site visits to observe component and system installation. Provide Daily Cx Report to COR after each site visit.
xiv. Review 3rd party testing agency qualifications, testing plan, and testing results. On-site 3rd party testing observations will be made when designated and preferred by the owner.
xv. The CxA shall observe all testing during pre-functional testing to verify compliance with the Pre-Functional Checklists (PFCs) that are completed by the Contractors.
xvi. Review and recommend approval (to the COR) of Contractor completed and submitted Pre-Functional Checklists.
xvii. Coordinate with the participants, witness, and document Contractor execution of all FPTs.
xviii. Identify, enter, and update deficiencies in Commissioning Issues Log with input from the Cx Team.
xix. Maintain a Commissioning Issues Log with updated status of documentation created during the commissioning process (i.e. PFCs and FPTs). Include any performance testing documentation that the CxA may not have developed or witnessed.
xx. Provide all completed PFCs and FPTs to the COR for review and acceptance.
xxi. Review, comment and recommend approval (to the COR) of Contractor provided warranties confirming that the Owner's responsibilities are clearly defined.
xxii. Prepare Final Commissioning Report.

6. Architect/Engineer

a. A/E Tasks may include the following, as directed by Owner:

i. Participate in Commissioning Kick-Off meeting.
ii. Provide responses to comments received on A/E work products (e.g., Project Manual, drawings, specifications) by other Cx Team members.

iii. Provide clarifications to design intent as well as operation and control of commissioned systems in areas where the specifications, control drawings or equipment documentation is not sufficient for writing detailed testing procedures.
iv. Participate in commissioning issue resolutions and coordination meetings.
v. Review and comment on PFCs and FPTs developed by the CxA to ensure the designer's intent for functionality has been properly interpreted.

7. Construction Manager/General Contractor (including Subcontractors, as applicable)

a. Contractor tasks include the following:

i. Assign responsibility of commissioning tasks to Subcontractors.
ii. Facilitate the coordination of the commissioning work; ensure activities are being scheduled into the Contractor's master schedule with appropriate durations and linking of precursor and successor activities.
iii. Provide responses to comments received on GC and Subs work products (e.g., installation tests) by other Cx Team members.
iv. During the submittal process, encourage vendors/Subcontractors to comment on whether the specified products are the newest, most current equipment, and application is suitable for the project(s).
v. Prepare and maintain an updated detailed commissioning testing schedule.
vi. Attend the Commissioning Kick-Off meeting and other selected commissioning meetings, as necessary, as requested by other Cx Team members.
vii. Review and comment on PFCs and FPTs, to assure they are applicable to demonstrate functional performance, can actually be performed, will not damage equipment and will not void equipment warranty.
viii. Execute and document completion of checkout plans and PFCs, per contract documents.
ix. Execute FPTs as coordinated by the CxA or COR.
x. Resolve commissioning issues in a timely manner and prior to Final Completion. Notify Cx Team in writing of corrective actions taken.
xi. Sign-off final acceptance on individual checkout plans, PFCs and FPTs as completed and passed.

5. Commissioning Process

This section sequentially (as practical) details the commissioning process by commissioning task or activity. The following descriptions are intended to indicate the sequence in which the activities generally take place, not to fully define the scope of the work. For full details on the commissioning processes and activities please see the project commissioning specifications.

5.A. Commissioning Kick-Off Meeting - Design Phase

1. A Cx Kick-Off meeting is planned and conducted by the CxA within 10 (Ten) days of Notice to Proceed.
2. In attendance are the respective representatives of the CxA, Owner, and A/E.
3. At the meeting:
   a. Design Phase Commissioning team members are introduced.
   b. Commissioning process is reviewed as a whole.
   c. Management and reporting lines are determined for the Design Phase.
   d. The processes for completion of commissioning design reviews, comment resolution, and comment tracking are discussed and agreed upon.
   e. The Draft Commissioning Plan is reviewed, process questions are addressed, lines of reporting and communications determined, and the work products list discussed.
   f. Team member(s) general list of responsibilities is defined.
4. The outcome of the meeting is an increased understanding by all team members of the commissioning process and their respective responsibilities. The meeting provides the CxA additional information needed to finalize the Construction Phase Commissioning Plan.

5.B. Commissioning OPR / BOD Review - Design Phase

1. The CxA will begin the design phase by first reviewing the OPR to develop a detailed understanding of what the Owner wishes to achieve in the building, as well as how it will operate.
2. After a firm understanding of the OPR, the CxA will review the BOD or DID to understand how the design profession will provide a design that satisfies the OPR.

5.C. Commissioning Specification Drafting - Design Phase

1. The CxA will develop the commissioning specifications for use in the construction documents.
2. The commissioning specifications will be developed based on the OPR and the commissioning scope listed above. The specifications will be provided prior to formal design reviews so that all stakeholders have an opportunity to review and comment.
3. The commissioning specifications will be developed to match the project specifications and include Divisions 1, 23, 26, 27, 28, and other sections as needed to ensure commissioning requirements are properly accounted for in the project documents.

5.D. Commissioning Design Reviews - Design Phase

1. The A/E will develop the construction documents which will be used to guide the construction team in implementing the design.

2. The CxA will participate in the 35%, 65%, 95% and 100% review documents and formal review by the Owner. The CxA will base the review on conformance to the OPR, the ability to operate and maintain the equipment, and the ability to commission the equipment.

3. At the completion of each formal review cycle the CxA will participate in a design review comment resolution meeting.

    a. The meeting will be facilitated by either the Owner or the A/E with the intent of resolving as many issues brought up during the design review processes as possible.

5.E. Commissioning Controls Review Meeting - Design Phase

1. A Controls Review meeting will be coordinated by the CxA and will include the A/E, and the Owner prior to the 95% design submission by the A/E.

    a. The intent of the meeting is to facilitate an open dialog between the Owner and the A/E about the controls system, features, alarms and sequences.
    b. At the completion of the meeting the A/E will revise any/all sequences of operation, alarm requirements, and controls features based on the Owner's decisions.

5.F. Commissioning Kick-Off Meeting - Construction Phase

1. A Cx Kick-Off meeting is planned and conducted by the CxA within forty-five (45) days of the beginning of construction or the CxA's notice to proceed, whichever is later.

2. In attendance are the respective representatives of the COR, GC, CxA, A/E and the mechanical, and electrical Subcontractors.

3. At the meeting:

    a. Commissioning team members are introduced.
    b. Commissioning process is reviewed.
    c. Management and reporting lines are determined.
    d. The flow of documents and CxA required submittals are discussed. This includes design submittals, factory witness test reports, installation test reports, detailed activity schedules, testing agency and controls contractor submittals.
    e. The Commissioning Plan is reviewed, process questions are addressed, lines of reporting and communications determined, and the work products list discussed.
    f. Team member(s) general list of responsibilities is defined.

4. The outcome of the meeting is an increased understanding by all team members of the commissioning process and their respective responsibilities. The meeting provides the CxA additional information needed to finalize the Construction Phase Commissioning Plan.

5. Prior to this meeting the CxA is given, by the Owner, all drawings and specifications and the construction schedule by trade. The CxA keeps notes and action lists from the meeting and distributes them to each team member through the approved document control application.

5.G. Final Commissioning Plan - Construction Phase

1. The CxA finalizes the Draft Construction Phase Commissioning Plan using the information gathered from the Kick-Off meeting.
2. The construction schedule is reviewed, amended and revised, as necessary, to incorporate commissioning activities and their durations. The timeline is fine-tuned as construction progresses.
3. The Cx Plan is approved by the COR and acknowledged by all Cx Team members in the Cx Team Data section of the Cx Plan.

5.H. Site Observation - Construction Phase

1. The CxA shall make periodic visits to the site, as necessary, to witness equipment and system installation.

5.I. Miscellaneous Meetings - Construction Phase

1. The CxA attends selected planning and job-site meetings in order to remain informed on construction progress and to update team members involved in commissioning.
2. The GC shall inform the CxA of submitted information regarding substitutions, change orders and any requests for information or Architect's Supplemental Instructions that may affect commissioning equipment, systems or the commissioning activities scheduled.
3. The CxA may review construction meeting minutes, change orders, requests for information or ASIs for the same purpose.
4. During construction, meetings between various commissioning team members shall be scheduled by the CxA, through the COR and GC as required.

5.J. Miscellaneous Management Protocols/Lines of Communication - Construction Phase

1. Informal lines of communication are permitted at all levels among all team members, when warranted. This shall be discussed at the Cx Kick-Off meeting.
2. Courtesy copies of communications are permitted at all levels, as needed.
3. Refer to Cx Team Data in section 2 of Cx Plan for specific points of contact.
4. Table 1. Addresses common issues and the associated protocols for communicating within the project team.

Table 1. Communication Protocols- Construction Phase

ISSUE	PROTOCOL
Requests for Information (RFI) or formal documentation requests:	At the direction of the COR, the CxA shall bring the issue to the weekly construction progress meeting for vetting prior to entering the issue into the approved document control application.
Minor or verbal information and clarifications:	The CxA issues a memo (or email) for documentation to the COR, GC, and the A/E (or other applicable team members).
Notifying contractors of commissioning related deficiencies:	The CxA documents commissioning related deficiencies in the issues log. Commissioning related deficiency issues may not be discussed with contractors prior to notifying the COR or GC. The CxA has no authority to provide direction.
Scheduling functional tests:	The CxA may provide input and perform some coordination of testing, but does not schedule. The COR and GC are responsible for scheduling the testing.
Scheduling commissioning meetings:	The CxA coordinates with the COR (and the GC) to identify an acceptable date/time/location.
Request for significant changes:	The CxA has no authority to issue change orders. Significant issues shall be brought to the attention of the COR and GC.
Minor changes in specified sequences of operations:	The CxA shall not make changes to specified sequences without approval from the COR. The CxA shall suggest recommendations, however, the CxA has no authority to provide direction.
Subcontractors disagreements with requests or interpretations by the CxA:	Subcontractors shall discuss and attempt resolution with the CxA first. When warranted, the GC (through the COR) shall resolve the situation. The COR shall provide the final resolution.

5.K. Field Reporting and Logs - Construction Phase

1. The CxA shall issue reports with increasing frequency as the commissioning activity increases. The CxA may adjust the reporting frequency as needed and as approved by the COR.
2. The field reports shall contain (as it relates to functional testing) an update of the schedule with a list of requested schedule changes and new items (PFCs, FPTs and/or ISTs) added to the schedule, a list of new and outstanding deficiencies, and a description of commissioning progress corresponding to the plan, etc.
3. The CxA keeps a log of all commissioning-related issues requiring current or future attention using a Commissioning Issues Log.

4. Commissioning Issues Log provides a sample format for tracking the status of documentation and testing for each piece of equipment and system (e.g., installer, or team member responsible for approval dates for checklist and testing forms as well as their completion, etc.).
5. The CxA regularly communicates with all members of the commissioning team, keeping them appraised of commissioning progress and scheduling issues.
6. The CxA shall keep all commissioning materials in an organized format.

5.L. Submittals, Notifications, Clarifications - Construction Phase

1. Standard Submittals
   a. Submittal Log. The CxA shall make official requests for any items not listed on the initial submittal log through the COR, who may in turn choose to forward request to the GC.
   b. Cx focused submittal reviews are performed concurrently with the normal A/E submittal review.
   c. The CxA shall review and comment on submissions relative to commissioning issues expressed in the contract documents - not for general contract compliance (which is the A/E's responsibility) unless specifically directed by the Owner to do so.
   d. CxA recommendations are provided to the COR through the approved document control application.
2. Special Submittals, Notifications and Clarifications
   a. All Cx Team members (i.e. the COR, GC, Subs, A/E) shall notify the CxA of any new design intent or operating parameter changes, added control strategies and sequences of operation, or other change orders that may affect commissioned systems and performance/acceptance criteria during testing.
   b. Thirty (30) days prior to performing Owner-contracted tests (i.e. installation tests), GC Subcontractors shall provide complete details of the procedures.
3. The CxA may request additional design narratives from the A/E and from the controls contractor if bid documentation and/or shop drawings are incomplete or insufficient.
4. All Cx RFIs shall be directed to the COR prior to entry into the approved document control application. The COR shall assess the issue for discussion at one of the periodic progress meetings. If the issue cannot be resolved at the progress meeting, the COR shall advise the CxA to enter the issue into the approved document control application. The COR shall be copied on any direct correspondence between the CxA and contractors.

5.M. Start-up Plan - Construction Phase

1. The sequence of start-up testing, within the overall construction and acceptance process, is performed after installation and when all initial Quality Control and inspection testing, concurrently with Pre-Functional Checklists has been completed and before Functional Performance Testing.

2. The GC has ultimate responsibility for the development of detailed start-up plans for all equipment. The GC typically assigns this responsibility to an applicable subcontractor. The CxA shall develop Pre-Functional Checklists for the contractor's use in documenting startup of associated equipment and systems as well as documenting readiness for functional performance testing. The manufacturer's start-up sequence for each piece of equipment shall be used as a starting point. The main difference between equipment specific manufacturer startup checks and the Pre-Functional Checklists (PFCs) is that the PFCs are performed on a system level and cross disciplines (i.e. mechanical, electrical and controls).

3. The Commissioning Issues Log, maintained by the CxA, is utilized for tracking the team member(s) responsible for start-up and initial checkout on each part. This information shall also be indicated on the appropriate Pre-Functional Checklist.

4. The following procedures shall be used for this project:

   a. The subcontractor is responsible for the start-up plan development.
   b. The designated subcontractor shall develop the Start-Up Plan and obtain manufacturer installation, start-up and checkout data, including actual field checkout sheets used by the field technicians.
   c. Systems that may not have adequate manufacturer start-up and checkout procedures, particularly for components being integrated with other equipment, shall be provided by the subcontractor with necessary detail and documenting format for approval, prior to execution.
   d. The subcontractor shall create copies of all pages with important instructional data and procedures (not covered in manufacturer field checkout sheets) from the start-up and checkout manuals. A signature line in the column by each procedure shall be added.
   e. The full Start-up Plan shall be transmitted by the subcontractor for review and approval. This information shall be used by the CxA as the starting point for PFC development.

5.N. Pre-Functional Checklists (PFCs) - Construction Phase

1. The sequence of Pre-Functional Checklist completion, within the overall construction and acceptance process, starts with the arrival of cable, devices, and equipment on-site (e.g., ensure proper device or equipment features). This sequence shall continue through initial installation testing and before functional performance testing.

2. PFCs ensure the equipment and systems are hooked up and operational to avoid unnecessary delays prior to functional testing.

3. PFCs are primarily static inspections and procedures to prepare the equipment for initial operation (e.g., oil levels OK, fan belt tension, labels affixed, gages in place, sensor calibration, electrical connections completed, controls connections completed, etc.).

4. Some PFC items entail simple testing of the function of a component or a piece of equipment, such as measuring the phase rotation on three phase feeders to PDU's.

5. Contractors typically perform some, if not many, of the CxA recommended PFC items as a part of their normal operation. However, few contractors document in writing the execution of these checklist items.
   a. This project requires all procedures to be documented in writing by the installing technician. The CxA may not witness the PFC completion, except for testing of larger or more critical pieces of equipment and some spot-checking.
6. PFC requirements are identified in the commissioning specifications.
7. The CxA shall develop the System Level and Cross Disciplined Pre-Functional Checklist for review and comment by the Cx Team (including the Subcontractors). The subcontractor's full startup plan shall be used as a starting point for each piece of equipment.
8. During the review and comment of the PFC, the GC shall elect which trade or contractor is responsible for completing each line item (mark in the "Contractor" column).
9. Upon approval of the PFC developed by the CxA, the GC shall assign the PFC to Subcontractors responsible for completion, which shall occur prior to the start of functional testing.

5.0. Execution of Start-up Plan and Pre-Functional Checklists - Construction Phase

1. Four (4) weeks prior to checkout, all subcontractors and vendors shall confirm the schedule for the initial checkout with the GC. The GC notifies the Cx Team of the schedule.
2. The initial checkout is directed, executed and documented by the subcontractor or vendor.
3. Before functional performance testing can be initiated, PFCs for all equipment must be completed and signed as a prerequisite (e.g., installation checks). When all items are complete, the PFC shall be routed for required signatures and then officially submitted and forwarded to the CxA for review prior to the start of functional testing.
4. Each piece of equipment receives a full construction completion checkout by the Contractor. No sampling strategies are permitted.
5. The CxA may observe the procedures for each piece of primary equipment, unless there are multiple units, when a sampling strategy is implemented.
6. For components of equipment, the CxA observes a sampling of the Pre-Functional Checklists.
7. The site technician shall document the checkout process. They shall initial and date each line-item task confirming completion of each paragraph procedure(s). The items shall also be checked off on the Pre-Functional Checklist.
8. Only individuals having direct knowledge of a line item being completed shall check or initial the forms.

9. Subcontractors and vendors shall execute the Pre-Functional Checklists and submit a signed copy of the completed Pre-Functional Checklists, per submittal process requirements. The CxA may review Pre-Functional Checklists in progress, as necessary.
    a. On smaller equipment or projects, forms of the Pre-Functional Checklists (which all contain more than one trade's responsibility) may be provided to the subcontractors for completion. On larger projects, each subcontractor may need a full Pre-Functional Checklist form in order to perform their work concurrently. When warranted, the GC shall consolidate the various portions of the checklist into a single comprehensive PFC prior to submission.
10. The CxA will attend any major equipment startups. For all other items where the owner wishes to have 3rd party testing, the GC will need to submit qualifications for 3rd party testing. For all systems identified in section 3B as "witness 3rd party test, review reports", the CxA will review reports and review qualifications as they come through in submittal process and test reports. The 3rd party testers do not work for the CxA, they will be working for the general contractor.

5.P. Deficiencies and Non-Conformance - Construction Phase

1. Outstanding items from the Pre-Functional Checklist procedures that were not completed successfully shall be clearly listed by the applicable subcontractor in the provided space on the PFC or on an attached sheet.
2. The PFCs (including listed deficiencies with resolution) shall be submitted within two (2) days of test completion for CxA review.
3. The CxA shall work with the GC regarding initial conversations on deficiencies identified during PFC form completion. If warranted, the CxA shall work with the subcontractors and vendors to correct and review any checklist deficiencies or incomplete items.
4. The installing subcontractors or vendors shall correct all deficient or incomplete areas according to the Pre-Functional Checklists.
5. The CxA recommends approval of the initial checkout of each system to the COR using the required submittal review process in the approved document control application.

5.Q. Controls Checkout Plan: EMCS and SCADA - Construction Phase

1. The controls contractor shall develop and submit a written step-by-step plan. The plan shall describe the intended process in checking the control system and identify the necessary documentation forms to be utilized. In the event that this plan does not sufficiently document or verify proper installation, the CxA shall modify the applicable portions of the PFC for this purpose.
2. The controls contractor shall execute the tests assigned to them and provide a qualified technician on site for assistance in performing the controls portions of the functional performance testing.

5.R. Development of Functional Performance Test Procedures - Construction Phase

1. Functional Performance Testing is the dynamic testing of systems (rather than just components) under full operation (e.g., the chiller pump is tested interactively with the chiller functions to see if the pump ramps up and down to maintain the differential pressure set-point; the UPS system response to varying loads and redundant module failures is tested to verify that the power to load remains in tolerance).

2. Systems are tested under all modes of operation (e.g., during low cooling or heating loads, high loads, component failures, unoccupied, varied outside air temperatures, fire alarm, power failure, simulated Negative Sequence and faults, etc.).

3. Systems are run through all of the control system's sequences of operation. Components are verified to be functioning as the sequences state.

4. The CxA shall develop the functional test procedures in a sequential written form, coordinate, oversee and document the actual testing. Testing is usually performed by the installing contractor or vendor. Refer to the "Equipment to Be Commissioned" table in the appendix of this plan.
   a. Before FPTs are written, the CxA shall obtain all requested documentation including, but not limited to, a current list of change orders affecting equipment or systems, an updated points list, control sequences, set-points and approved submittals.
   b. Functional testing and verification may be achieved by manual testing (persons manipulate the equipment and observe performance) and/or by monitoring the performance and analyzing the results using the control system's trend log capabilities or by stand-alone data loggers.
   c. The CxA shall use his or her own judgment to recommend which method is most appropriate. The CxA shall obtain approval from the COR.
   d. Level of rigor
      i. On this project, all pieces of equipment receive in-depth testing with a high level of rigor. The CxA shall review the specifications for Owner-contracted, factory or required acceptance tests and determine what further testing may be required. Redundancy is minimized.
      ii. Test procedures shall be developed for each piece of commissioned equipment. Sample PFCs and FPTs are provided in Appendix A to illustrate the expected level of rigor for these checklists and test procedures. These are not necessarily site and/or project specific FPTs; they are provided as a sample of the level of rigor expected. Site/project specific PFCs and FPTs shall be developed and issued separately from this Cx Plan, using approved submittals.
   e. Draft Procedures
      i. The CxA shall develop draft FPTs verifying proper operation of each piece of equipment and system using the performance requirements in the contract documents. The CxA shall

obtain clarification, as needed, from the A/E regarding sequences and operation to develop these tests.

ii. The CxA shall provide the draft FPTs to the Cx Team (to include the installing subcontractor) for review and comment on the testing approach, level of rigor, ability to prove system intent, feasibility, safety, warranty and equipment protection.

iii. The CxA shall respond to and incorporate Cx Team comments (as applicable and as approved by the COR).

f. Final Procedures

i. Upon incorporation of the Cx Team comments (as applicable and as approved by the COR), the CxA shall distribute the FPT as Final (aka Approved for Use).

g. Blank copies of the procedures shall be provided by the CxA to the COR with the Final Cx Report for future use by operations staff.

5.S. Systems Manual - Acceptance Phase

1. Standard Operation & Maintenance (O&M) Manuals

a. The O&M Manual and warranty submissions shall consist of a draft and a final, per specification requirements. The draft shall consist of O&M Manuals and progress submissions of as-builts.

b. The CxA shall review the O&M Manuals and progress submissions of the as-builts for applicability of use during operator training.

c. In accordance with the timeline identified in the specifications, the GC shall provide final documentation and redlined as-builts for commissioned systems to verify compliance with the specifications. This review process does not supersede or replace any reviews provided by the A/E.

d. The CxA shall recommend approval and acceptance of these submissions to the COR.

e. The CxA shall review each equipment warranty and verify all requirements are met to maintain the warranty. The CxA shall advise the COR of approval and acceptance recommendations.

f. When possible, and at no additional expense to the Owner, the contractor shall provide the required documentation in an electronic, Microsoft Word searchable and fully text retrievable format.

2. As applicable to the scope of the project, the Contractor shall augment the O&M Manuals with systems level content, as required in the specifications.

5.T. Execution of Functional Performance Testing - Acceptance Phase

1. Testing Plan/Schedule Overview

a. The sequence of FPTs within the overall construction and acceptance process is performed after installation, and

i. after all initial Quality Control and inspection testing,
ii. after construction completion,
iii. after Pre-Functional Checklist completion, and
iv. before final acceptance of the project by the COR.

b. Testing shall be performed starting with components to subsystems to systems and finally to interlocks and connections between systems.
c. The Commissioning Issues Log shall be maintained by the CxA and provided to the Cx Team. The Commissioning Issues Log provides a current status of the prerequisites to Functional Performance Testing, as well as the status of Functional Performance Testing. The form assists the Cx Team in moving more efficiently to functional testing.
d. The detailed FPT execution schedule is updated and maintained by the GC and provided to the Cx Team.

i. The form shall identify which contractors are needed for each test and the anticipated level of effort.
ii. The GC shall update and publish the FPT execution schedule weekly, or more often as warranted, during the testing phase of the project.
iii. The GC shall coordinate all scheduled FPT execution dates with the COR and the CxA up to two-weeks prior to the start of testing for each FPT. This notice allows the Owner and the CxA to plan and schedule the appropriate resources to witness the testing.
iv. The GC shall coordinate attendance of all required team members at functional testing.

2. Testing Process

a. The GC shall schedule functional tests through the COR with notification to the CxA. The GC shall also coordinate participation by the appropriate subcontractors.
b. For any given system, prior to performing functional testing, the CxA shall wait until the Pre-Functional Checklist has been submitted with the necessary signatures, confirming the system is ready for functional testing.
c. The CxA shall coordinate the process, witnesses and document the functional testing of all equipment and systems according to this Commissioning Plan.
d. The GC shall execute the tests in coordination with the CxA. The GC shall assign the execution work to the appropriate subcontractors.
e. The control system functional performance testing shall be successfully completed before it is implemented to verify performance of other components or systems.

3. Deficiencies and Re-Testing

a. The CxA documents the results of the test (including all encountered deficiencies, regardless of whether they are fixed during testing).
b. Minor deficiencies identified during the tests shall be corrected during testing if correcting them immediately will be less disruptive to the test schedule than correcting and re-testing them at a later time.

c. Deficiencies not corrected during testing shall be corrected at a later time and scheduled by the GC for re-testing and in accordance with the FPT scheduling process (two-weeks notification required or as mutually agreed upon by the COR, CxA, and Contractor).
d. The CxA shall record the results of the testing on the test form, summarize those results in a Daily Commissioning Report and update the status on the Commissioning Issues Log.
e. Deficiencies or non-conformance issues shall be noted and reported to the COR and GC on the Commissioning Issues Log.
f. Subcontractors shall correct deficiencies and notify the GC of the resolved status. The GC shall notify the COR and shall schedule re-testing, as applicable.
g. The GC shall be responsible for confirming all deficiencies have been corrected prior to scheduling of re-testing.
h. The GC shall schedule retesting through the COR with notification to the CxA. The GC shall also coordinate the participation of the applicable subcontractor(s). Subcontractors shall correct items independently and separately from the scheduled retesting time. Subcontractors shall make every attempt to correct the deficiency prior to CxA re-test witnessing. If the CxA returns to the site and determines that a reportedly corrected issue is not corrected, the Contractor shall be at risk of being back-charged by the COR for the CxA visit or a portion thereof, however, the CxA and COR will also be flexible with this determination.
i. Final authority resides with the COR in areas of dispute. Based on the results of the testing, the CxA recommends acceptance of each completed test to the COR.
j. The COR gives final approval on each test.
k. The CxA shall categorize each completed FPT as one of the three following categories:
    i. Accepted (A) – all functional performance test steps passed on the first time that they were attempted with no corrections or retesting required.
    ii. Accepted with Corrective Measures (AWCM) – a corrective measure was required to be taken during the initial testing in order for all functional performance test steps to pass.
    iii. Accepted with Retest Required (AWRT) – functional performance test was not able to pass all steps during the initial testing and requires retesting at a later time/date.

4. Facility Staff Participation

a. The Owner's facilities operating staff are encouraged to attend and participate in the testing process. Operating staff shall be kept aware of the testing activities through the COR and by reviewing the most recent construction schedule.
b. The Owner AHJ shall be present at acceptance testing of Fire Alarm/Fire Protection and Life Safety systems. The contractor shall coordinate and notify the AHJ a minimum of fourteen (14) calendar days prior to testing. Testing that has not been witnessed by the AHJ shall not be accepted.

5. Phased Testing

a. Due to the nature of some projects, functional testing may be executed in phases, as is practical without compromising the intent of the functional performance testing.
b. Phased projects that necessitate performing commissioning activities out of sequence (i.e. PFC or FPT) shall be carefully reviewed by the Cx Team and approved by the COR.

6. Sampling

a. There is no sampling of FPTs. All procedures are observed.

5.U. Training and Orientation of Owner Personnel - Acceptance Phase

1. Operator training shall be scheduled and coordinated to take place after Functional Performance Testing to ensure system functionality is able to be successfully demonstrated for the training sessions.

a. After COR approval of the Specific Training Agenda, the GC shall submit all training materials and handouts for COR review and approval.
b. During the training, the GC's trainer provides a copy of the agenda and all training materials and handouts to each trainee.
c. Training Record. During each training session, the GC's trainer signs for the session and obtains the signature of each trainee. The trainer also checks off subjects covered on the Agenda. When the training is complete, the GC provides one copy of all approved Training materials and handouts to the Owner and CxA.
d. The Owner and CxA review training submittals and make final approval by signing it.
e. The CxA may witness any of the training sessions.

2. Phased Projects

a. Operator training shall be scheduled and coordinated to take place prior to functional performance testing and shall clearly differentiate the operations, maintenance, emergency service and warranty responsibility for the equipment and systems included in the project.
b. For phased projects that require turnover of equipment or systems from the GC to the COR, prior to project completion, the GC shall coordinate training to take place prior to the turnover of each system or piece of equipment, at the completion of the project, and prior to any phase of the project that results in the modification of the integration and/or interoperability of any equipment or systems.
c. Recognizing that projects may include the turnover of identical equipment or systems, the COR may elect to receive refresher training during or after the phased project rather than repeating the full initial training. This determination shall be made by the COR during the Cx meetings (or Construction Progress Meetings) and prior to the initial training submittals.

5.V. Final Commissioning Report - Acceptance Phase

1. A final commissioning report by the CxA shall be provided to the COR within sixty (60) days of the completion of functional performance testing.

2. The report shall include an
   a. Executive Summary,
   b. List of Participants and Roles,
   c. Brief Building Description,
   d. Overview of Commissioning and Testing Scope, and
   e. General Description of Testing and Verification Methods as well as findings.
3. For each piece of commissioned equipment, the report shall contain the disposition of the commissioning authority regarding the adequacy of the equipment and documentation per compliance with the contract documents in the following areas:
   a. Functional performance and efficiency (ability of equipment to function as specified)
   b. Equipment documentation (e.g., submittals) and design intent
4. All outstanding non-compliance Cx items shall be specifically listed. Each non-compliance issue shall be referenced to the specific functional test, inspection, trend log, etc. where the deficiency is documented. An updated copy of the Cx issues log shall fulfill this requirement.
5. Recommendations for improvement to equipment or operations, future actions, commissioning process changes, etc. shall also be listed.
6. The functional performance and efficiency section for each piece of equipment shall include a brief description of the verification method used (manual testing, BAS trend logs, data loggers, etc.) and include observations and conclusions from the testing.
7. Appendices shall contain:
   a. Cx Issues logs
   b. Cx meeting minutes
   c. Cx Site Visit Reports
   d. Unresolved issues
   e. Completed Pre-Functional Checklists, functional performance tests, and integrated systems tests
   f. Blank Pre-Functional Checklists, functional performance tests, and integrated systems tests
   g. Operation and Maintenance Manuals

5.W. Warranty Phase Commissioning

1. Start of the warranty period for each piece of equipment, cable or protective device is defined elsewhere in the project specifications.
2. During the warranty phase, seasonal testing and other deferred testing (if contracted) may be completed at this time.
   a. The CxA shall coordinate this activity with the assistance and cooperation of the COR & GC, as required in the contract documents.

b. Tests are executed and any deficiencies shall be corrected by the appropriate subcontractors and witnessed by facilities staff and/or the CxA.
c. Any final adjustments to the O&M Manuals and as-builts due to the testing shall be made by the GC. Refer to applicable specification sections for seasonal testing details for this project.

3. In addition, the CxA shall return to the project approximately 10-months into the 12-month warranty period to conduct a Warranty Phase Cx Review. During the visit, the CxA shall

a. Review with facility staff the current building operation and the condition of outstanding issues related to the original and seasonal commissioning,
b. Interview facility staff and identify problems or concerns.
c. Offer suggestions for improvements and for recording these changes in the O&M manuals,
d. Identify areas that may be under warranty or under the original construction contract,
e. Assist facility staff in developing reports, documents and requests for services to remedy outstanding problems.

6. Schedule

6.A. General Issues

1. The following sequential priorities shall be followed:
   a. In order to avoid damaging equipment, equipment shall not be "temporarily" started (for heating or cooling), until Pre-Functional Checklist items and all manufacturers' pre-start and start-up procedures are completed and moisture, dust and other environmental and building integrity issues have been addressed.
   b. Functional performance testing shall not begin until start-up and Pre-Functional Checklists are completed for a given system (this does not preclude a phased approach).
   c. The controls system and equipment it controls are not functionally tested until all points have been calibrated and Pre-Functional Checklists completed.

6.B. Project Schedule

1. Commissioning activities for inclusion into the GC's master shall be provided.
2. A tentative schedule is provided below for information only, the final schedule will be included in the GC's master schedule:

Table 2. Initial Commissioning Schedule

Initial Commissioning Schedule		
Commissioning Task	Estimated Start	Deliverable
Review and Comment on OPR	1 week post contractor award	N/A
Design Document Review(s)	10 working days after receipt	Design Review Log
BOD/DID Review	10 working days after receipt	Design Review Log
Develop Cx Specifications	10 working days after design review	Cx Specifications
Preliminary Cx Plan	20 Days of Notice To Proceed	Preliminary Cx Plan
Construction Kickoff Meeting	20 Days of Notice To Proceed	Meeting Minutes
Commissioning Duration Schedule	10 working days after kickoff meeting	Cx Duration Schedule
Final Commissioning Plan	10 working days after kickoff meeting	Final Cx Plan
Submittal Reviews	5 working days after receipt	Submittal Review Log

Initial Commissioning Schedule		
Commissioning Task	Estimated Start	Deliverable
Commissioning Progress Meetings	Ongoing	Meeting Minutes
Construction Site Observations	Ongoing	Meeting Minutes
Draft PFC/FPTs	1 month after all submittal reviews	Draft PFC/FPTs
Final PFC/FPTs	10 working days after review period	Final PFC/FPTs
Submitted PFC Review	5 working days after receipt	Cx Issues Log
PFC Spot-Check	10 working days after receipt	Cx Issues Log Site Observation Report
Functional Testing	10 working days after receipt	Cx Issues Log Site Observation Report
Systems Manual	1 month after functional testing	Systems Manual
Systems Training	1 month after functional testing	Training Agenda Training Materials
Final Commissioning Report	1 month after issue resolutions	Final Cx Report
Deferred Systems Testing	Attempted to occur during Monthly shutdown. If not, 3 year shutdown that occurs where applicable.	Cx Issues Log Site Observation Report
Warranty Phase Site Visit	10 months after substantial completion	Cx Issues Log Site Observation Report
Warranty Addendum Report	10 working days after Warranty Phase Site Visit	Cx Report Addendum

7. Construction Phase Commissioning Plan Revision History

7.A. Revision History

This revision log shall be utilized to document changes and updates to these procedures AFTER the initial approved procedure has been released. Changes shall be accepted by the Owner's Representative initials in the table below.

Revision	Date	By	Description	PM Initials
00	01/22/2025	CM	DRAFT Cx Plan	ATG

Appendix A: Roles & Responsibilities

Commissioning Team Roles and Responsibilities Design Phase						
Phase	**Project Phase/Cx Task (ref Table above for description)**	**Commissioning Team Member Responsibilities**				
		VA PM	**VA-CFM**	**VAMC**	**A/E Team**	**Commissioning Agent**
SD-2	Design Submission Review	Facilitate delivery of Design Submission Documents to Commissioning Agent Review Commissioning Agent Issues Log & Provide Feedback as appropriate Facilitate Resolution of Comments by A/E Team	Review Commissioning Agent Issues Log & Provide Feedback as appropriate	Review Commissioning Agent Issues Log & Provide Feedback as appropriate	Deliver Documents to Commissioning Agent for review. Review Commissioning Agent Issues Log Provide Written Responses to Issues	Review and comment on SD2 Design Review Log. Provide clarifications as required. Record resolution for each issues based on A/E Response

Commissioning Team Roles and Responsibilities Design Phase						
Phase	**Project Phase/Cx Task (ref Table above for description)**	**Commissioning Team Member Responsibilities**				
		VA PM	**VA-CFM**	**VAMC**	**A/E Team**	**Commissioning Agent**
SD-2	Design Narrative	Review Design Narrative & Comment	Review Design Narrative & Provide Feedback as appropriate	Review Design Narrative & Provide Feedback as appropriate	Update Design Narrative to Include OPR and Basis of Design response to OPR.	Review Design Narrative for compliance with VA Standards and other stated VA Objectives for project. Provide support for developing measurable performance criteria for installed systems.
SD-2	Commissioning Plan	Distribute Updated Design Phase Cx Plan Review Cx Plan & Comment	Review Cx Plan & Comment	Review Cx Plan & Comment	Review Cx Plan & Comment	Update & Submit Project Commissioning Plan
SD-2	Duration Schedule for Commissioning Activities	Distribute schedule Review and comment	Review and comment	Review and comment	Review schedule and incorporate into project design schedule	Update Duration Schedule for Design Phase Commissioning Activities
SDS-2	Commissioning Specifications					

Commissioning Team Roles and Responsibilities Design Phase						
Phase	**Project Phase/Cx Task (ref Table above for description)**	**Commissioning Team Member Responsibilities**				
		VA PM	**VA-CFM**	**VAMC**	**A/E Team**	**Commissioning Agent**
SD-2	Design Review Meeting	Facilitate Design Review Meeting. Facilitate Resolution of Cx Issues.	Attend Design Review Meeting as required by other VA requirements. Participate in Issue Resolution as appropriate.	Attend Design Review Meeting as required by other VA requirements. Participate in Issue Resolution as appropriate.	Attend Design Review Meeting. Provide responses to and clarifications of identified Commissioning Issues.	Attend Design Review Meeting. Provide clarification and facilitate resolution to Commissioning Issues Identified
SD-2	Design Phase Issue Log Resolution	Review & Comment on Revised Design Phase Commissioning Issues Log	Review & Comment on Revised Design Phase Commissioning Issues Log	Review & Comment on Revised Design Phase Commissioning Issues Log	Review & Comment on Revised Design Phase Commissioning Issues Log	Record resolutions to Cx Issues on the Design Phase Commissioning Issues Log.

Commissioning Team Roles and Responsibilities Design Phase						
Phase	**Project Phase/Cx Task (ref Table above for description)**	**Commissioning Team Member Responsibilities**				
		VA PM	**VA-CFM**	**VAMC**	**A/E Team**	**Commissioning Agent**
DD-1	Design Submission Review	Facilitate delivery of Design Submission Documents to Commissioning Agent Review Commissioning Agent Issues Log & Provide Feedback as appropriate Facilitate Resolution of Comments by A/E Team	Review Commissioning Agent Issues Log & Provide Feedback as appropriate	Review Commissioning Agent Issues Log & Provide Feedback as appropriate	Deliver Documents to Commissioning Agent for review. Review Commissioning Agent Issues Log Provide Written Responses to Issues	Review and comment on DD1 Design Review Log. Provide clarifications as required. Record resolution for each issues based on A/E Response

Commissioning Team Roles and Responsibilities Design Phase						
Phase	**Project Phase/Cx Task (ref Table above for description)**	**Commissioning Team Member Responsibilities**				
		VA PM	**VA-CFM**	**VAMC**	**A/E Team**	**Commissioning Agent**
DD-1	Design Narrative	Review Design Narrative & Comment	Review Design Narrative & Provide Feedback as appropriate	Review Design Narrative & Provide Feedback as appropriate	Update Design Narrative to Include OPR and Basis of Design response to OPR.	Review Design Narrative for compliance with VA Standards and other stated VA Objectives for project. Provide support for developing measurable performance criteria for installed systems.
DD-1	Design Phase Controls Meeting	Facilitate and schedule meeting. Participate in meeting	Attend and participate in meeting	Attend and participate in meeting	Chair meeting Attend and participate in meeting	Attend and participate in meeting
DD-1	Commissioning Plan	Distribute Updated Design Phase Cx Plan Review Cx Plan & Comment	Review Cx Plan & Comment	Review Cx Plan & Comment	Review Cx Plan & Comment	Update & Project Commissioning Plan

Commissioning Team Roles and Responsibilities Design Phase						
Phase	**Project Phase/Cx Task (ref Table above for description)**	**Commissioning Team Member Responsibilities**				
		VA PM	**VA-CFM**	**VAMC**	**A/E Team**	**Commissioning Agent**
DD-1	Duration Schedule for Commissioning Activities	Distribute schedule Review and comment	Review and comment	Review and comment	Review schedule and incorporate into project design schedule	Update Duration Schedule for Design Phase Commissioning Activities Prepare draft duration schedule for Construction Phase Commissioning Activities
DD-1	Commissioning Specification	Review Cx Draft Specs & Comment	Review Cx Draft Specs & Comment	Review Cx Draft Specs & Comment	Incorporate Draft Cx Specifications into Project Specification Submittal. Review Cx Draft Specs & Comment	Develop Draft Cx Specifications & Cx Coordination Matrix. Deliver to A/E Team for incorporation into Specification Submittal.
DD-1	Design Review Meeting	Facilitate Design Review Meeting. Facilitate Resolution of Cx Issues.	Attend Design Review Meeting as required by other VA requirements. Participate in Issue Resolution as appropriate.	Attend Design Review Meeting as required by other VA requirements. Participate in Issue Resolution as appropriate.	Attend Design Review Meeting. Provide responses to and clarifications of identified Commissioning Issues.	Attend Design Review Meeting. Provide clarification and facilitate resolution to Commissioning Issues Identified

Commissioning Team Roles and Responsibilities Design Phase						
Phase	**Project Phase/Cx Task (ref Table above for description)**	**Commissioning Team Member Responsibilities**				
		VA PM	**VA-CFM**	**VAMC**	**A/E Team**	**Commissioning Agent**
DD-1	Design Phase Issue Log Resolution	Review & Comment on Revised Design Phase Commissioning Issues Log	Review & Comment on Revised Design Phase Commissioning Issues Log	Review & Comment on Revised Design Phase Commissioning Issues Log	Review & Comment on Revised Design Phase Commissioning Issues Log	Record resolutions to Cx Issues on the Design Phase Commissioning Issues Log.
DD-2	Design Submission Review	Facilitate delivery of Design Submission Documents to Commissioning Agent Review Commissioning Agent Issues Log & Provide Feedback as appropriate Facilitate Resolution of Comments by A/E Team	Review Commissioning Agent Issues Log & Provide Feedback as appropriate	Review Commissioning Agent Issues Log & Provide Feedback as appropriate	Deliver Documents to Commissioning Agent for review. Review Commissioning Agent Issues Log Provide Written Responses to Issues	Review and comment on DD2 Design Review Log. Provide clarifications as required. Record resolution for each issues based on A/E Response

DD-2	Design Narrative	Review Design Narrative & Comment	Review Design Narrative & Provide Feedback as appropriate	Review Design Narrative & Provide Feedback as appropriate	Review Updated Design Narrative to Include OPR and Basis of Design response to OPR.	Commissioning Agent to update, review and reconcile the Project Design Narrative. The Design Narrative should reflect the evolution of the project design and note all significant deviations from prior version for ease of review and reconciliation. Design Narrative should describe designer's response to the project requirements. Where appropriate, provide documentation of approval of deviations from VA Design Criteria and reasoning for same. Provide support for developing measurable performance criteria for installed systems.
DD-2	Preliminary Pre-Functional Checklists and Preliminary System Functional	Distribute to Cx Team. Review and comment	None	Review and Comment	Review and Comment	Prepare Preliminary PFC and FPT. Incorporate review comments into the Draft

Commissioning Team Roles and Responsibilities Design Phase						
Phase	**Project Phase/Cx Task (ref Table above for description)**	**Commissioning Team Member Responsibilities**				
		VA PM	**VA-CFM**	**VAMC**	**A/E Team**	**Commissioning Agent**
	Performance Test Procedures					PFCs and FPTs as appropriate.
DD-2	Design Phase Controls Meeting	Facilitate and schedule meeting. Participate in meeting	Attend and participate in meeting	Attend and participate in meeting	Chair meeting Attend and participated in meeting	Attend and participate in meeting
DD-2	Commissioning Plan	Distribute Updated Design Phase Cx Plan Review Cx Plan & Comment	Review Cx Plan & Comment	Review Cx Plan & Comment	Review Cx Plan & Comment	Update & Submit Project Commissioning Plan

Commissioning Team Roles and Responsibilities Design Phase						
Phase	**Project Phase/Cx Task (ref Table above for description)**	**Commissioning Team Member Responsibilities**				
		VA PM	**VA-CFM**	**VAMC**	**A/E Team**	**Commissioning Agent**
DD-2	Commissioning Specification	Review Cx Preliminary Specs & Comment	Review Cx Draft Preliminary & Comment	Review Cx Draft Preliminary & Comment	Incorporate Preliminary Cx Specifications into Project Specification Submittal. Review Cx Draft Specs & Comment	Develop Preliminary Cx Specifications & Cx Coordination Matrix. Deliver to A/E Team for incorporation into Specification Submittal.
DD-2	Duration Schedule for Commissioning Activities	Distribute schedule Review and comment	Review and comment	Review and comment	Review schedule and incorporate into project design schedule	Update Duration Schedule for Design Phase Commissioning Activities Update draft duration schedule for Construction Phase Commissioning Activities

Commissioning Team Roles and Responsibilities Design Phase						
Phase	**Project Phase/Cx Task (ref Table above for description)**	**Commissioning Team Member Responsibilities**				
		VA PM	**VA-CFM**	**VAMC**	**A/E Team**	**Commissioning Agent**
DD-2	Design Review Meeting	Facilitate Design Review Meeting. Facilitate Resolution of Cx Issues.	Attend Design Review Meeting as required by other VA requirements. Participate in Issue Resolution as appropriate.	Attend Design Review Meeting as required by other VA requirements. Participate in Issue Resolution as appropriate.	Attend Design Review Meeting. Provide responses to and clarifications of identified Commissioning Issues.	Attend Design Review Meeting. Provide clarification and facilitate resolution to Commissioning Issues Identified
DD-2	Design Phase Issue Log Resolution	Review & Comment on Revised Design Phase Commissioning Issues Log	Review & Comment on Revised Design Phase Commissioning Issues Log	Review & Comment on Revised Design Phase Commissioning Issues Log	Review & Comment on Revised Design Phase Commissioning Issues Log	Record resolutions to Cx Issues on the Design Phase Commissioning Issues Log.

Commissioning Team Roles and Responsibilities Design Phase						
Phase	**Project Phase/Cx Task (ref Table above for description)**	**Commissioning Team Member Responsibilities**				
		VA PM	**VA-CFM**	**VAMC**	**A/E Team**	**Commissioning Agent**
CD-1	Design Submission Review	Facilitate delivery of Design Submission Documents to Commissioning Agent Review Commissioning Agent Issues Log & Provide Feedback as appropriate Facilitate Resolution of Comments by A/E Team	Review Commissioning Agent Issues Log & Provide Feedback as appropriate	Review Commissioning Agent Issues Log & Provide Feedback as appropriate	Deliver Documents to Commissioning Agent for review. Review Commissioning Agent Issues Log Provide Written Responses to Issues	Review and comment on CD1 Design Review Log. Provide clarifications as required. Record resolution for each issues based on A/E Response

Commissioning Team Roles and Responsibilities Design Phase						
Phase	**Project Phase/Cx Task (ref Table above for description)**	**Commissioning Team Member Responsibilities**				
		VA PM	**VA-CFM**	**VAMC**	**A/E Team**	**Commissioning Agent**
CD-1	Design Narrative	Review Design Narrative & Comment	Review Design Narrative & Provide Feedback as appropriate	Review Design Narrative & Provide Feedback as appropriate	Review Design Narrative for conformance with current project status. Verify recorded decisions are consistent with Design Team intent and contracts with the VA.	Commissioning Agent to update, review and reconcile the Project Design Narrative. The Design Narrative should reflect the evolution of the project design and note all significant deviations from prior version for ease of review and reconciliation. Design Narrative should describe designer's response to the project requirements. Where appropriate, provide documentation of approval of deviations from VA Design Criteria and reasoning for same.

Commissioning Team Roles and Responsibilities Design Phase						
Phase	**Project Phase/Cx Task (ref Table above for description)**	**Commissioning Team Member Responsibilities**				
		VA PM	**VA-CFM**	**VAMC**	**A/E Team**	**Commissioning Agent**
CD-1	Draft Pre-Functional Checklists and Functional Performance Test procedures	Distribute to team Review and comment	None	Review and Comment	Review and comment	Starting from the Preliminary PFCs and FPTs and review comments, develop Draft PFCx and FPTs. Incorporate into the Construction Phase Commissioning Plan and Commissioning Specifications.
CD-1	Design Phase Controls Meeting	Facilitate and schedule meeting. Participate in meeting	Attend and participate in meeting	Attend and participate in meeting	Chair meeting Attend and participated in meeting	Attend and participate in meeting
CD-1	Commissioning Plan	Distribute Updated Design Phase Cx Plan Review Cx Plan & Comment	Review Cx Plan & Comment	Review Cx Plan & Comment	Review Cx Plan & Comment	Update & Submit Project Commissioning Plan

Commissioning Team Roles and Responsibilities Design Phase						
Phase	**Project Phase/Cx Task (ref Table above for description)**	**Commissioning Team Member Responsibilities**				
		VA PM	**VA-CFM**	**VAMC**	**A/E Team**	**Commissioning Agent**
CD-1	Duration Schedule for Commissioning Activities	Distribute schedule Review and comment	Review and comment	Review and comment	Review schedule and incorporate into project design schedule	Update Duration Schedule for Design Phase Commissioning Activities Update draft duration schedule for Construction Phase Commissioning Activities
CD-1	Commissioning Specification	Review Cx Final Specs & Comment	Review Cx Final Specs & Comment	Review Cx Final Specs & Comment	Incorporate Final Cx Specifications into Project Specification Submittal. Review Cx Final Specs & Comment	Develop Final Cx Specifications & Cx Coordination Matrix. Deliver to A/E Team for incorporation into Specification Submittal.

Commissioning Team Roles and Responsibilities Design Phase						
Phase	**Project Phase/Cx Task (ref Table above for description)**	**Commissioning Team Member Responsibilities**				
		VA PM	**VA-CFM**	**VAMC**	**A/E Team**	**Commissioning Agent**
CD-1	Design Review Meeting	Facilitate Design Review Meeting. Facilitate Resolution of Cx Issues.	Attend Design Review Meeting as required by other VA requirements. Participate in Issue Resolution as appropriate.	Attend Design Review Meeting as required by other VA requirements. Participate in Issue Resolution as appropriate.	Attend Design Review Meeting. Provide responses to and clarifications of identified Commissioning Issues.	Attend Design Review Meeting. Provide clarification and facilitate resolution to Commissioning Issues Identified
CD-1	Design Phase Issue Log Resolution	Review & Comment on Revised Design Phase Commissioning Issues Log	Review & Comment on Revised Design Phase Commissioning Issues Log	Review & Comment on Revised Design Phase Commissioning Issues Log	Review & Comment on Revised Design Phase Commissioning Issues Log	Record resolutions to Cx Issues on the Design Phase Commissioning Issues Log.

Commissioning Team Roles and Responsibilities Design Phase						
Phase	**Project Phase/Cx Task (ref Table above for description)**	**Commissioning Team Member Responsibilities**				
		VA PM	**VA-CFM**	**VAMC**	**A/E Team**	**Commissioning Agent**
Final	Design Final Design Submission Review	Facilitate delivery of Design Submission Documents to Commissioning Agent Facilitate Resolution of Comments by A/E Team	None	None	Deliver Documents to Commissioning Agent for review. Review Commissioning Agent Issues Log Provide Written Responses to all Outstanding Issues	Review Final Design Submission for resolution of Outstanding Commissioning Issues

Commissioning Team Roles and Responsibilities Design Phase						
Phase	**Project Phase/Cx Task (ref Table above for description)**	**Commissioning Team Member Responsibilities**				
		VA PM	**VA-CFM**	**VAMC**	**A/E Team**	**Commissioning Agent**
Final	Design Narrative	Review & Approve Final Design Narrative	None	None	Review Design Narrative for conformance with current project status. Verify recorded decisions are consistent with Design Team intent and contracts with the VA.	Commissioning Agent to provide Final Project Design Narrative. The Design Narrative should reflect the evolution of the project design and note all significant deviations from prior version for ease of review and reconciliation. Design Narrative should describe designer's response to the project requirements. Where appropriate, provide documentation of approval of deviations from VA Design Criteria and reasoning for same.

Commissioning Team Roles and Responsibilities Design Phase						
Phase	**Project Phase/Cx Task (ref Table above for description)**	**Commissioning Team Member Responsibilities**				
		VA PM	**VA-CFM**	**VAMC**	**A/E Team**	**Commissioning Agent**
Final	Commissioning Plan	Distribute Updated Design Phase Cx Plan Review Cx Plan & Comment	Review Cx Plan & Comment	Review Cx Plan & Comment	Review Cx Plan & Comment	Update & Submit Project Commissioning Plan
Final	Draft Pre-Functional Checklists and Functional Performance Test procedures	Distribute Review and back-check	None	Review and back-check	Review and back-check	Incorporate back-check comments into the Draft PFCs and FPTs; incorporate into the Commissioning Plan and Final Commissioning Specifications.
Final	Duration Schedule for Commissioning Activities	Distribute schedule Review and comment	Review and comment	Review and comment	Review schedule and incorporate into project design schedule	Update Duration Schedule for Design Phase Commissioning Activities Update draft duration schedule for Construction Phase Commissioning Activities

Commissioning Team Roles and Responsibilities Design Phase						
Phase	**Project Phase/Cx Task (ref Table above for description)**	**Commissioning Team Member Responsibilities**				
		VA PM	**VA-CFM**	**VAMC**	**A/E Team**	**Commissioning Agent**
Final	Commissioning Specification	Review Cx Updated Specs & Approve	Review Cx Updated Specs & Comment	Review Cx Updated Specs & Comment	Incorporate Updated Cx Specifications into Project Specification Submittal.	Provide updated Final Cx Specifications & Cx Coordination Matrix. Deliver to A/E Team for incorporation into Specification Submittal.
Final	Design Phase Issue Log Resolution	Review & Comment on Revised Design Phase Commissioning Issues Log	None	N one	None	Record resolutions to Cx Issues on the Design Phase Commissioning Issues Log.
Final	Design Phase Commissioning Report	Review, comment and approve	Review and Comment	Review and Comment	Review and Comment	Prepare and submit Design Phase Commissioning Report.

Appendix B: Detailed Commissioning Team Roles & Responsibilities Matrix (per VA spec 01 91 00)

The following table outlines the roles and responsibilities for the Commissioning Team members during the Construction Phase:

Construction Phase		CxA = Commissioning Agent RE = Resident Engineer A/E = Design Arch/Engineer PC = Prime Contractor O&M = Gov't Facility O&M				
Commissioning Roles & Responsibilities (L = Lead, P = Participate, A = Approve, R = Review, O = Optional)						
Category	Task Description	CxA	RE	A/E	PC	O&M
Meetings	Construction Commissioning Kick Off meeting	L	A	P	P	O
	Commissioning Meetings	L	A	P	P	O
	Project Progress Meetings	P	A	P	L	O
	Controls Meeting	L	A	P	P	O
Coordination	Coordinate with [OGC's, AHJ, Vendors, etc.] to ensure that Cx interacts properly with other systems as needed to support the OPR and BOD.	L	A	P	P	N/A
Cx Plan & Spec	Final Commissioning Plan	L	A	R	R	O
Schedules	Duration Schedule for Commissioning Activities	L	A	R	R	N/A
OPR and BOD	Maintain OPR on behalf of Owner	L	A	R	R	O
	Maintain BOD/DID on behalf of Owner	L	A	R	R	O
Document Reviews	TAB Plan Review	L	A	R	R	O
	Submittal and Shop Drawing Review	R	A	R	L	O
	Review Contractor Equipment Startup Checklists	L	A	R	R	N/A
	Review Change Orders, ASI, and RFI	L	A	R	R	N/A
Site Observations	Witness Factory Testing	P	A	P	L	O
	Construction Observation Site Visits	L	A	R	R	O
Functional Test Protocols	Final Pre-Functional Checklists	L	A	R	R	O
	Final Functional Performance Test Protocols	L	A	R	R	O
Technical Activities	Issues Resolution Meetings	P	A	P	L	O
Reports and Logs	Status Reports	L	A	R	R	O
	Maintain Commissioning Issues Log	L	A	R	R	O

The following table outlines the roles and responsibilities for the Commissioning Team members during the Acceptance Phase:

Acceptance Phase		CxA = Commissioning Agent RE = Resident Engineer A/E = Design Arch/Engineer PC = Prime Contractor O&M = Gov't Facility O&M				
Commissioning Roles & Responsibilities (L = Lead, P = Participate, A = Approve, R = Review, O = Optional)						
Category	Task Description	CxA	RE	A/E	PC	O&M
Meetings	Commissioning Meetings	L	A	P	P	O
	Project Progress Meetings	P	A	P	L	O
	Pre-Test Coordination Meeting	L	A	P	P	O
	Lessons Learned and Commissioning Report Review Meeting	L	A	P	P	O
Coordination	Coordinate with [OGC's, AHJ, Vendors, etc.] to ensure that Cx interacts properly with other systems as needed to support OPR and BOD	L	P	P	P	O
Cx Plan & Spec	Maintain/Update Commissioning Plan	L	A	R	R	O
Schedules	Prepare Functional Test Schedule	L	A	R	R	O
OPR and BOD	Maintain OPR on behalf of Owner	L	A	R	R	O
	Maintain BOD/DID on behalf of Owner	L	A	R	R	O
Document Reviews	Review Completed Pre-Functional Checklists	L	A	R	R	O
	Pre-Functional Checklist Verification	L	A	R	R	O
	Review Operations & Maintenance Manuals	L	A	R	R	R
	Training Plan Review	L	A	R	R	R
	Warranty Review	L	A	R	R	O
	Review TAB Report	L	A	R	R	O
Site Observations	Construction Observation Site Visits	L	A	R	R	O
	Witness Selected Equipment Startup	L	A	R	R	O
Functional Test Protocols	TAB Verification	L	A	R	R	O
	Systems Functional Performance Testing	L	A	P	P	P
	Retesting	L	A	P	P	P
Technical Activities	Issues Resolution Meetings	P	A	P	L	O
	Systems Training	L	S	R	P	P
Reports and Logs	Status Reports	L	A	R	R	O
	Maintain Commissioning Issues Log	L	A	R	R	O
	Final Commissioning Report	L	A	R	R	R
	Prepare Systems Manuals	L	A	R	R	R

The following table outlines the roles and responsibilities for the Commissioning Team members during the Warranty Phase:

Warranty Phase		CxA = Commissioning Agent RE = Resident Engineer A/E = Design Arch/Engineer PC = Prime Contractor O&M = Gov't Facility O&M				
Commissioning Roles & Responsibilities (L = Lead, P = Participate, A = Approve, R = Review, O = Optional)						
Category	Task Description	CxA	RE	A/E	PC	O&M
Meetings	Post-Occupancy User Review Meeting	L	A	O	P	P
Site Observations	Periodic Site Visits	L	A	O	O	P
Functional Test Protocols	Deferred and/or seasonal Testing	L	A	O	P	P
Technical Activities	Issues Resolution Meetings	L	S	O	O	P
	Post-Occupancy Warranty Checkup and review of Significant Outstanding Issues	L	A		R	P
Reports and Logs	Final Commissioning Report Amendment	L	A		R	R
	Status Reports	L	A		R	R

Appendix C: Sample PFC and FPT Forms

(These documents will be updated during the design phase to be project specific. They will include all items included on VA example PFC/FPTs)

2207 Garnet Avenue Suite I
San Diego, CA 92109
Direct: (619) 770-8552

Exhaust Fan
Pre-Functional Checklist

Project:	VA CT West Haven EHRM Infrastructure Upgrade
Building:	
Project Location:	West Haven, CT
Equipment ID:	
Equipment Location:	
Manufacturer:	
Model #:	
Serial #:	
Service:	

Statement of Readiness
The above equipment and/or systems integral to them are complete and ready for functional testing, except as noted. None of the outstanding items preclude safe and reliable functional tests being performed. This checklist does not take the place of the manufacturer's recommended checkout and startup procedures or report.

Responsible Contractor Sign Here

CONTRACTOR	PRINTED NAME	SIGNATURE	DATE
General Contractor (GC)			
Mechanical Contractor (MC)			
Electrical Contractor (EC)			
TAB Contractor (TAB)			
Controls Contractor (CC)			

This statement of readiness has been received by the Commissioning Agent on _____ and will be incorporated as part of the final commissioning report.

1. Delivery Book

A. Model Verification (Note: 1. as specified, 2. as submitted, 3. as installed)		**Enter Note #**	**Comment/Issues**	**Contractor Initial**	**VA CM Intial**	**Date**
1	Manufacturer					
2	Model					
3	Serial Number					
4	Fan Type					
5	Capacity / Static Pressure (cfm / in. wg)					
6	Motor Power / Speed (hp / rpm)					
7	Motor Voltage / Phase / Frequency (V / - / Hz)					
8	Start-up report is complete and has been provided to the GC for approval by the VA					
9	Operation & Maintenance manual has been compiled and provided to the GC for approval by the VA					
10	Training plan and instructor qualifications has been complete and provided to the GC for approval by the VA					
B. Physical Checks		**Yes, No, N/A**	**Comment/Issues**	**Contractor Initial**	**VA CM Intial**	**Date**
1	Unit is free from physical damage					
2	The air openings are sealed with plastic					
3	All components present (belt guard, motor, damper, spring isolators, etc.)					
4	Installation and startup manual provided					
5	Unit tags affixed					

SAMPLE

2207 Garnet Avenue Suite I
San Diego, CA 92109
Direct: (619) 770-8552

2. Construction Checklist

A. Installation of Exhaust Fan		Yes, No, N/A	Comment/Issues	Contractor Initial	VA CM Intial	Date
1	Unit secured as required by manufacturer and specifications					
2	Adequate clearance around unit for service					
3	All components accessible for maintenance					
4	Unit can be removed from the building					
5	Shipping bolts have been removed (if applicable)					
6	Belts are tight (if applicable)					
7	Back draft damper installed and moves freely					
8	Protective shrouds for fan and belts in place and secure					
9	Unit labeled and is easy to see					
B. Ductwork		**Yes, No, N/A**	**Comment/Issues**	**Contractor Initial**	**VA CM Intial**	**Date**
1	Adequate locations available for testing and balancing of unit					
2	All dampers and sensors are accessible (access panels)					
3	Vibration isolators installed					
4	All dampers close tightly and stroke fully and easily					
5	Ductwork is clean and free of debris					
C. Electrical		**Yes, No, N/A**	**Comment/Issues**	**Contractor Initial**	**VA CM Intial**	**Date**
1	Safety disconnect installed in accessible location					
2	Motor rotation in the proper direction					
3	All electrical connections are tight					
4	All electrical components are grounded					
D. Controls - Installation		**Yes, No, N/A**	**Comment/Issues**	**Contractor Initial**	**VA CM Intial**	**Date**
1	Control panel accessible and labeled properly					
2	Dampers actuators installed and calibration verified					
3	Safety items installed and verified (freezestat, high pressure, motor overload, etc.)					
E. Mechanical - Startup		**Yes, No, N/A**	**Comment/Issues**	**Contractor Initial**	**VA CM Intial**	**Date**
1	Unit is clean					
2	Internal isolators free to move					
3	Fans and motors lubricated and aligned					
4	Fan belts have proper tension and are in good condition					
5	System starts and runs without any unusual noise or vibration					
6	Manufacturer's startup checklist completed and attached					
F. Controls - Startup		**Yes, No, N/A**	**Comment/Issues**	**Contractor Initial**	**VA CM Intial**	**Date**
1	Remote start/stop from central system verified					
2	Sequence of control is correct (e.g., interlock)					

SAMPLE

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G. TAB		Yes, No, N/A	Comment/Issues	Contractor Initial	VA CM Intial	Date
1	Air flow, design / actual (cfm)					
2	Pressure drop, design / actual (in. wg)					
3	Fan rotation is in the proper direction					
4	Motor overloads verified					
5	Motor voltage and amps verified - each phase					
6	TAB report is complete and has been provided to the GC for approval by the VA					

SAMPLE

2207 Garnet Avenue Suite I
San Diego, CA 92109
Direct: (619) 770-8552

Supply Fan
Pre-Functional Checklist

Project:	VA CT West Haven EHRM Infrastructure Upgrade
Building:	
Project Location:	West Haven, CT
Equipment ID:	
Equipment Location:	
Manufacturer:	
Model #:	
Serial #:	
Service:	

Statement of Readiness
The above equipment and/or systems integral to them are complete and ready for functional testing, except as noted. None of the outstanding items preclude safe and reliable functional tests being performed. This checklist does not take the place of the manufacturer's recommended checkout and startup procedures or report.

Responsible Contractor Sign Here

CONTRACTOR	PRINTED NAME	SIGNATURE	DATE
General Contractor (GC)			
Mechanical Contractor (MC)			
Electrical Contractor (EC)			
TAB Contractor (TAB)			
Controls Contractor (CC)			

This statement of readiness has been received by the Commissioning Agent on _____ and will be incorporated as part of the final commissioning report.

1. Delivery Book

A. Model Verification (Note: 1. as specified, 2. as submitted, 3. as installed)		**Enter Note #**	**Comment/Issues**	**Contractor Initial**	**VA CM Intial**	**Date**
1	Manufacturer					
2	Model					
3	Serial Number					
4	Fan Type					
5	Capacity / Static Pressure (cfm / in. wg)					
6	Motor Power / Speed (hp / rpm)					
7	Motor Voltage / Phase / Frequency (V / - / Hz)					
8	Start-up report is complete and has been provided to the GC for approval by the VA					
9	Operation & Maintenance manual has been compiled and provided to the GC for approval by the VA					
10	Training plan and instructor qualifications has been complete and provided to the GC for approval by the VA					
B. Physical Checks		**Yes, No, N/A**	**Comment/Issues**	**Contractor Initial**	**VA CM Intial**	**Date**
1	Unit is free from physical damage					
2	The air openings are sealed with plastic					
3	All components present (belt guard, motor, damper, spring isolators, etc.)					
4	Installation and startup manual provided					
5	Unit tags affixed					

SAMPLE

2207 Garnet Avenue Suite I
San Diego, CA 92109
Direct: (619) 770-8552

2. Construction Checklist

A. Installation of Supply Fan		Yes, No, N/A	Comment/Issues	Contractor Initial	VA CM Intial	Date
1	Unit secured as required by manufacturer and specifications					
2	Adequate clearance around unit for service					
3	All components accessible for maintenance					
4	Unit can be removed from the building					
5	Shipping bolts have been removed (if applicable)					
6	Belts are tight (if applicable)					
7	Back draft damper installed and moves freely					
8	Protective shrouds for fan and belts in place and secure					
9	Unit labeled and is easy to see					
B. Ductwork		**Yes, No, N/A**	**Comment/Issues**	**Contractor Initial**	**VA CM Intial**	**Date**
1	Adequate locations available for testing and balancing of unit					
2	All dampers and sensors are accessible (access panels)					
3	Vibration isolators installed					
4	All dampers close tightly and stroke fully and easily					
5	Ductwork is clean and free of debris					
C. Electrical		**Yes, No, N/A**	**Comment/Issues**	**Contractor Initial**	**VA CM Intial**	**Date**
1	Safety disconnect installed in accessible location					
2	Motor rotation in the proper direction					
3	All electrical connections are tight					
4	All electrical components are grounded					
D. Controls - Installation		**Yes, No, N/A**	**Comment/Issues**	**Contractor Initial**	**VA CM Intial**	**Date**
1	Control panel accessible and labeled properly					
2	Dampers actuators installed and calibration verified					
3	Safety items installed and verified (freezestat, high pressure, motor overload, etc.)					
E. Mechanical - Startup		**Yes, No, N/A**	**Comment/Issues**	**Contractor Initial**	**VA CM Intial**	**Date**
1	Unit is clean					
2	Internal isolators free to move					
3	Fans and motors lubricated and aligned					
4	Fan belts have proper tension and are in good condition					
5	System starts and runs without any unusual noise or vibration					
6	Manufacturer's startup checklist completed and attached					
F. Controls - Startup		**Yes, No, N/A**	**Comment/Issues**	**Contractor Initial**	**VA CM Intial**	**Date**
1	Remote start/stop from central system verified					
2	Sequence of control is correct (e.g., interlock)					

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G. TAB		Yes, No, N/A	Comment/Issues	Contractor Initial	VA CM Intial	Date
1	Air flow, design / actual (cfm)					
2	Pressure drop, design / actual (in. wg)					
3	Fan rotation is in the proper direction					
4	Motor overloads verified					
5	Motor voltage and amps verified - each phase					
6	TAB report is complete and has been provided to the GC for approval by the VA					

SAMPLE

DAVENERGY SOLUTIONS
ENGINEERING | CONSTRUCTION MANAGEMENT

2207 Garnet Avenue Suite I
San Diego, CA 92109
Direct: (619) 770-8552

Computer Room Air Conditioner (CRAC) Pre-Functional Checklist

Project:	VA CT West Haven EHRM Infrastructure Upgrade
Building:	
Project Location:	West Haven, CT
Equipment ID:	
Equipment Location:	
Manufacturer:	
Model #:	
Serial #:	
Service:	

1. Delivery Book

A. Model Verification (Note: 1. as specified, 2. as submitted, 3. as installed)		Enter Note #	Comment/ Issues	Contractor Initial	CM Initial	Date
1	Manufacturer					
2	Model					
3	Serial Number					
4	Airflow Rate (cfm)					
5	Total Cooling Capacity (MBH)					
6	Fan Power/Speed (hp/rpm)					
7	Voltage / Phase / Frequency (V/ph/Hz)					
B. Physical Checks		**Yes, No, N/A**	**Comment/ Issues**	**Contractor Initial**	**CM Initial**	**Date**
1	Unit is free from physical damage					
2	All components present					
3	Stabilizers, if present during shipping, have been removed					
4	Unit has been secured to the floor or to an adjacent cabinet					
5	Lower front baffle panel has been removed					
6	The base supports have been adjusted so the unit is level					
7	Tie down brackets are installed if required					
8	Unit tags affixed					
C. Other		**Yes, No, N/A**	**Comment/Issues**	**Contractor Initial**	**CM Initial**	**Date**
1	Start-up report is complete and has been provided to the GC for approval by the owner					
2	Operation & Maintenance manual has been compiled and provided to the GC for approval by the owner					
3	Training plan and instructor qualifications has been complete and provided to the GC for approval by the owner					
4	TAB report is complete and has been provided to the GC for approval by the owner					

DAVENERGY SOLUTIONS
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2. Construction Checklist

A. Installation		Yes, No, N/A	Comment/ Issues	Contractor Initial	CM Initial	Date
1	Flexible joints and vibration isolation installed					
2	Access clear of piping and conduits					
3	All condensate drain pans clean and slope to drain					
4	Refrigerant piping installed properly and leak free					
5	If applicable, humidifier piping is properly installed and inlet water pressure is within manufacturer specified ranges					
6	Piping system cleaned and flushed					
7	Clean filters installed					
8	All moving parts are lubricated					
9	Unit labeled and is easy to see					
B. Electrical		**Yes, No, N/A**	**Comment/ Issues**	**Contractor Initial**	**CM Initial**	**Date**
1	Power wiring connected, secure and grounded to both units					
2	Supply voltage balanced and within normal limits					
3	Supply amperage balanced and within normal limits					
C. Controls		**Yes, No, N/A**	**Comment/ Issues**	**Contractor Initial**	**CM Initial**	**Date**
1	All equipment status and enable (supply fan, condenser, humidifier if applicable) are functioning					
2	All temperature sensors (Return, supply, suction line, liquid line, rack inlet, space air) have been properly installed and calibrated.					
3	All humidity sensors (Return air, rack inlet, space air) have been properly installed and calibrated.					
4	System alarms for moisture and refrigerant have been tested and are functioning correctly					
5	Sequence of operations programmed per approved system submittal					
6	All specified monitoring/control points available at building front end					
7	System trending enabled					
8	Specified point-to-point checks have been completed and documentation record submitted for this system					
9	Device Calibration checks have been completed and documentation record submitted for this system					
10	System graphics have been installed					

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Dehumidifier
Pre-Functional Checklist

Project:	VA CT West Haven EHRM Infrastructure Upgrade
Building:	
Project Location:	West Haven, CT
Equipment ID:	
Equipment Location:	
Manufacturer:	
Model #:	
Serial #:	
Service:	

1. Delivery Book

A. Model Verification (Note: 1. as specified, 2. as submitted, 3. as installed)		Enter Note #	Comment/Issues	Contractor Initial	CM Initial	Date
1	Manufacturer					
2	Model					
3	Serial Number					
4	Size (in.)					
5	Max/Min Airflow (cfm)					
6	Dehumidifier Capacity (MBH/gpm/kW/etc.)					

B. Physical Checks		Yes, No, N/A	Comment/Issues	Contractor Initial	CM Initial	Date
1	Unit is free from physical damage					
2	The air openings are sealed with plastic					
3	The water openings are sealed with plastic plugs					
4	The airflow sensing tubing is unplugged					
5	The grommets for the airflow sensing tubing are secure					
6	Installation and startup manual provided					
7	Unit tags affixed					
8	Manufacturer's ratings readable/accurate					

C. Other		Yes, No, N/A	Comment/Issues	Contractor Initial	CM Initial	Date
1	Training plan and instructor qualifications has been complete and provided to the GC for approval by the owner					
2	Start-up report is coomplete and has been provided to the GC for approval by the owner					
3	Operation & Maintenance manual has been compiled and provided to the GC for approval by the owner					
4	TAB report is complete and has been provided to the GC for approval by the owner					

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2. Construction Checklist

A. Piping Installation		Yes, No, N/A	Comment/Issues	Contractor Initial	CM Initial	Date
1	Pipe fittings complete and pipes properly supported allowing for thermal expansion and contraction and building expansion joints.					
2	Pipe joints properly installed					
3	Required seismic anchoring installed					
4	Pipes properly labeled					
5	Pipes properly insulated					
6	Pipes properly sloped					
7	All piping materials used are per the plans and specifications					
8	All piping connections per the plans and specifications					
9	All piping has been pressure tested and flushed					
10	All valves have been installed per plans and specifications					
11	No leaking apparent around fittings					
B. Hanging		**Yes, No, N/A**	**Comment/Issues**	**Contractor Initial**	**CM Initial**	**Date**
1	Unit is supported as required by manufacturer and specifications					
2	Metal to metal connections eliminated to prevent noise problems					
3	Adequate clearance around chilled beam control panel for maintenance					
4	Clear access below unit for easy maintenance					
5	Unit labeled and is easy to see					
6	Box openings temporarily sealed to maintain system cleanliness					
C. Ductwork		**Yes, No, N/A**	**Comment/Issues**	**Contractor Initial**	**CM Initial**	**Date**
1	Sufficient length of straight ductwork installed upstream of unit					
2	Downstream ductwork free of transitions for sufficient length					
3	All components are accessible for maintenance					
D. Piping		**Yes, No, N/A**	**Comment/Issues**	**Contractor Initial**	**CM Initial**	**Date**
1	All piping components have been installed (in the correct order) as required by detail drawing					
2	Piping is arranged for ease of unit/coil removal					
3	Piping supported as required by specifications					
4	Piping is clean					
5	Piping insulation is complete and installed as per specifications					
6	All valves and test ports are easily accessible					
7	Valve tags attached					

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E. Controls - Installation		Yes, No, N/A	Comment/Issues	Contractor Initial	CM Initial	Date
1	Temperature sensor calibration verified					
2	Crcuit setter installed and calibration verified					
3	Airflow sensor calibration verified					
4	Point-to-point connections of control wiring verified					
5	Central system accurately represents conditions of unit					
F. Controls - Startup		**Yes, No, N/A**	**Comment/Issues**	**Contractor Initial**	**CM Initial**	**Date**
1	Dehumidifying sequence of control verified					
G. TAB		**Yes, No, N/A**	**Comment/Issues**	**Contractor Initial**	**CM Initial**	**Date**
1	Airflow (cfm) (design/measured)					
2	Entering and leaving coil air temperatures (°F)					
3	Entering and leaving coil water temperatures (°F)					
4	Coil flow and air/water pressure drops verified					

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Ductless Split-System Pre-Functional Checklist

Project:	VA CT West Haven EHRM Infrastructure Upgrade
Building:	
Project Location:	West Haven, CT
Equipment ID:	
Equipment Location:	
Manufacturer:	
Model #:	
Serial #:	
Service:	

1. Delivery Book

A. Model Verification (Note: 1. as specified, 2. as submitted, 3. as installed)		Enter Note #	Comment/ Issues	Contractor Initial	CM Initial	Date
1	Manufacturer					
2	Model					
3	Serial Number					
4	Size (in)					
5	Airflow Max/Min (cfm)					
6	Heating Capacity (MBH/gpm/kW/etc.)					
7	Fan Power/Speed (hp/rpm)					
8	Voltage / Phase / Frequency (V/ph/Hz)					
B. Physical Checks		**Yes, No, N/A**	**Comment/ Issues**	**Contractor Initial**	**CM Initial**	**Date**
1	Unit is free from physical damage					
2	All components present					
3	The refrigerant line openings are sealed					
4	Installation and startup manual provided					
5	Unit tags affixed					
C. Other		**Yes, No, N/A**	**Comment/Issues**	**Contractor Initial**	**CM Initial**	**Date**
1	Start-up report is complete and has been provided to the GC for approval by the owner					
2	Operation & Maintenance manual has been compiled and provided to the GC for approval by the owner					
3	Training plan and instructor qualifications has been complete and provided to the GC for approval by the owner					
4	TAB report is complete and has been provided to the GC for approval by the owner					

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2. Construction Checklist

A. Piping		Yes, No, N/A	Comment/ Issues	Contractor Initial	CM Initial	Date
1	Refrigeration lineset pressure tested					
2	Vacuum pulled on lineset					
3	Lineset is strapped properly					
4	Lineset is properly insulated					
5	Lineset insulation above roofline is UV protected					
6	Filter drier is installed					
B. Electrical		**Yes, No, N/A**	**Comment/ Issues**	**Contractor Initial**	**CM Initial**	**Date**
1	Power wiring connected, secure and grounded to both units					
C. Controls		**Yes, No, N/A**	**Comment/ Issues**	**Contractor Initial**	**CM Initial**	**Date**
1	Thermostat mounted and wired if not remote controller					
2	Control wiring between fan coil and condensing unit installed					
3	Controls contractor has status monitored					
4	System has correct refrigerant charge					
5	Motors and compressors running in the right direction					
6	Split system works off thermostat and reaches setpoint					
7	Specified point-to-point checks have been completed and documentation record submitted for this system					
8	Device Calibration checks have been completed and documentation record submitted for this system					
9	System graphics have been installed					

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DX COOLING COIL
Pre-Functional Checklist

Project:	VA CT West Haven EHRM Infrastructure Upgrade
Building:	
Project Location:	West Haven, CT
Equipment ID:	
Equipment Location:	
Manufacturer:	
Model #:	
Serial #:	
Service:	

Statement of Readiness
The above equipment and/or systems integral to them are complete and ready for functional testing, except as noted. None of the outstanding items preclude safe and reliable functional tests being performed. This checklist does not take the place of the manufacturer's recommended checkout and startup procedures or report.

Responsible Contractor Sign Here

CONTRACTOR	PRINTED NAME	SIGNATURE	DATE
General Contractor (GC)			
Mechanical Contractor (MC)			
Electrical Contractor (EC)			
TAB Contractor (TAB)			
Controls Contractor (CC)			

This statement of readiness has been received by the Commissioning Agent on _____ and will be incorporated as part of the final commissioning report

1. Delivery Book

A. Model Verification (Note: 1. as specified, 2. as submitted, 3. as installed)		**Enter Note #**	**Comment/Issues**	**Contractor Initial**	**VA CM Initial**	**Date**
1	Manufacturer					
2	Model					
3	Serial Number					
4	Type					
5	Flow Capacity (cfm)					
6	Cooling Capacity (MBH/kW/etc.)					
B. Physical Checks		**Yes, No, N/A**	**Comment/Issues**	**Contractor Initial**	**VA CM Initial**	**Date**
1	Unit is free from physical damage					
2	All components present					
3	Installation and startup manual provided					
4	Unit tags affixed					
C. Other		**Yes, No, N/A**	**Comment/Issues**	**Contractor Initial**	**VA CM Initial**	**Date**
1	Training plan and instructor qualifications has been completed and provided to the GC for approval by the VA					
2	Start-up report is complete and has been provided to the GC for approval by the VA					
3	Operation & Maintenance manual has been compiled and provided to the GC for approval by the VA					

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2. Construction Checklist

A. Installation of Cooling Coil		Yes, No, N/A	Comment/Issues	Contractor Initial	VA CM Initial	Date
1	Unit secured as required by manufacturer and specifications					
2	Adequate clearance around unit for service					
3	All components accessible for maintenance					
4	Unit can be removed from the building					
5	Shipping bolts have been removed (if applicable)					
6	Unit labeled and is easy to see					
F. TAB		**Yes, No, N/A**	**Comment/Issues**	**Contractor Initial**	**VA CM Initial**	**Date**
1	Air flow verified					
2	Cooling Output Verified					
3	TAB report is complete and has been provided to the GC for approval by the VA					

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Electrical Panelboard Pre-Functional Checklist

Project:	VA CT West Haven EHRM Infrastructure Upgrade
Building:	
Project Location:	West Haven, CT
Equipment ID:	
Equipment Location:	
Manufacturer:	
Model #:	
Serial #:	
Service:	

A. Model Verification (Note: 1. as specified, 2. as submitted, 3. as installed)		**Enter Note #**	**Comment/Issues**	**Contractor Initial**	**CM Initial**	**Date**
1	Manufacturer					
2	Model					
3	Serial Number					
4	Voltage/Phase Rating					
5	Main Bus Amperage					
6	Short Circuit Capacity					
7	Main Breaker / Fuse Type & Amperage					

B. Construction Check List		**Yes, No, N/A**	**Comment/Issues**	**Contractor Initial**	**CM Initial**	**Date**
1	Is the cabinet level, plumb and rigidly installed in a position where it is not exposed to physical damage?					
2	Is the cabinet installed in a position where it is readily accessible?					
3	Is there a way to prevent moisture and water from entering the cabinet?					
4	Is the cabinet mounted at least three feet from the ceiling?					
5	Is there at least 36" deep by 30" wide of working clearance?					
6	Is there at least 6 feet 3 inches of head room?					
7	Is the cabinet secured tightly and reliably to the supporting surface?					
8	If flush mounted, is the front flange of the box flush with the final finished surface?					
9	Is the cabinet properly grounded?					
10	Is the cabinet free of any foreign material that may have accumulated sinceit was installed?					
11	Is the return flange of the deadfront pan no more than 3/16" from the front of the box?					
12	Have all fasteners been tightened to form a rigid structure?					
13	Have the line and branch conductors been connected to their proper terminals?					
14	Have the line and branch conductors been identified on the card furnished with the cover?					
15	Have the conductors all been arranged and distributed neatly in the wiring gutters?					

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16	Does the aluminum or copper wire used match the sizes stamped on the lug?					
17	Are all the wire lugs tightened securely?					
18	Are the equipment-grounding conductors connected to the equipment-grounding terminal bar?					
19	Is the equipment grounding terminal bar securely bonded to the cabinet or panelboard frame and not connected to the neutral bar?					

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Energy Recovery Ventilator
Pre-Functional Checklist

Project:	VA CT West Haven EHRM Infrastructure Upgrade
Building:	
Project Location:	West Haven, CT
Equipment ID:	
Equipment Location:	
Manufacturer:	
Model #:	
Serial #:	
Service:	

Statement of Readiness
The above equipment and/or systems integral to them are complete and ready for functional testing, except as noted. None of the outstanding items preclude safe and reliable functional tests being performed. This checklist does not take the place of the manufacturer's recommended checkout and startup procedures or report.

Responsible Contractor Sign Here

CONTRACTOR	PRINTED NAME	SIGNATURE	DATE
General Contractor (GC)			
Mechanical Contractor (MC)			
Electrical Contractor (EC)			
TAB Contractor (TAB)			
Controls Contractor (CC)			

This statement of readiness has been received by the Commissioning Agent on _____ and will be incorporated as part of the final commissioning report.

1. Delivery Book

	A. Model Verification (Note: 1. as specified, 2. as submitted, 3. as installed)	Enter Note #	Comment/ Issues	Contractor Initial	VA CM Initial	Date
1	Manufacturer					
2	Model					
3	Serial Number					
4	Cooling Capacity (MBH/gpm/kW/etc.)					
5	Heating Capacity (MBH/gpm/kW/etc.)					
6	Supply Fan Motor Power / Speed (hp / rpm)					
7	Exhaust Fan Motor Power / Speed (hp / rpm)					
8	Supply entering Air flow, Design / Minimum (cfm)					
9	Exhaust Leaving Air flow, Design / Minimum (cfm)					
10	Voltage / Phase / Frequency (V / - / Hz)					

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B. Physical Checks		Yes, No, N/A	Comment/ Issues	Contractor Initial	VA CM Initial	Date
1	Unit is free from physical damage					
2	Wheel surface areas are free of damage					
3	The air openings are sealed with plastic					
4	All components present and in proper order					
5	All access doors are operable					
6	Installation and startup manual provided					
7	Unit tags affixed					
8	Permanent labels affixed, including for fans					
9	Casing condition good: no dents, leaks, door gaskets installed					
10	Access doors close tightly - no leaks					
11	Boot between duct and unit tight and in good condition					
12	Vibration isolation equipment installed & released from shipping locks					
13	Maintenance access acceptable for unit and components					
14	Sound attenuation installed					
15	Thermal insulation properly installed and according to specification					
16	Instrumentation installed according to specification (thermometers, pressure gages, flow meters, etc.)					
17	Clean up of equipment completed					
18	Filters installed and replacement type and efficiency permanently affixed to housing--construction filters removed					
C. Other		**Yes, No, N/A**	**Comment/Issues**	**Contractor Initial**	**VA CM Initial**	**Date**
1	Training plan and instructor qualifications has been completed and provided to the GC for approval by the VA					
2	Start-up report is complete and has been provided to the GC for approval by the VA				**VA CM Initial**	
3	Operation & Maintenance manual has been compiled and provided to the GC for approval by the VA					
4	TAB report is complete and has been provided to the GC for approval by the VA					

2. Construction Checklist

A. Installation of ERV		Yes, No, N/A	Comment/ Issues	Contractor Initial	VA CM Initial	Date
1	Unit secured as required by manufacturer and specifications					
2	Adequate clearance around unit for service					
3	All components accessible for maintenance					
4	Unit can be removed from the building					
5	All access doors can be open in full capacity					

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B. Wheel		Yes, No, N/A	Comment/ Issues	Contractor Initial	VA CM Initial	Date
1	All wheel components have been installed (in the correct order) as required by detail drawing					
2	Wheel arranged for ease of removal					
3	Energy wheel supported as required by specifications					
4	Energy wheel is clean					
5	No leaking apparent around fittings					
6	Energy wheel is clean and fins are in good condition					
7	Sensors calibrated					
8	Wheel motor alignment is correct					
9	Wheel motor belt tension & condition are good					
10	Wheel motor protective shrouds for belts in place and secure					
11	Wheel motor area is clean					
12	Wheel motor properly lubricated					
13	Wheel motor matches manufactures electrical specs.					
C. Ductwork		**Yes, No, N/A**	**Comment/ Issues**	**Contractor Initial**	**VA CM Initial**	**Date**
1	Adequate locations available for testing and balancing of unit					
2	All dampers and sensors are accessible (access panels)					
3	Outdoor and return air arrangement will not freeze coils, i.e. outdoor air and return air is adequately mixed before reaching coils					
4	Vibration isolators installed					
5	All dampers close tightly and stroke fully and easily					
6	Ductwork is clean and free of debris					
7	Sound attenuators installed					
8	Duct joint sealant properly installed					
9	No apparent severe duct restrictions					
10	Turning vanes in square elbows as per drawings					
11	OSA intakes located away from pollutant sources & exhaust outlets					
12	Pressure leakage tests completed					
13	Branch duct control dampers operable					
14	Ducts cleaned as per specifications					
15	Balancing dampers installed as per drawings and TAB's site visit					
D. Fans & Dampers		**Yes, No, N/A**	**Comment/ Issues**	**Contractor Initial**	**VA CM Initial**	**Date**
1	Suuply Fan and motor alignment are correct					
2	Supply fan belt tension & condition is good					
3	Supply fan protective shrouds for belts in place and secure					
4	Supply fan area is clean					
5	Supply fan and motor are properly lubricated					
6	Exhaust Fan and motor alignment is correct					
7	Exhaust fan belt tension & condition is good					
8	Exhaust fan protective shrouds for belts in place and secure					
9	Exhaust fan area is clean					
10	Exhaust fan and motor are properly lubricated					

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11	OA filter and RA filter are clean and tight fitting					
12	Ouside Air Damper installed properly					
13	Exhaust Air Damper installed properly					
14	Ouside Bypass Air Damper installed properly					
15	Exhaust Bypass Air Damper installed properly					
16	Return Air Bypass Damper installed properly					
17	All dampers (EAD, RAD, Min OAD, Max OAD, etc.) close tightly					
18	All damper linkages (EAD, RAD, Min OAD, Max OAD, etc.) have minimum play					
19	Low limit freeze stat sensor located to deal with stratification & bypass					
E. Electrical & Control		**Yes, No, N/A**	**Comment**	**Contractor Initial**	**VA CM Initial**	**Date**
1	Local disconnect installed in accessible location					
2	Motor rotation in the proper direction					
3	All electrical connections are tight					
4	All electrical components are grounded					
5	Power disconnects in place and labeled					
6	Proper grounding installed for components and unit					
7	Safeties in place and operable					
8	Starter overload breakers installed and correct size					
9	Sensors are calibrated					
10	Control system interlocks hooked up and functional					
F. Startup Inspection		**Yes, No, N/A**	**Comment/ Issues**	**Contractor Initial**	**VA CM Initial**	**Date**
1	Start-Up by Manufacturers Representative					
2	Unit is clean					
3	Internal isolators free to move					
4	Fans and motors lubricated and aligned					
5	Wheel motor belts have proper tension and are in good condition					
6	Protective shrouds for fans and belts in place and secure					
7	Filters installed properly (no bypass air) and are clean					
8	System starts and runs without any unusual noise or vibration					
9	Wheel Rotation Correct					
10	Electrical Interlocks Verified					
11	Wheel Status Indicators Verified (Local/Remote)					
12	Local Air Leakage Acceptable					
13	Freeze Protection Operational					
14	Vibration and Noise Level Acceptable					
15	Motor Amps-Rated ____ Actual ____					
16	Motor Amps-Rated ____ Actual ____					
17	Motor Volts-Rated ____ Actual ____					
18	Final Operating Filters Installed					
19	Safety items installed and verified (freezestat, high pressure, motor overload, etc.)					
G. Other		**Yes, No, N/A**	**Comment/ Issues**	**Contractor Initial**	**VA CM Initial**	**Date**
1	Provide MERV 8 filters					

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Fuel Tank
Pre-Functional Checklist

Project:	VA CT West Haven EHRM Infrastructure Upgrade
Building:	
Project Location:	West Haven, CT
Equipment ID:	
Equipment Location:	
Manufacturer:	
Model #:	
Serial #:	
Service:	

1. Delivery Book

A. Model Verification (Note: 1. as specified, 2. as submitted, 3. as installed)		Enter Note #	Comment/Issues	Contractor Initial	CM Initial	Date
1	Manufacturer					
2	Model					
3	Serial Number					
4	Tank Storage (Gal.)					
5	Tank Design Pressure (PSIG)					
6	Tank Operating Pressure (PSIG)					
7	Pump Quantity					
8	Pump Type					
9	Impeller diameter (in.)					
10	Inlet / Outlet Sizes (in.)					
11	Capacity / Head (gpm / ft wg)					
12	Motor Speed / Power (rpm / hp)					
13	Motor Voltage / Phase / Frequency (V / - / Hz)					

SAMPLE

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Lighting
Pre-Functional Checklist

Project:	VA CT West Haven EHRM Infrastructure Upgrade
Building:	
Project Location:	West Haven, CT
Equipment ID:	
Equipment Location:	
Manufacturer:	
Model #:	
Serial #:	
Service:	

	A. Installation	Yes, No, N/A	Comment/Issues	Contractor Initial	CM Initial	Date
1	Light switches are located per plans					
2	Light switches are labeled with proper ID to match drawings or field changes					
3	Light switches are controlling the fixtures in the area indicated on design drawings					
4	Lighting fixtures are installed per drawings and specifications					
5	Lighting fixtures are properly supported for seismic zone.					
6	Proper ballast type is installed in each fixture to match fixture schedule and specifications					
7	Proper lamp type is installed in each fixture to match fixture schedule and specifications					

	B. Electrical	Yes, No, N/A	Comment/Issues	Contractor Initial	CM Initial	Date
1	Emergency lighting is connected to the emergency lighting panel					
2	All electrical connections are tight					
3	Specified Light switch circuits are routed through the lighting control panels as required					

	C. Controls	Yes, No, N/A	Comment/Issues	Contractor Initial	CM Initial	Date
1	Lighting control is installed per manufacturer recommendations (attached recommendations to					
2	Lighting control is calibrated per manufacturer checklist					
3	Occupancy sensors are installed per plans and specifications					
4	Occupancy sensors are configured with maximum sensitivity and maximum time duration					

	D. Other	Yes, No, N/A	Comment/Issues	Contractor Initial	CM Initial	Date
1	Training plan and instructor qualifications has been completed and provided to the GC for approval by the owner					
2	Start-up report is complete and has been provided to the GC for approval by the owner					
3	Operation & Maintenance manual has been compiled and provided to the GC for approval by the owner					

SAMPLE

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2207 Garnet Avenue Suite I
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VRV Unit
Pre-Functional Checklist

Project:	VA CT West Haven EHRM Infrastructure Upgrade
Building:	
Project Location:	Brooklyn, New York
Equipment ID:	
Equipment Location:	
Manufacturer:	
Model #:	
Serial #:	
Service:	

1. Delivery Book

A. Model Verification (Note: 1. as specified, 2. as submitted, 3. as installed)		**Enter Note #**	**Comment/ Issues**	**Contractor Initial**	**CM Initial**	**Date**
1	Manufacturer					
2	Model					
3	Serial Number					
4	Size (in)					
5	Airflow Max/Min (cfm)					
7	Fan Power/Speed (hp/rpm)					
8	Voltage / Phase / Frequency (V/ph/Hz)					
B. Physical Checks		**Yes, No, N/A**	**Comment/ Issues**	**Contractor Initial**	**CM Initial**	**Date**
1	Unit is free from physical damage					
2	All components present					
3	The refrigerant line openings are sealed					
4	Installation and startup manual provided					
5	Unit tags affixed					
C. Other		**Yes, No, N/A**	**Comment/Issues**	**Contractor Initial**	**CM Initial**	**Date**
1	Start-up report is complete and has been provided to the GC for approval by the owner					
2	Operation & Maintenance manual has been compiled and provided to the GC for approval by the owner					
3	Training plan and instructor qualifications has been complete and provided to the GC for approval by the owner					
4	TAB report is complete and has been provided to the GC for approval by the owner					

SAMPLE

DAVENERGY SOLUTIONS
ENGINEERING | CONSTRUCTION MANAGEMENT

2207 Garnet Avenue Suite I
San Diego, CA 92109
Direct: (619) 770-8552

2. Construction Checklist

A. Indoor Unit		Yes, No, N/A	Comment/ Issues	Contractor Initial	CM Initial	Date
1	Slide-in air filter installed					
2	Low ambient temperature controls installed					
3	Factory wall mounting hardware used in installation					
4	Minimum 3/4" condensate drain line					
B. Air-Cooled Condensing Unit		**Yes, No, N/A**	**Comment/ Issues**	**Contractor Initial**	**CM Initial**	**Date**
1	Crank case heater installed					
2	Seismic rated equipment stand for roof mounted units installed					
3	Condensate drain pump installed					
4	Legs for roof mounted support is sealed for water proof					
5	Minimum 20 gage sheet metal pan around refrigerant lines from bottom wall anchor to eave					
6	20 gage sheet metal pan is painted to match building color of oil base paint					
C. Piping		**Yes, No, N/A**	**Comment/ Issues**	**Contractor Initial**	**CM Initial**	**Date**
1	Refrigeration lineset pressure tested					
2	Vacuum pulled on lineset					
3	Lineset is strapped properly					
4	Lineset is properly insulated					
5	Minimum of 12" braided flexible refrigerant line					
D. Electrical		**Yes, No, N/A**	**Comment/ Issues**	**Contractor Initial**	**CM Initial**	**Date**
1	Power wiring connected, secure and grounded to both units					
E. Controls		**Yes, No, N/A**	**Comment/ Issues**	**Contractor Initial**	**CM Initial**	**Date**
1	Thermostat mounted and wired if not remote controller					
2	Control wiring between fan coil and condensing unit installed					
3	Controls contractor has status monitored					
4	System has correct refrigerant charge					
5	Motors and compressors running in the right direction					
6	Split system works off thermostat and reaches setpoint					
7	Specified point-to-point checks have been completed and documentation record submitted for this system					
8	Device Calibration checks have been completed and documentation record submitted for this system					
9	System graphics have been installed					

SAMPLE

DAVENERGY SOLUTIONS
ENGINEERING | CONSTRUCTION MANAGEMENT

2207 Garnet Avenue Suite I
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Direct: (619) 770-8552

Electric Unit Heater
Pre-Functional Checklist

Project:	VA CT West Haven EHRM Infrastructure Upgrade
Building:	
Project Location:	West Haven, CT
Equipment ID:	EUH
Equipment Location:	
Manufacturer:	
Model #:	
Serial #:	
Service:	

1. Delivery Book

	A. Model Verification (Note: 1. as specified, 2. as submitted, 3. as installed)	Enter Note #	Comment/Issues	Contractor Initial	CM Initial	Date
1	Manufacturer					
2	Model					
3	Serial Number					
4	Type					
5	Flow Capacity (cfm)					
6	Heat Capacity (kW)					
7	Motor Voltage / Phase / Frequency (V / - / Hz)					

	B. Physical Checks	Yes, No, N/A	Comment/Issues	Contractor Initial	CM Initial	Date
1	Unit is free from physical damage					
2	All components present (belt guard, motor, spring isolators, etc.)					
3	Installation and startup manual provided					
4	Unit tags affixed					

	C. Other	Yes, No, N/A	Comment/Issues	Contractor Initial	CM Initial	Date
1	Training plan and instructor qualifications has been completed and provided to the GC for approval by the owner					
2	Start-up report is complete and has been provided to the GC for approval by the owner					
3	Operation & Maintenance manual has been compiled and provided to the GC for approval by the owner					

2. Construction Checklist

	A. Installation of Unit Heater	Yes, No, N/A	Comment/Issues	Contractor Initial	CM Initial	Date
1	Unit secured as required by manufacturer and specifications					
2	Adequate clearance around unit for service					
3	All components accessible for maintenance					
4	Unit can be removed from the building					
5	Shipping bolts have been removed (if applicable)					
6	Fan blades are tight (if applicable)					
7	Protective shrouds for fan and belts in place and secure					
8	Unit labeled and is easy to see					

SAMPLE

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B. Electrical		Yes, No, N/A	Comment/Issues	Contractor Initial	CM Initial	Date
1	Safety disconnect installed in accessible location					
2	Motor rotation in the proper direction					
3	All electrical connections are tight					
4	All electrical components are grounded					
C. Controls - Installation		**Yes, No, N/A**	**Comment/Issues**	**Contractor Initial**	**CM Initial**	**Date**
1	Control panel accessible and labeled properly					
2	Safety items installed and verified (freezestat, high pressure, motor overload, etc.)					
D. Mechanical - Startup		**Yes, No, N/A**	**Comment/Issues**	**Contractor Initial**	**CM Initial**	**Date**
1	Unit is clean					
2	Internal isolators free to move					
3	Fans and motors lubricated and aligned					
4	System starts and runs without any unusual noise or vibration					
5	Manufacturer's startup checklist completed and attached					
E. Controls - Startup		**Yes, No, N/A**	**Comment/Issues**	**Contractor Initial**	**CM Initial**	**Date**
1	Remote start/stop from central system verified					
2	Sequence of control is correct (e.g., interlock)					
F. TAB		**Yes, No, N/A**	**Comment/Issues**	**Contractor Initial**	**CM Initial**	**Date**
1	Air flow verified					
2	Heat Output Verified					
3	Fan rotation is in the proper direction					
4	Motor overloads verified					
5	Motor voltage and amps verified - each phase					
6	TAB report is complete and has been provided to the GC for approval by the owner					

SAMPLE

DAVENERGY SOLUTIONS
ENGINEERING | CONSTRUCTION MANAGEMENT

2207 Garnet Avenue Suite I
San Diego, CA 92109
Direct: (619) 770-8552

Computer Room Air Conditioner (CRAC) Functional Performance Test

Project:	**VA CT West Haven EHRM Infrastructure Upgrade**
Building:	
Project Location:	**West Haven, CT**
Equipment ID:	
Equipment Location:	
Manufacturer:	
Model #:	
Serial #:	
Service:	

System Description

Description: The test procedure is intended to verify that the fan coil unit is functioning properly per the control sequence of operations.

Operational Assumptions: All associated building heating and cooling systems are currently functional and operating normally.

* No faults or alarms associated with the equipment being tested are present.
* BAS shows no major alarms that would affect the testing.

Initial Test			Start Date	End Date	Initials
Results	**Yes / No**	**Explanation**			
Pass					
Fail					
Partial Test w/Corrective Actions					
Complete Test w/Corrective Actions					
Other					

SYSTEM TRENDING REQUIREMENTS

	DESCIPTION	Frequency	Trending Established (Circle)	
1	Return Air Temperature	15 Min	Yes	No
2	Return Air Humidity	15 Min	Yes	No
3	System Air Flow	15 Min	Yes	No
4	Supply Air Temperature	15 Min	Yes	No
5	Infrared Humidifier Status	15 Min	Yes	No
6	Suction Line Temp	15 Min	Yes	No
7	Liquid Line Temp	15 Min	Yes	No
8	Humidifier Valve	15 Min	Yes	No
9	Supply Fan Status	15 Min	Yes	No
10	Condenser Status	15 Min	Yes	No
11	Rack Inlet Humidity Average	15 Min	Yes	No
12	Rack Inlet Temperature Average	15 Min	Yes	No
13	Space Air Temperature	15 Min	Yes	No
14	Filter Differential Pressure	15 Min	Yes	No
15	Space Air Humidity	15 Min	Yes	No

DAVENERGY SOLUTIONS
ENGINEERING | CONSTRUCTION MANAGEMENT

2207 Garnet Avenue Suite I
San Diego, CA 92109
Direct: (619) 770-8552

Computer Room Air Conditioner (CRAC) Functional Performance Test

Project:	**VA CT West Haven EHRM Infrastructure Upgrade**
Building:	
Project Location:	**West Haven, CT**
Equipment ID:	
Equipment Location:	
Manufacturer:	
Model #:	
Serial #:	
Service:	

POINT-TO-POINT CHECKOUT

	CONTROL SENSORS (ANALOG/DIGITAL INPUTS)	Measured	BAS	Cal Off-Set	Notes
1	Return Air Temperature				
2	Return Air Humidity				
3	System Air Flow				
4	Supply Air Temperature				
5	Chilled Water Valve Position				
6	Infrared Humidifier Status				
7	Suction Line Temp				
8	Liquid Line Temp				
9	Humidifier Valve Position				
10	Supply Fan Status				
11	Moisture Sensor				
12	Condenser Status				
13	Rack Inlet Temperature PDU-1				
14	Rack Inlet Temperature PDU-2				
15	Rack Inlet Humidity PDU-1				
16	Rack Inlet Humidity Average				
17	Rack Inlet Temperature Average				
18	Refrigerant Sensor				
19	Space Air Temperature				
20	Filter Differential Pressure				
21	Space Air Humidity				
22	Space Smoke Detector				

Record Issues:	Initial	Date

	DAMPERS / ACTUATOR INFORMATION:	0%	50%	100%	CONDITION / COMMENT
1	Supply Fan VSMC				
2	Coiling Valve V-1				
3	Supply Fan Start/Stop		NA		

Record Issues:	Initial	Date

OCCUPANCY SCHEDULE

	Record the Occupancy Schedule below	Occupied Hours	Unoccupied Hours
1	Weekday		
2	Weekend		
3	Holiday		

DAVENERGY SOLUTIONS
ENGINEERING | CONSTRUCTION MANAGEMENT

2207 Garnet Avenue Suite I
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Computer Room Air Conditioner (CRAC) Functional Performance Test

Project:	**VA CT West Haven EHRM Infrastructure Upgrade**
Building:	
Project Location:	**West Haven, CT**
Equipment ID:	
Equipment Location:	
Manufacturer:	
Model #:	
Serial #:	
Service:	

Functional Performance Agenda:

PRE-TEST CHECKLIST
TEMPERATURE CONTROL
HUMIDITY CONTROL
SAFETIES & ALARMS
RETURN TO INITIAL CONDITIONS

Functional Performance Test:

A. PRE-TEST CHECKLIST

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments / Issues
1	Verify that is operating under normal conditions and is ready to test.	No alarms are present.		
		The unit is in occupied mode and is maintaining operational temperature set points.		

Record Issues:	Initial	Date

B. TEMPERATURE CONTROL

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments / Issues
2	Record Initial Conditions	Avg Rack Inlet Temp Setpoint		
		Avg Rack Inlet Temp		
		System Airflow		

Record Issues:	Initial	Date

3	Set the avg rack inlet temperature setpoint to 5F below the current avg rack inlet temperature. Continue reducing the temperature setpoint if needed to achieve all stages of cooling. Stay above 50F avg rack inlet temperature at all times.	The system airflow shall increase		
		After maximum airflow is achieved, the first stage of cooling shall engage at the compressor		
		After the first stage of cooling is engaged and setpoint is still not met, the second stage of cooling shall engage		
		If applicable, additional CRAC units in the system shall engage to meet the cooling load		
		The new avg rack inlet temperature setpoint shall be achieved		

Record Issues:	Initial	Date

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2207 Garnet Avenue Suite I
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Computer Room Air Conditioner (CRAC) Functional Performance Test

Project:	**VA CT West Haven EHRM Infrastructure Upgrade**
Building:	
Project Location:	**West Haven, CT**
Equipment ID:	
Equipment Location:	
Manufacturer:	
Model #:	
Serial #:	
Service:	

4	Set the avg rack inlet temperature setpoint to 5F above the current avg rack inlet temperature. Continue increasing rack inlet temperature setpoint until all stages of cooling are disengaged. Stay below 80F avg rack inlet temperature at all times.	The second stage cooling shall disengage		
		The first stage cooling shall disengage		
		The airflow shall decrease		
		Additional CRAC units shall disengage		
		The new avg rack inlet temperature setpoint shall be achieved		
Record Issues:			**Initial**	**Date**

5	Reset the avg rack inlet temperature setpoint to the original setting	The system shall resume normal operation.		
Record Issues:			**Initial**	**Date**

C. HUMIDITY CONTROL

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments / Issues
6	Record Initial Conditions	Space Humidity		
		Space Humidity Setpoint		
		Supply Air Humidity		
		Humidifier Position		
Record Issues:			**Initial**	**Date**

7	Override the space humidity setpoint to 5% above the current space humidity. Do not exceed 60% humidity.	The humidifier shall engage and modulate to maintain the space humidity setpoint		
Record Issues:			**Initial**	**Date**

8	While the humidifier is operating, override the supply air humidity to be above 95%	The humidifier shall disengage		
Record Issues:			**Initial**	**Date**

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Computer Room Air Conditioner (CRAC) Functional Performance Test

Project:	**VA CT West Haven EHRM Infrastructure Upgrade**
Building:	
Project Location:	**West Haven, CT**
Equipment ID:	
Equipment Location:	
Manufacturer:	
Model #:	
Serial #:	
Service:	

9	Release override to the supply air humidity and reset all setpoints to original values	The system shall resume normal operation.		

Record Issues:	Initial	Date

D. SAFETIES & ALARMS

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments/ Issues
10	Override the supply air discharge temperature to below 50F (adj)	A supply air temperature alarm is generated		
	Reset the supply air discharge temperature to automatic operation	The alarm is reset and the system resumes normal operation		
11	Override the space temperature to be above 85F (adj).	A space temperature alarm is generated		
	Reset the space temperature sensor to automatic operation	The alarm is reset and system resumes normal operation		
12	Override the space humidity to be above 60% (adj).	A space humidity alarm is generated		
	Reset the space humidity sensor to automatic operation	The alarm is reset and system resumes normal operation		
13	Override the space moisture sensor to read positive or touch a damp rag to the physical sensor	A moisture alarm is generated		
	Reset the space moisture sensor override or dry the physical sensor	The alarm is reset and system resumes normal operation		

Record Issues:	Initials	Date

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2207 Garnet Avenue Suite I
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Direct: (619) 770-8552

Computer Room Air Conditioner (CRAC) Functional Performance Test

Project:	**VA CT West Haven EHRM Infrastructure Upgrade**
Building:	
Project Location:	**West Haven, CT**
Equipment ID:	
Equipment Location:	
Manufacturer:	
Model #:	
Serial #:	
Service:	

E. RETURN TO INITIAL CONDITIONS

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments / Issues
14	Release all overrides to the system, returning to initial conditions.	Unit resume normal operation.		
		All equipment is operational.		

Record Issues:	Initial	Date

--End of Test--

2207 Garnet Avenue Suite I
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Direct: (619) 770-8552

Dehumidifier
Functional Performance Test

Project:	VA CT West Haven EHRM Infrastructure upgrade
Building:	
Project Location:	West Haven, CT
Equipment ID:	
Equipment Location:	
Manufacturer:	
Model #:	
Serial #:	
Service:	

System Description

Description: The test procedure is intended to verify that the exhaust fans are functioning properly.

The equipment included in this FPT: Dehumidifier

Operational Assumptions: Start-Up testing of the exhaust fans and systems has been completed.
*No faults or alarms associated with the equipment being tested are present.
*BAS shows no major alarms that would affect the testing.

Initial Test			Start Date	End Date	Initials
Results	**Yes/No**	**Explanation**			
Pass					
Fail					
Partial Test w/ Corrective Actions					
Complete Test w/ Corrective Actions					
Other					

SAMPLE

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OCCUPANCY SCHEDULE

Record the Occupancy Schedule below		Occupied Hours	Unoccupied Hours
1	Weekday		
2	Weekend		
3	Holiday		

Initial Ambient Conditions

Functional Performance Agenda:

FUNCTIONAL OPERATION

Functional Performance Test:

The Commissioning Authority will make and document any changes/addition/deletions to this test procedure required by current system conditions (i.e. weather, system load, utility availability, etc.).

FUNCTIONAL OPERATION

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments/ Issues	
1	Adjust relative humidty setpoint to be below current zone reading	Unit Turns on			
	Adjust relative humidty setpoint to be above current zone reading	Unit Turns off			

Record Issues:	Initials	Date

SAMPLE

DAVENERGY SOLUTIONS
ENGINEERING | CONSTRUCTION MANAGEMENT

2207 Garnet Avenue Suite I
San Diego, CA 92109
Direct: (619) 770.8552

Exhaust Fans
Functional Performance Test

Project:	**West Haven EHRM Infrastructure upgrade**
Building:	
Project Location:	**West Haven ,CT**
Equipment ID:	**EF-1**
Equipment Location:	
Manufacturer:	
Model #:	
Serial #:	
Service:	

System Description

Description: The test procedure is intended to verify that the Exhaust Fans are functioning properly.

Operational Assumptions: Start-Up testing of the main air handling equipment and systems has been completed.

***** No faults or alarms associated with the equipment being tested are present.
***** BAS shows no major alarms that would affect the testing.

Initial Test			Start Date	End Date	Initials
Results	**Yes/No**	**Explanation**			
Pass					
Fail					
Partial Test w/Corrective Actions					
Complete Test w/Corrective Actions					
Other					

SYSTEM TRENDING REQUIREMENTS

	Description	Frequency	Trending Established	
1	Fan Status	15 min	Yes	No
2	Fan Control	15 min	Yes	No
3	Damper Control	15 min	Yes	No
4	Damper Status	15 min	Yes	No
5	Duct Pressure Sensor (if applicable)	15 min	Yes	No
6	Space Temperature (if applicable)	15 min	Yes	No
7	Space Pressure (if applicable)	15 min	Yes	No

POINT-TO-POINT CHECKOUT

	CONTROL SENSORS (ANALOG/DIGITAL INPUTS)	Measured	BAS	Cal Off-Set	Notes
1	Fan Status				
2	Duct Pressure Sensor (if applicable)				
3	Space Temperature (if applicable)				
4	Space Pressure (if applicable)				

Record Issues:	Initial	Date

SAMPLE

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2207 Garnet Avenue Suite I
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Direct: (619) 770.8552

Exhaust Fans
Functional Performance Test

Project:	**West Haven EHRM Infrastructure upgrade**
Building:	
Project Location:	**West Haven ,CT**
Equipment ID:	**EF-1**
Equipment Location:	
Manufacturer:	
Model #:	
Serial #:	
Service:	

	DAMPERS / ACTUATOR INFORMATION:	0%	50%	100%	CONDITION / COMMENT
1	Damper Control (0%/50%/100%)				
2	Fan Control (0%/50%/100%)				

Record Issues:	Initial	Date

SAMPLE

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2207 Garnet Avenue Suite I
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Direct: (619) 770-8552

Electric Unit Heater
Functional Performance Test

Project:	VA CT West Haven EHRM Infrastructure upgrade
Building:	
Project Location:	West Haven, CT
Equipment ID:	
Equipment Location:	
Manufacturer:	
Model #:	
Serial #:	
Service:	

System Description

Description: The unit heater shall be controlled by a local thermostat.

Operational Assumptions: The test begins with the ventilation fan disabled.

Initial Test			Start Date	End Date	Initials
Results	**Yes/No**	**Explanation**			
Pass					
Fail					
Partial Test w/Corrective Actions					
Complete Test w/Corrective Actions					
Other					

System Readiness Summary Checklist

	Description	Yes/No	Date
1	System Ready for Test		
2	Required Personnel Available		
3	Required Tools/Test Equipment/Supplies Available		
4	Required Safety Equipment Available		

Initial Ambient Conditions

Dry Bulb Temperature		**Precipitation**	
Wet Bulb Temperature		**Relative Humidity**	

Set Point and Limit Verification

Setpoints

	Parameter	Setpoint Design	Setpoint Actual	BAS Displayed Parameter Name	Adjustable Range Design	Adjustable Range Actual
1	Room Setpoint					
2	Room Temp					

Comments:	Initial	Date

SAMPLE

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2207 Garnet Avenue Suite I
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Functional Performance Test

Test Procedures

On/Off Operation:

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments/ Issues
1	Place the unit heater into heating mode	The cabinet unit heater shall be energized.		
2	Take the unit heater out of heating mode	The cabinet unit heater shall be de-energized.		

Comments:	Initials	Date

SAMPLE

2207 Garnet Avenue Suite I
San Diego, CA 92109
Direct: (619) 770-8552

Energy Recovery Ventilator
Functional Performance Test

Project:	VA CT West Haven EHRM Infrastructure upgrade
Building:	
Project Location:	West Haven, CT
Equipment ID:	
Equipment Location:	
Manufacturer:	
Model #:	
Serial #:	
Service:	

System Description

Description: The test procedure is intended to verify that the ERV/DOAS is functioning properly per the control sequence of operations.

Operational Assumptions: All associated building heating and cooling systems are currently functional and operating normally.

* No faults or alarms associated with the equipment being tested are present.
* BAS shows no major alarms that would affect the testing.

Initial Test			Start Date	End Date	Initials
Results		**Explanation**			
Pass					
Fail					
Partial Test w/Corrective Actions					
Complete Test w/Corrective Actions					
Other					

TEST PARTICIPANTS

Organization	Required	Optional
General Contractor		
Mechanical Contractor		
TAB Contractor		
Controls Contractor		
Owner's O&M Personnel		

SAMPLE

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System Readiness Summary Checklist

	Description	Yes/No	Date
1	Tools available for everyone including earplugs, flashlights as needed, access keys, radios, other communication devices.		
2	Access/security to equipment location		
3	Radios, cell phones, public address and/or fire alarm intercom available for communications.		
4	Initial Start-Up testing has been completed by the GC/Mechanical Contractor		
5	System Ready for Test		
6	Required Personnel Notified		
7	All Electrical and Mechanical verification testing complete.		

SYSTEM TRENDING REQUIREMENTS

	Description	*Frequency*	*Trending Established (Y/N)*
1	Supply Air Temperature (°F)	15 min	
2	Exhaust Air From Building Temperature (°F)	15 min	
3	Cooling Coil Discharge Air Temperature (°F)	15 min	
4	Exhaust Air From Building Filter Status	15 min	
5	Chilled Water Control Valve	COV	
6	Heating Water Control Valve	COV	
7	Freezestat	15 min	
8	Duct Smoke Detector	COV	
9	Supply Fan Status	COV	
10	Exhaust Fan Start/Stop	COV	
11	Exhaust Fan Status	COV	
12	Exhaust Air From Building Humidity (%)	15 min	
13	Enthalpy Wheel Status	COV	
14	Supply Air Humidity (%)	15 min	
15	Exhaust Air Temperature (°F)	15 min	
16	Outside Air Humidity (%)	15 min	
17	Supply Fan VFD Speed	15 min	
18	Outside Air Damper (%)	15 min	
19	Outside Air Damper Position	COV	
20	Exhaust Air Damper Position	COV	
21	Outside Air Bypass Damper (%)	15 min	
22	Exhaust Air Bypass Damper (%)	15 min	
23	Return Air Bypass Damper (%)	COV	
24	Outside Air Bypass Damper Position	COV	
25	Exhaust Air Bypass Damper Position	COV	
26	Return Air Bypass Damper Position	COV	

SAMPLE

2207 Garnet Avenue Suite I
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POINT-TO-POINT CHECKOUT

	CONTROL SENSORS (ANALOG/DIGITAL INPUTS)	Measured	BAS	Cal Off-Set	Notes
1	Supply Air Temperature (°F)				
2	Supply Air Humidity (%)				
3	Supply Air Flow Measuring Station				
4	Supply Air Temperature (DHC-1) (°F)				
5	Return Air Temperature (°F)				
6	Return Air Humidity (%)				
7	Pre-heat Air Temperature (°F)				
8	Outside Air Temperature (°F)				
9	Outside Air Humidity (%)				
10	Outside Air Flow Measuring Station				
11	Exhaust Air Temperature (°F)				
12	Exhaust Air Humidity (%)				
13	Exhaust Air from Bldg. Temperature (°F)				
14	Exhaust Air from Bldg. Humidity (%)				
15	Cooling Coil Discharge Air Temperature (°F)				
16	Heating Coil Air Discharge Temperature (°F)				

Record Issues:	Initial	Date

	DAMPERS / ACTUATOR INFORMATION:	0%	50%	100%	CONDITION / COMMENT
1	SF Speed (0%/50%/100%)				
2	EF Speed (0%/50%/100%)				
3	Heating Water Control Valve (0%/50%/100%)				
4	Chilled Water Control Valve (0%/50%/100%)				
5	Outside Air Damper Position (0%/50%/100%)				
6	Exhaust Air Damper Position (0%/50%/100%)				
7	Outside Air Bypass Damper Position (0%/50%/100%)				
8	ExhaustAir Bypass Damper Position (0%/50%/100%)				
9	Return Air Bypass Damper Position (0%/50%/100%)				

Record Issues:	Initial	Date

OCCUPANCY SCHEDULE

	Record the Occupancy Schedule below	Occupied Hours	Unoccupied Hours
1	Weekday		
2	Weekend		
3	Holiday		

SAMPLE

2207 Garnet Avenue Suite I
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Direct: (619) 770-8552

Initial Ambient Conditions

Dry Bulb Temperature		**Precipitation**	
Wet Bulb Temperature		**Relative Humidity**	

Functional Performance Agenda:

PRE-TEST CHECKLIST
COOLING MODE
HEATING MODE
HUMIDITY CONTROL
HEAT RECOVERY WHEEL OPERATION
SMOKE DETECTOR ACTIVATION
FREEZESTAT ACTIVATION
SAFETIES AND ALARMS
EMERGENCY SHUTDOWN
RETURN TO INITIAL CONDITIONS

Functional Performance Test:

A. PRE-TEST CHECKLIST

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments / Issues
1	Verify that the ERV is operating under normal conditions and is ready to test.	No alarms are present.		
		ERV is in occupied mode and is maintaining operational temperature, RH, and static pressure set points.		

Record Issues:	Initial	Date

Task #	Action Item	Set Points and As Found Conditions	Record Data	Comments / Issues
	Record the initial operating conditions:	**Setpoints**		
		Zone Temperature SP:		
		Supply Air Temperature SP:		
		Supply Air Humidity SP:		
		Exhaust Air Temperature SP:		
		Exhaust Air Humidity SP:		
		Supply Air Temperature (DHC-1) SP:		
		Heating Coil Discharge Air Temperature SP:		
		Outside Air Temperature SP:		
		Outside Air Humidity SP:		
		Exhaust Air from Bldg. Temperature SP:		
		Exhaust Air from Bldg. Humidity SP:		

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2		**As-Found Conditions**		
		SF VFD Speed		
		SF Staus		
		EF Status		
		EF VFD Speed		
		Supply Air Temperature		
		Supply Air Humidity		
		Exhaust Air Temperature		
		Exhaust Air Humidity		
		Supply Air Temperature (DHC-1)		
		Heating Coil Discharge Air Temperature		
		Outside Air Temperature		
		Outside Air Humidity		
		Return Air Temperature		
		Return Air Humidity		
		Pre-heat Air Temperature		
		Exhaust Air from Bldg. Temperature		
		Exhaust Air from Bldg. Humidity		
		Heating Valve Position		
		Cooling Valve Position		
		Enthalpy Wheel Status		
		Exhaust Air Damper Position		
		Outside Air Damper Position		
		Outside Air Bypass Damper Position		
		Exhaust Air Bypass Damper Position		
		Return Air Bypass Damper Position		
Record Issues:			**Initial**	**Date**

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B.OCCUPIED COOLING MODE

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments / Issues
3	Override Zone Temperature Cooling Setpoint so that its is below the current zone temperature.	Outside Air Damper opens		
		Exhaust Air Damper No. 1 opens		
		ERV is energized		
		Exhaust fan turns on after a 10-second delay		
		Supply fan starts 5 seconds after exhaust fan		
		SF and EF maintain supply airflow.		
		Chilled Water Control Valve maintains a SAT of 55°F		
		Hot Water Control Valve modulates to maintain a SAT of 55°F		
		Duct Mounted Reheat Coil is energized to maintain a leaving air temperature of 73°F		
		Zone temperature decreases to meet the zone temperature setpoint.		

Record Issues:	Initial	Date

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments / Issues
4	Remove all cooling overrides.	Outside Air Damper remains open		
		Exahust Air Damper No. 1 remains open		
		ERV remains energized		
		Exhaust fan remains on		
		Supply fan remains on		
		SF and EF maintain supply airflow.		
		Chilled Water Control Valve and Hot Water Control valve modulate to maintain SAT		
		Duct Mounted Reheat Coil is energized to maintain the leaving air temperature setpoint		
		Zone Cooling setpoint returns to previous value.		

Record Issues:	Initial	Date

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Task #	Action Item	Expected Response	Passed (Yes/No)	Comments / Issues
5	Override the ERV so that it is de-energized	ERV is de-energized		
		SF and EF de-energize		
6	Release overrides	ERV is energized		
		SF and EF are energized		

Record Issues:	Initial	Date

C. OCCUPIED HEATING MODE

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments / Issues
7	Override Zone Temperature Heating Setpoint so that its is above the current zone temperature and goes into heating mode	Outside Air Damper opens		
		Exahust Air Damper No. 1 opens		
		ERV is energized		
		Exhaust fan turns on after a 10-second delay		
		Supply fan starts 5 seconds after exhaust fan		
		SF and EF maintain supply airflow.		
		Chilled Water Control Valve and Hot Water Control valve modulate to maintain SAT		
		Duct Mounted Reheat Coil is energized to maintain the leaving air temperature setpoint		
		Zone temperature increases to meet the zone temperature setpoint.		

Record Issues:	Initial	Date

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Task #	Action Item	Expected Response	Passed (Yes/No)	Comments / Issues
8	Remove all overrides.	Outside Air Damper remains open		
		Exhaust Air Damper No. 1 remains open		
		ERV remains energized		
		Exhaust fan remains on		
		Supply fan remains on		
		SF and EF maintain supply airflow.		
		Chilled Water Control Valve and Hot Water Control valve modulate to maintain SAT		
		Duct Mounted Reheat Coil is energized to maintain the leaving air temperature setpoint		
		Zone Heating setpoint returns to previous value.		

Record Issues:	Initial	Date

D. HUMIDITY CONTROL

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments / Issues
9	Override Zone Temperature Heating Setpoint so that its is above the current zone temperature and goes into heating mode	Outside Air Damper opens		
		Exahust Air Damper No. 1 opens		
		ERV is energized		
		Exhaust fan turns on after a 10-second delay		
		Supply fan starts 5 seconds after exhaust fan		
		SF and EF maintain supply airflow.		
		Chilled Water Control Valve and Hot Water Control valve modulate to maintain SAT		
		Duct Mounted Reheat Coil is energized to maintain the leaving air temperature setpoint		
		Zone temperature increases to meet the zone temperature setpoint.		

Record Issues:	Initial	Date

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Task #	Action Item	Expected Response	Passed (Yes/No)	Comments / Issues
10	Override the Supply Air Humidity sensor to show a relative humidity higher than 55%	Duct mounted reheat coil is activated		
		DHC-1 starts to dehumidify the Supply Air		
		Once the Supply Air reaches a 55% RH reading the DHC-1 shall de-energize		

Record Issues:	Initials	Date

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments / Issues
11	Remove the Supply Air Humidity sensor override.	DHC-1 returns to normal operation under the BAS		
		Supply Air Humidity senor returns to normal operation under the BAS		

Record Issues:	Initials	Date

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments / Issues
12	Remove all overrides.	Outside Air Damper remains open		
		Exhaust Air Damper No. 1 remains open		
		ERV remains energized		
		Exhaust fan remains on		
		Supply fan remains on		
		SF and EF maintain supply airflow.		
		Chilled Water Control Valve and Hot Water Control valve modulate to maintain SAT		
		Duct Mounted Reheat Coil is energized to maintain the leaving air temperature setpoint		
		Zone Heating setpoint returns to previous value.		

Record Issues:	Initial	Date

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E. HEAT RECOVERY WHEEL OPERATION

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments / Issues
13	Override the OAT so that it is less than the RAT and override the SAT so it is greater than the SAT setpoint	Economizer cooling is enabled		
		Heat Recovery Wheel stops		
		OA bypass damper opens		
		EA bypass damper opens		
		RA bypass damper opens		

Record Issues:	Initials	Date

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments / Issues
14	Remove overrides	Economizer cooling is disabled		
		Heat Recovery Wheel returns to normal operation		
		OA bypass damper return to normal operation under the BAS		
		EA bypass damper returns to normal operation under the BAS		
		RA bypass damper returns to normal operation under the BAS		

Record Issues:	Initials	Date

F. SMOKE DETECTOR ACTIVATION

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments / Issues
15	Enable the smoke detector in the supply duct to generate an alarm.	Supply Fan shuts OFF.		
		Exhaust Fan shuts OFF.		
		Outside air damper fully closes.		
		ERV unit shuts down		
		A Supply Air Smoke Alarm is generated at the BAS.		

Record Issues:	Initials	Date

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Task #	Action Item	Expected Response	Passed (Yes/No)	Comments / Issues
16	Remove the smoke detector override.	ERV returns to normal operation.		
		Alarm is removed from the BAS.		

Record Issues:	Initials	Date

G. FREEZESTAT ACTIVATION

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments/ Issues
17	Trip the freezestat sensor (either via test button or with compressed air can)	ERV is de-energized		
		Supply Fan is de-energized		
		Exhaust Fan is de-energized		
		Chilled Water Control Valve opens to 10%		
		Hot Water Control Valve opens to 100%		
		OAD fully closes		
		EAD fully closes		
		A Freezestat alarm is generated		

Record Issues:	Initials	Date

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments/ Issues
18	Release/reset the freezestat sensor.	The Freezestat alarm is cleared		
		ERV is energized		
		Supply Fan is energized		
		Exhaust Fan is energized		
		The CHW and Heating valves are enabled and modulate to maintain the SAT set point.		
		OAD resumes normal DDC control		
		EAD resumes normal DDC control		

Record Issues:	Initials	Date

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H. SAFETIES AND ALARMS

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments/ Issues
19	Override the supply fan failure settings to initiate an SF failure alarm.	ERV is shutdown and alarm is generated on the BAS		
	Remove all overrides.	Alarm is cleared from the BAS.		

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments/ Issues
20	Manually fail the exahust fan	The exhaust fan is de-energized		
		ERV is shutdown and alarm is generated on the BAS showing fan failure		
21	Re-enable the failed exhaust fan	Alarm is cleared from the BAS.		
		Exhaust fan is energized		
		ERV returns normal conditions under control of the BAS		

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments/ Issues
22	Simulate an emergency shutdown for the ERV	ERV shuts down an alarm is generated on the BAS.		
		EAD and OAD fully close		
	Remove all overrides.	Alarm is cleared from the BAS.		

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments/ Issues
23	Simulate a power loss to the ERV	ERV shuts down		
	Restore power to ERV	Unit automatically resets and starts operating according to normal operating sequence		

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments/ Issues
24	Manually disable the OAD	An Outside Air Damper alarm is shown on the BAS		
	Reset OAD and return to intial conditions	The alarm is cleared and the system is operational		

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments/ Issues
25	Override energy wheel DPS to indicate frosting.	ERV cycles the enthalpy wheel for 5 minutes every 1/2 hour. A DPS alarm is generated at the BAS.		
	Remove all overrides.	Alarm is cleared from the BAS.		

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I. EMERGENCY SHUTDOWN

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments/ Issues
26	Simulate an emergency shutdown for the ERV	ERV shuts down an alarm is generated on the BAS.		
		EAD No.1 and OAD shall fully close		
27	Manually clear alarm at shutdown switches on both floors	Alarm is cleared from the BAS.		
		Unit starts automatically in accordance to normal operating sequence		

J. RETURN TO INITIAL CONDITIONS

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments / Issues
28	Release all overrides to the system, returning to initial conditions.	DDC resumes normal control of the fans, valves, and dampers.		
		All equipment is operational.		

Record Issues:	Initial	Date

Final Sign-Off

Commissioning Agent	Printed Name	Initials	Date

Contractor	Printed Name	Initials	Date
General Contractor (GC)			
Mechanical Contractor (MC)			
Electrical Contractor (EC)			
TAB Contractor (TAB)			
Controls Contractor (CC)			
Owner's O&M Personnel			

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Energy Recovery Ventilator
Functional Performance Test

Project:	VA CT West Haven EHRM Infrastructure upgrade
Building:	
Project Location:	West Haven, CT
Equipment ID:	
Equipment Location:	
Manufacturer:	
Model #:	
Serial #:	
Service:	

System Description

Description: The test procedure is intended to verify that the ERV/DOAS is functioning properly per the control sequence of operations.

Operational Assumptions: All associated building heating and cooling systems are currently functional and operating normally.

* No faults or alarms associated with the equipment being tested are present.
* BAS shows no major alarms that would affect the testing.

Initial Test			Start Date	End Date	Initials
Results		**Explanation**			
Pass					
Fail					
Partial Test w/Corrective Actions					
Complete Test w/Corrective Actions					
Other					

TEST PARTICIPANTS

Organization	Required	Optional
General Contractor		
Mechanical Contractor		
TAB Contractor		
Controls Contractor		
Owner's O&M Personnel		

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System Readiness Summary Checklist

	Description	Yes/No	Date
1	Tools available for everyone including earplugs, flashlights as needed, access keys, radios, other communication devices.		
2	Access/security to equipment location		
3	Radios, cell phones, public address and/or fire alarm intercom available for communications.		
4	Initial Start-Up testing has been completed by the GC/Mechanical Contractor		
5	System Ready for Test		
6	Required Personnel Notified		
7	All Electrical and Mechanical verification testing complete.		

SYSTEM TRENDING REQUIREMENTS

	Description	*Frequency*	*Trending Established (Y/N)*
1	Supply Air Temperature (°F)	15 min	
2	Exhaust Air From Building Temperature (°F)	15 min	
3	Cooling Coil Discharge Air Temperature (°F)	15 min	
4	Exhaust Air From Building Filter Status	15 min	
5	Chilled Water Control Valve	COV	
6	Heating Water Control Valve	COV	
7	Freezestat	15 min	
8	Duct Smoke Detector	COV	
9	Supply Fan Status	COV	
10	Exhaust Fan Start/Stop	COV	
11	Exhaust Fan Status	COV	
12	Exhaust Air From Building Humidity (%)	15 min	
13	Enthalpy Wheel Status	COV	
14	Supply Air Humidity (%)	15 min	
15	Exhaust Air Temperature (°F)	15 min	
16	Outside Air Humidity (%)	15 min	
17	Supply Fan VFD Speed	15 min	
18	Outside Air Damper (%)	15 min	
19	Outside Air Damper Position	COV	
20	Exhaust Air Damper Position	COV	
21	Outside Air Bypass Damper (%)	15 min	
22	Exhaust Air Bypass Damper (%)	15 min	
23	Return Air Bypass Damper (%)	COV	
24	Outside Air Bypass Damper Position	COV	
25	Exhaust Air Bypass Damper Position	COV	
26	Return Air Bypass Damper Position	COV	

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POINT-TO-POINT CHECKOUT

	CONTROL SENSORS (ANALOG/DIGITAL INPUTS)	Measured	BAS	Cal Off-Set	Notes
1	Supply Air Temperature (°F)				
2	Supply Air Humidity (%)				
3	Supply Air Flow Measuring Station				
4	Supply Air Temperature (DHC-1) (°F)				
5	Return Air Temperature (°F)				
6	Return Air Humidity (%)				
7	Pre-heat Air Temperature (°F)				
8	Outside Air Temperature (°F)				
9	Outside Air Humidity (%)				
10	Outside Air Flow Measuring Station				
11	Exhaust Air Temperature (°F)				
12	Exhaust Air Humidity (%)				
13	Exhaust Air from Bldg. Temperature (°F)				
14	Exhaust Air from Bldg. Humidity (%)				
15	Cooling Coil Discharge Air Temperature (°F)				
16	Heating Coil Air Discharge Temperature (°F)				

Record Issues:	Initial	Date

	DAMPERS / ACTUATOR INFORMATION:	0%	50%	100%	CONDITION / COMMENT
1	SF Speed (0%/50%/100%)				
2	EF Speed (0%/50%/100%)				
3	Heating Water Control Valve (0%/50%/100%)				
4	Chilled Water Control Valve (0%/50%/100%)				
5	Outside Air Damper Position (0%/50%/100%)				
6	Exhaust Air Damper Position (0%/50%/100%)				
7	Outside Air Bypass Damper Position (0%/50%/100%)				
8	ExhaustAir Bypass Damper Position (0%/50%/100%)				
9	Return Air Bypass Damper Position (0%/50%/100%)				

Record Issues:	Initial	Date

OCCUPANCY SCHEDULE

	Record the Occupancy Schedule below	Occupied Hours	Unoccupied Hours
1	Weekday		
2	Weekend		
3	Holiday		

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Initial Ambient Conditions

Dry Bulb Temperature		**Precipitation**	
Wet Bulb Temperature		**Relative Humidity**	

Functional Performance Agenda:

PRE-TEST CHECKLIST
COOLING MODE
HEATING MODE
HUMIDITY CONTROL
HEAT RECOVERY WHEEL OPERATION
SMOKE DETECTOR ACTIVATION
FREEZESTAT ACTIVATION
SAFETIES AND ALARMS
EMERGENCY SHUTDOWN
RETURN TO INITIAL CONDITIONS

Functional Performance Test:

A. PRE-TEST CHECKLIST

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments / Issues
1	Verify that the ERV is operating under normal conditions and is ready to test.	No alarms are present.		
		ERV is in occupied mode and is maintaining operational temperature, RH, and static pressure set points.		

Record Issues:	Initial	Date

Task #	Action Item	Set Points and As Found Conditions	Record Data	Comments / Issues
	Record the initial operating conditions:	**Setpoints**		
		Zone Temperature SP:		
		Supply Air Temperature SP:		
		Supply Air Humidity SP:		
		Exhaust Air Temperature SP:		
		Exhaust Air Humidity SP:		
		Supply Air Temperature (DHC-1) SP:		
		Heating Coil Discharge Air Temperature SP:		
		Outside Air Temperature SP:		
		Outside Air Humidity SP:		
		Exhaust Air from Bldg. Temperature SP:		
		Exhaust Air from Bldg. Humidity SP:		

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2		**As-Found Conditions**		
		SF VFD Speed		
		SF Staus		
		EF Status		
		EF VFD Speed		
		Supply Air Temperature		
		Supply Air Humidity		
		Exhaust Air Temperature		
		Exhaust Air Humidity		
		Supply Air Temperature (DHC-1)		
		Heating Coil Discharge Air Temperature		
		Outside Air Temperature		
		Outside Air Humidity		
		Return Air Temperature		
		Return Air Humidity		
		Pre-heat Air Temperature		
		Exhaust Air from Bldg. Temperature		
		Exhaust Air from Bldg. Humidity		
		Heating Valve Position		
		Cooling Valve Position		
		Enthalpy Wheel Status		
		Exhaust Air Damper Position		
		Outside Air Damper Position		
		Outside Air Bypass Damper Position		
		Exhaust Air Bypass Damper Position		
		Return Air Bypass Damper Position		

Record Issues:	**Initial**	**Date**

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B.OCCUPIED COOLING MODE

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments / Issues
3	Override Zone Temperature Cooling Setpoint so that its is below the current zone temperature.	Outside Air Damper opens		
		Exhaust Air Damper No. 1 opens		
		ERV is energized		
		Exhaust fan turns on after a 10-second delay		
		Supply fan starts 5 seconds after exhaust fan		
		SF and EF maintain supply airflow.		
		Chilled Water Control Valve maintains a SAT of 55°F		
		Hot Water Control Valve modulates to maintain a SAT of 55°F		
		Duct Mounted Reheat Coil is energized to maintain a leaving air temperature of 73°F		
		Zone temperature decreases to meet the zone temperature setpoint.		

Record Issues:	Initial	Date

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments / Issues
4	Remove all cooling overrides.	Outside Air Damper remains open		
		Exahust Air Damper No. 1 remains open		
		ERV remains energized		
		Exhaust fan remains on		
		Supply fan remains on		
		SF and EF maintain supply airflow.		
		Chilled Water Control Valve and Hot Water Control valve modulate to maintain SAT		
		Duct Mounted Reheat Coil is energized to maintain the leaving air temperature setpoint		
		Zone Cooling setpoint returns to previous value.		

Record Issues:	Initial	Date

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Task #	Action Item	Expected Response	Passed (Yes/No)	Comments / Issues
5	Override the ERV so that it is de-energized	ERV is de-energized		
		SF and EF de-energize		
6	Release overrides	ERV is energized		
		SF and EF are energized		

Record Issues:	Initial	Date

C. OCCUPIED HEATING MODE

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments / Issues
7	Override Zone Temperature Heating Setpoint so that its is above the current zone temperature and goes into heating mode	Outside Air Damper opens		
		Exahust Air Damper No. 1 opens		
		ERV is energized		
		Exhaust fan turns on after a 10-second delay		
		Supply fan starts 5 seconds after exhaust fan		
		SF and EF maintain supply airflow.		
		Chilled Water Control Valve and Hot Water Control valve modulate to maintain SAT		
		Duct Mounted Reheat Coil is energized to maintain the leaving air temperature setpoint		
		Zone temperature increases to meet the zone temperature setpoint.		

Record Issues:	Initial	Date

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Task #	Action Item	Expected Response	Passed (Yes/No)	Comments / Issues
8	Remove all overrides.	Outside Air Damper remains open		
		Exhaust Air Damper No. 1 remains open		
		ERV remains energized		
		Exhaust fan remains on		
		Supply fan remains on		
		SF and EF maintain supply airflow.		
		Chilled Water Control Valve and Hot Water Control valve modulate to maintain SAT		
		Duct Mounted Reheat Coil is energized to maintain the leaving air temperature setpoint		
		Zone Heating setpoint returns to previous value.		

Record Issues:	Initial	Date

D. HUMIDITY CONTROL

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments / Issues
9	Override Zone Temperature Heating Setpoint so that its is above the current zone temperature and goes into heating mode	Outside Air Damper opens		
		Exahust Air Damper No. 1 opens		
		ERV is energized		
		Exhaust fan turns on after a 10-second delay		
		Supply fan starts 5 seconds after exhaust fan		
		SF and EF maintain supply airflow.		
		Chilled Water Control Valve and Hot Water Control valve modulate to maintain SAT		
		Duct Mounted Reheat Coil is energized to maintain the leaving air temperature setpoint		
		Zone temperature increases to meet the zone temperature setpoint.		

Record Issues:	Initial	Date

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Task #	Action Item	Expected Response	Passed (Yes/No)	Comments / Issues
10	Override the Supply Air Humidity sensor to show a relative humidity higher than 55%	Duct mounted reheat coil is activated		
		DHC-1 starts to dehumidify the Supply Air		
		Once the Supply Air reaches a 55% RH reading the DHC-1 shall de-energize		

Record Issues:	Initials	Date

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments / Issues
11	Remove the Supply Air Humidity sensor override.	DHC-1 returns to normal operation under the BAS		
		Supply Air Humidity senor returns to normal operation under the BAS		

Record Issues:	Initials	Date

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments / Issues
12	Remove all overrides.	Outside Air Damper remains open		
		Exhaust Air Damper No. 1 remains open		
		ERV remains energized		
		Exhaust fan remains on		
		Supply fan remains on		
		SF and EF maintain supply airflow.		
		Chilled Water Control Valve and Hot Water Control valve modulate to maintain SAT		
		Duct Mounted Reheat Coil is energized to maintain the leaving air temperature setpoint		
		Zone Heating setpoint returns to previous value.		

Record Issues:	Initial	Date

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E. HEAT RECOVERY WHEEL OPERATION

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments / Issues
13	Override the OAT so that it is less than the RAT and override the SAT so it is greater than the SAT setpoint	Economizer cooling is enabled		
		Heat Recovery Wheel stops		
		OA bypass damper opens		
		EA bypass damper opens		
		RA bypass damper opens		

Record Issues:	Initials	Date

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments / Issues
14	Remove overrides	Economizer cooling is disabled		
		Heat Recovery Wheel returns to normal operation		
		OA bypass damper return to normal operation under the BAS		
		EA bypass damper returns to normal operation under the BAS		
		RA bypass damper returns to normal operation under the BAS		

Record Issues:	Initials	Date

F. SMOKE DETECTOR ACTIVATION

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments / Issues
15	Enable the smoke detector in the supply duct to generate an alarm.	Supply Fan shuts OFF.		
		Exhaust Fan shuts OFF.		
		Outside air damper fully closes.		
		ERV unit shuts down		
		A Supply Air Smoke Alarm is generated at the BAS.		

Record Issues:	Initials	Date

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Task #	Action Item	Expected Response	Passed (Yes/No)	Comments / Issues
16	Remove the smoke detector override.	ERV returns to normal operation.		
		Alarm is removed from the BAS.		

Record Issues:	Initials	Date

G. FREEZESTAT ACTIVATION

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments/ Issues
17	Trip the freezestat sensor (either via test button or with compressed air can)	ERV is de-energized		
		Supply Fan is de-energized		
		Exhaust Fan is de-energized		
		Chilled Water Control Valve opens to 10%		
		Hot Water Control Valve opens to 100%		
		OAD fully closes		
		EAD fully closes		
		A Freezestat alarm is generated		

Record Issues:	Initials	Date

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments/ Issues
18	Release/reset the freezestat sensor.	The Freezestat alarm is cleared		
		ERV is energized		
		Supply Fan is energized		
		Exhaust Fan is energized		
		The CHW and Heating valves are enabled and modulate to maintain the SAT set point.		
		OAD resumes normal DDC control		
		EAD resumes normal DDC control		

Record Issues:	Initials	Date

SAMPLE

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H. SAFETIES AND ALARMS

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments/ Issues
19	Override the supply fan failure settings to initiate an SF failure alarm.	ERV is shutdown and alarm is generated on the BAS		
	Remove all overrides.	Alarm is cleared from the BAS.		

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments/ Issues
20	Manually fail the exahust fan	The exhaust fan is de-energized		
		ERV is shutdown and alarm is generated on the BAS showing fan failure		
21	Re-enable the failed exhaust fan	Alarm is cleared from the BAS.		
		Exhaust fan is energized		
		ERV returns normal conditions under control of the BAS		

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments/ Issues
22	Simulate an emergency shutdown for the ERV	ERV shuts down an alarm is generated on the BAS.		
		EAD and OAD fully close		
	Remove all overrides.	Alarm is cleared from the BAS.		

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments/ Issues
23	Simulate a power loss to the ERV	ERV shuts down		
	Restore power to ERV	Unit automatically resets and starts operating according to normal operating sequence		

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments/ Issues
24	Manually disable the OAD	An Outside Air Damper alarm is shown on the BAS		
	Reset OAD and return to intial conditions	The alarm is cleared and the system is operational		

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments/ Issues
25	Override energy wheel DPS to indicate frosting.	ERV cycles the enthalpy wheel for 5 minutes every 1/2 hour. A DPS alarm is generated at the BAS.		
	Remove all overrides.	Alarm is cleared from the BAS.		

SAMPLE

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I. EMERGENCY SHUTDOWN

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments/ Issues
26	Simulate an emergency shutdown for the ERV	ERV shuts down an alarm is generated on the BAS.		
		EAD No.1 and OAD shall fully close		
27	Manually clear alarm at shutdown switches on both floors	Alarm is cleared from the BAS.		
		Unit starts automatically in accordance to normal operating sequence		

J. RETURN TO INITIAL CONDITIONS

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments / Issues
28	Release all overrides to the system, returning to initial conditions.	DDC resumes normal control of the fans, valves, and dampers.		
		All equipment is operational.		

Record Issues:	Initial	Date

Final Sign-Off

Commissioning Agent	Printed Name	Initials	Date

Contractor	Printed Name	Initials	Date
General Contractor (GC)			
Mechanical Contractor (MC)			
Electrical Contractor (EC)			
TAB Contractor (TAB)			
Controls Contractor (CC)			
Owner's O&M Personnel			

SAMPLE

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Energy Recovery Ventilator
Functional Performance Test

Project:	VA CT West Haven EHRM Infrastructure upgrade
Building:	
Project Location:	West Haven, CT
Equipment ID:	
Equipment Location:	
Manufacturer:	
Model #:	
Serial #:	
Service:	

System Description

Description: The test procedure is intended to verify that the ERV/DOAS is functioning properly per the control sequence of operations.

Operational Assumptions: All associated building heating and cooling systems are currently functional and operating normally.

* No faults or alarms associated with the equipment being tested are present.
* BAS shows no major alarms that would affect the testing.

Initial Test			Start Date	End Date	Initials
Results		**Explanation**			
Pass					
Fail					
Partial Test w/Corrective Actions					
Complete Test w/Corrective Actions					
Other					

TEST PARTICIPANTS

Organization	Required	Optional
General Contractor		
Mechanical Contractor		
TAB Contractor		
Controls Contractor		
Owner's O&M Personnel		

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System Readiness Summary Checklist

	Description	Yes/No	Date
1	Tools available for everyone including earplugs, flashlights as needed, access keys, radios, other communication devices.		
2	Access/security to equipment location		
3	Radios, cell phones, public address and/or fire alarm intercom available for communications.		
4	Initial Start-Up testing has been completed by the GC/Mechanical Contractor		
5	System Ready for Test		
6	Required Personnel Notified		
7	All Electrical and Mechanical verification testing complete.		

SYSTEM TRENDING REQUIREMENTS

	Description	*Frequency*	*Trending Established (Y/N)*
1	Supply Air Temperature (°F)	15 min	
2	Exhaust Air From Building Temperature (°F)	15 min	
3	Cooling Coil Discharge Air Temperature (°F)	15 min	
4	Exhaust Air From Building Filter Status	15 min	
5	Chilled Water Control Valve	COV	
6	Heating Water Control Valve	COV	
7	Freezestat	15 min	
8	Duct Smoke Detector	COV	
9	Supply Fan Status	COV	
10	Exhaust Fan Start/Stop	COV	
11	Exhaust Fan Status	COV	
12	Exhaust Air From Building Humidity (%)	15 min	
13	Enthalpy Wheel Status	COV	
14	Supply Air Humidity (%)	15 min	
15	Exhaust Air Temperature (°F)	15 min	
16	Outside Air Humidity (%)	15 min	
17	Supply Fan VFD Speed	15 min	
18	Outside Air Damper (%)	15 min	
19	Outside Air Damper Position	COV	
20	Exhaust Air Damper Position	COV	
21	Outside Air Bypass Damper (%)	15 min	
22	Exhaust Air Bypass Damper (%)	15 min	
23	Return Air Bypass Damper (%)	COV	
24	Outside Air Bypass Damper Position	COV	
25	Exhaust Air Bypass Damper Position	COV	
26	Return Air Bypass Damper Position	COV	

SAMPLE

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POINT-TO-POINT CHECKOUT

	CONTROL SENSORS (ANALOG/DIGITAL INPUTS)	Measured	BAS	Cal Off-Set	Notes
1	Supply Air Temperature (°F)				
2	Supply Air Humidity (%)				
3	Supply Air Flow Measuring Station				
4	Supply Air Temperature (DHC-1) (°F)				
5	Return Air Temperature (°F)				
6	Return Air Humidity (%)				
7	Pre-heat Air Temperature (°F)				
8	Outside Air Temperature (°F)				
9	Outside Air Humidity (%)				
10	Outside Air Flow Measuring Station				
11	Exhaust Air Temperature (°F)				
12	Exhaust Air Humidity (%)				
13	Exhaust Air from Bldg. Temperature (°F)				
14	Exhaust Air from Bldg. Humidity (%)				
15	Cooling Coil Discharge Air Temperature (°F)				
16	Heating Coil Air Discharge Temperature (°F)				

Record Issues:	Initial	Date

	DAMPERS / ACTUATOR INFORMATION:	0%	50%	100%	CONDITION / COMMENT
1	SF Speed (0%/50%/100%)				
2	EF Speed (0%/50%/100%)				
3	Heating Water Control Valve (0%/50%/100%)				
4	Chilled Water Control Valve (0%/50%/100%)				
5	Outside Air Damper Position (0%/50%/100%)				
6	Exhaust Air Damper Position (0%/50%/100%)				
7	Outside Air Bypass Damper Position (0%/50%/100%)				
8	ExhaustAir Bypass Damper Position (0%/50%/100%)				
9	Return Air Bypass Damper Position (0%/50%/100%)				

Record Issues:	Initial	Date

OCCUPANCY SCHEDULE

	Record the Occupancy Schedule below	Occupied Hours	Unoccupied Hours
1	Weekday		
2	Weekend		
3	Holiday		

SAMPLE

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Initial Ambient Conditions

Dry Bulb Temperature		**Precipitation**	
Wet Bulb Temperature		**Relative Humidity**	

Functional Performance Agenda:

PRE-TEST CHECKLIST
COOLING MODE
HEATING MODE
HUMIDITY CONTROL
HEAT RECOVERY WHEEL OPERATION
SMOKE DETECTOR ACTIVATION
FREEZESTAT ACTIVATION
SAFETIES AND ALARMS
EMERGENCY SHUTDOWN
RETURN TO INITIAL CONDITIONS

Functional Performance Test:

A. PRE-TEST CHECKLIST

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments / Issues
1	Verify that the ERV is operating under normal conditions and is ready to test.	No alarms are present.		
		ERV is in occupied mode and is maintaining operational temperature, RH, and static pressure set points.		

Record Issues:	Initial	Date

Task #	Action Item	Set Points and As Found Conditions	Record Data	Comments / Issues
	Record the initial operating conditions:	**Setpoints**		
		Zone Temperature SP:		
		Supply Air Temperature SP:		
		Supply Air Humidity SP:		
		Exhaust Air Temperature SP:		
		Exhaust Air Humidity SP:		
		Supply Air Temperature (DHC-1) SP:		
		Heating Coil Discharge Air Temperature SP:		
		Outside Air Temperature SP:		
		Outside Air Humidity SP:		
		Exhaust Air from Bldg. Temperature SP:		
		Exhaust Air from Bldg. Humidity SP:		

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2		**As-Found Conditions**		
		SF VFD Speed		
		SF Staus		
		EF Status		
		EF VFD Speed		
		Supply Air Temperature		
		Supply Air Humidity		
		Exhaust Air Temperature		
		Exhaust Air Humidity		
		Supply Air Temperature (DHC-1)		
		Heating Coil Discharge Air Temperature		
		Outside Air Temperature		
		Outside Air Humidity		
		Return Air Temperature		
		Return Air Humidity		
		Pre-heat Air Temperature		
		Exhaust Air from Bldg. Temperature		
		Exhaust Air from Bldg. Humidity		
		Heating Valve Position		
		Cooling Valve Position		
		Enthalpy Wheel Status		
		Exhaust Air Damper Position		
		Outside Air Damper Position		
		Outside Air Bypass Damper Position		
		Exhaust Air Bypass Damper Position		
		Return Air Bypass Damper Position		
Record Issues:			**Initial**	**Date**

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B.OCCUPIED COOLING MODE

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments / Issues
3	Override Zone Temperature Cooling Setpoint so that its is below the current zone temperature.	Outside Air Damper opens		
		Exhaust Air Damper No. 1 opens		
		ERV is energized		
		Exhaust fan turns on after a 10-second delay		
		Supply fan starts 5 seconds after exhaust fan		
		SF and EF maintain supply airflow.		
		Chilled Water Control Valve maintains a SAT of 55°F		
		Hot Water Control Valve modulates to maintain a SAT of 55°F		
		Duct Mounted Reheat Coil is energized to maintain a leaving air temperature of 73°F		
		Zone temperature decreases to meet the zone temperature setpoint.		

Record Issues:	Initial	Date

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments / Issues
4	Remove all cooling overrides.	Outside Air Damper remains open		
		Exahust Air Damper No. 1 remains open		
		ERV remains energized		
		Exhaust fan remains on		
		Supply fan remains on		
		SF and EF maintain supply airflow.		
		Chilled Water Control Valve and Hot Water Control valve modulate to maintain SAT		
		Duct Mounted Reheat Coil is energized to maintain the leaving air temperature setpoint		
		Zone Cooling setpoint returns to previous value.		

Record Issues:	Initial	Date

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Task #	Action Item	Expected Response	Passed (Yes/No)	Comments / Issues
5	Override the ERV so that it is de-energized	ERV is de-energized		
		SF and EF de-energize		
6	Release overrides	ERV is energized		
		SF and EF are energized		

Record Issues:	Initial	Date

C. OCCUPIED HEATING MODE

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments / Issues
7	Override Zone Temperature Heating Setpoint so that its is above the current zone temperature and goes into heating mode	Outside Air Damper opens		
		Exahust Air Damper No. 1 opens		
		ERV is energized		
		Exhaust fan turns on after a 10-second delay		
		Supply fan starts 5 seconds after exhaust fan		
		SF and EF maintain supply airflow.		
		Chilled Water Control Valve and Hot Water Control valve modulate to maintain SAT		
		Duct Mounted Reheat Coil is energized to maintain the leaving air temperature setpoint		
		Zone temperature increases to meet the zone temperature setpoint.		

Record Issues:	Initial	Date

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Task #	Action Item	Expected Response	Passed (Yes/No)	Comments / Issues
8	Remove all overrides.	Outside Air Damper remains open		
		Exhaust Air Damper No. 1 remains open		
		ERV remains energized		
		Exhaust fan remains on		
		Supply fan remains on		
		SF and EF maintain supply airflow.		
		Chilled Water Control Valve and Hot Water Control valve modulate to maintain SAT		
		Duct Mounted Reheat Coil is energized to maintain the leaving air temperature setpoint		
		Zone Heating setpoint returns to previous value.		

Record Issues:	Initial	Date

D. HUMIDITY CONTROL

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments / Issues
9	Override Zone Temperature Heating Setpoint so that its is above the current zone temperature and goes into heating mode	Outside Air Damper opens		
		Exahust Air Damper No. 1 opens		
		ERV is energized		
		Exhaust fan turns on after a 10-second delay		
		Supply fan starts 5 seconds after exhaust fan		
		SF and EF maintain supply airflow.		
		Chilled Water Control Valve and Hot Water Control valve modulate to maintain SAT		
		Duct Mounted Reheat Coil is energized to maintain the leaving air temperature setpoint		
		Zone temperature increases to meet the zone temperature setpoint.		

Record Issues:	Initial	Date

SAMPLE

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Task #	Action Item	Expected Response	Passed (Yes/No)	Comments / Issues
10	Override the Supply Air Humidity sensor to show a relative humidity higher than 55%	Duct mounted reheat coil is activated		
		DHC-1 starts to dehumidify the Supply Air		
		Once the Supply Air reaches a 55% RH reading the DHC-1 shall de-energize		

Record Issues:	Initials	Date

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments / Issues
11	Remove the Supply Air Humidity sensor override.	DHC-1 returns to normal operation under the BAS		
		Supply Air Humidity senor returns to normal operation under the BAS		

Record Issues:	Initials	Date

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments / Issues
12	Remove all overrides.	Outside Air Damper remains open		
		Exhaust Air Damper No. 1 remains open		
		ERV remains energized		
		Exhaust fan remains on		
		Supply fan remains on		
		SF and EF maintain supply airflow.		
		Chilled Water Control Valve and Hot Water Control valve modulate to maintain SAT		
		Duct Mounted Reheat Coil is energized to maintain the leaving air temperature setpoint		
		Zone Heating setpoint returns to previous value.		

Record Issues:	Initial	Date

SAMPLE

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E. HEAT RECOVERY WHEEL OPERATION

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments / Issues
13	Override the OAT so that it is less than the RAT and override the SAT so it is greater than the SAT setpoint	Economizer cooling is enabled		
		Heat Recovery Wheel stops		
		OA bypass damper opens		
		EA bypass damper opens		
		RA bypass damper opens		

Record Issues:	Initials	Date

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments / Issues
14	Remove overrides	Economizer cooling is disabled		
		Heat Recovery Wheel returns to normal operation		
		OA bypass damper return to normal operation under the BAS		
		EA bypass damper returns to normal operation under the BAS		
		RA bypass damper returns to normal operation under the BAS		

Record Issues:	Initials	Date

F. SMOKE DETECTOR ACTIVATION

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments / Issues
15	Enable the smoke detector in the supply duct to generate an alarm.	Supply Fan shuts OFF.		
		Exhaust Fan shuts OFF.		
		Outside air damper fully closes.		
		ERV unit shuts down		
		A Supply Air Smoke Alarm is generated at the BAS.		

Record Issues:	Initials	Date

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Task #	Action Item	Expected Response	Passed (Yes/No)	Comments / Issues
16	Remove the smoke detector override.	ERV returns to normal operation.		
		Alarm is removed from the BAS.		

Record Issues:	Initials	Date

G. FREEZESTAT ACTIVATION

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments/ Issues
17	Trip the freezestat sensor (either via test button or with compressed air can)	ERV is de-energized		
		Supply Fan is de-energized		
		Exhaust Fan is de-energized		
		Chilled Water Control Valve opens to 10%		
		Hot Water Control Valve opens to 100%		
		OAD fully closes		
		EAD fully closes		
		A Freezestat alarm is generated		

Record Issues:	Initials	Date

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments/ Issues
18	Release/reset the freezestat sensor.	The Freezestat alarm is cleared		
		ERV is energized		
		Supply Fan is energized		
		Exhaust Fan is energized		
		The CHW and Heating valves are enabled and modulate to maintain the SAT set point.		
		OAD resumes normal DDC control		
		EAD resumes normal DDC control		

Record Issues:	Initials	Date

SAMPLE

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H. SAFETIES AND ALARMS

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments/ Issues
19	Override the supply fan failure settings to initiate an SF failure alarm.	ERV is shutdown and alarm is generated on the BAS		
	Remove all overrides.	Alarm is cleared from the BAS.		

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments/ Issues
20	Manually fail the exahust fan	The exhaust fan is de-energized		
		ERV is shutdown and alarm is generated on the BAS showing fan failure		
21	Re-enable the failed exhaust fan	Alarm is cleared from the BAS.		
		Exhaust fan is energized		
		ERV returns normal conditions under control of the BAS		

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments/ Issues
22	Simulate an emergency shutdown for the ERV	ERV shuts down an alarm is generated on the BAS.		
		EAD and OAD fully close		
	Remove all overrides.	Alarm is cleared from the BAS.		

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments/ Issues
23	Simulate a power loss to the ERV	ERV shuts down		
	Restore power to ERV	Unit automatically resets and starts operating according to normal operating sequence		

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments/ Issues
24	Manually disable the OAD	An Outside Air Damper alarm is shown on the BAS		
	Reset OAD and return to intial conditions	The alarm is cleared and the system is operational		

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments/ Issues
25	Override energy wheel DPS to indicate frosting.	ERV cycles the enthalpy wheel for 5 minutes every 1/2 hour. A DPS alarm is generated at the BAS.		
	Remove all overrides.	Alarm is cleared from the BAS.		

SAMPLE

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I. EMERGENCY SHUTDOWN

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments/ Issues
26	Simulate an emergency shutdown for the ERV	ERV shuts down an alarm is generated on the BAS.		
		EAD No.1 and OAD shall fully close		
27	Manually clear alarm at shutdown switches on both floors	Alarm is cleared from the BAS.		
		Unit starts automatically in accordance to normal operating sequence		

J. RETURN TO INITIAL CONDITIONS

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments / Issues
28	Release all overrides to the system, returning to initial conditions.	DDC resumes normal control of the fans, valves, and dampers.		
		All equipment is operational.		

Record Issues:	Initial	Date

Final Sign-Off

Commissioning Agent	Printed Name	Initials	Date

Contractor	Printed Name	Initials	Date
General Contractor (GC)			
Mechanical Contractor (MC)			
Electrical Contractor (EC)			
TAB Contractor (TAB)			
Controls Contractor (CC)			
Owner's O&M Personnel			

SAMPLE

2207 Garnet Avenue Suite I
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Energy Recovery Ventilator
Functional Performance Test

Project:	VA CT West Haven EHRM Infrastructure upgrade
Building:	
Project Location:	West Haven, CT
Equipment ID:	
Equipment Location:	
Manufacturer:	
Model #:	
Serial #:	
Service:	

System Description

Description: The test procedure is intended to verify that the ERV/DOAS is functioning properly per the control sequence of operations.

Operational Assumptions: All associated building heating and cooling systems are currently functional and operating normally.

* No faults or alarms associated with the equipment being tested are present.
* BAS shows no major alarms that would affect the testing.

Initial Test			Start Date	End Date	Initials
Results		**Explanation**			
Pass					
Fail					
Partial Test w/Corrective Actions					
Complete Test w/Corrective Actions					
Other					

TEST PARTICIPANTS

Organization	Required	Optional
General Contractor		
Mechanical Contractor		
TAB Contractor		
Controls Contractor		
Owner's O&M Personnel		

SAMPLE

2207 Garnet Avenue Suite I
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System Readiness Summary Checklist

	Description	Yes/No	Date
1	Tools available for everyone including earplugs, flashlights as needed, access keys, radios, other communication devices.		
2	Access/security to equipment location		
3	Radios, cell phones, public address and/or fire alarm intercom available for communications.		
4	Initial Start-Up testing has been completed by the GC/Mechanical Contractor		
5	System Ready for Test		
6	Required Personnel Notified		
7	All Electrical and Mechanical verification testing complete.		

SYSTEM TRENDING REQUIREMENTS

	Description	*Frequency*	*Trending Established (Y/N)*
1	Supply Air Temperature (°F)	15 min	
2	Exhaust Air From Building Temperature (°F)	15 min	
3	Cooling Coil Discharge Air Temperature (°F)	15 min	
4	Exhaust Air From Building Filter Status	15 min	
5	Chilled Water Control Valve	COV	
6	Heating Water Control Valve	COV	
7	Freezestat	15 min	
8	Duct Smoke Detector	COV	
9	Supply Fan Status	COV	
10	Exhaust Fan Start/Stop	COV	
11	Exhaust Fan Status	COV	
12	Exhaust Air From Building Humidity (%)	15 min	
13	Enthalpy Wheel Status	COV	
14	Supply Air Humidity (%)	15 min	
15	Exhaust Air Temperature (°F)	15 min	
16	Outside Air Humidity (%)	15 min	
17	Supply Fan VFD Speed	15 min	
18	Outside Air Damper (%)	15 min	
19	Outside Air Damper Position	COV	
20	Exhaust Air Damper Position	COV	
21	Outside Air Bypass Damper (%)	15 min	
22	Exhaust Air Bypass Damper (%)	15 min	
23	Return Air Bypass Damper (%)	COV	
24	Outside Air Bypass Damper Position	COV	
25	Exhaust Air Bypass Damper Position	COV	
26	Return Air Bypass Damper Position	COV	

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POINT-TO-POINT CHECKOUT

	CONTROL SENSORS (ANALOG/DIGITAL INPUTS)	Measured	BAS	Cal Off-Set	Notes
1	Supply Air Temperature (°F)				
2	Supply Air Humidity (%)				
3	Supply Air Flow Measuring Station				
4	Supply Air Temperature (DHC-1) (°F)				
5	Return Air Temperature (°F)				
6	Return Air Humidity (%)				
7	Pre-heat Air Temperature (°F)				
8	Outside Air Temperature (°F)				
9	Outside Air Humidity (%)				
10	Outside Air Flow Measuring Station				
11	Exhaust Air Temperature (°F)				
12	Exhaust Air Humidity (%)				
13	Exhaust Air from Bldg. Temperature (°F)				
14	Exhaust Air from Bldg. Humidity (%)				
15	Cooling Coil Discharge Air Temperature (°F)				
16	Heating Coil Air Discharge Temperature (°F)				

Record Issues:	Initial	Date

	DAMPERS / ACTUATOR INFORMATION:	0%	50%	100%	CONDITION / COMMENT
1	SF Speed (0%/50%/100%)				
2	EF Speed (0%/50%/100%)				
3	Heating Water Control Valve (0%/50%/100%)				
4	Chilled Water Control Valve (0%/50%/100%)				
5	Outside Air Damper Position (0%/50%/100%)				
6	Exhaust Air Damper Position (0%/50%/100%)				
7	Outside Air Bypass Damper Position (0%/50%/100%)				
8	ExhaustAir Bypass Damper Position (0%/50%/100%)				
9	Return Air Bypass Damper Position (0%/50%/100%)				

Record Issues:	Initial	Date

OCCUPANCY SCHEDULE

	Record the Occupancy Schedule below	Occupied Hours	Unoccupied Hours
1	Weekday		
2	Weekend		
3	Holiday		

SAMPLE

2207 Garnet Avenue Suite I
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Initial Ambient Conditions

Dry Bulb Temperature		**Precipitation**	
Wet Bulb Temperature		**Relative Humidity**	

Functional Performance Agenda:

PRE-TEST CHECKLIST
COOLING MODE
HEATING MODE
HUMIDITY CONTROL
HEAT RECOVERY WHEEL OPERATION
SMOKE DETECTOR ACTIVATION
FREEZESTAT ACTIVATION
SAFETIES AND ALARMS
EMERGENCY SHUTDOWN
RETURN TO INITIAL CONDITIONS

Functional Performance Test:

A. PRE-TEST CHECKLIST

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments / Issues
1	Verify that the ERV is operating under normal conditions and is ready to test.	No alarms are present.		
		ERV is in occupied mode and is maintaining operational temperature, RH, and static pressure set points.		

Record Issues:	Initial	Date

Task #	Action Item	Set Points and As Found Conditions	Record Data	Comments / Issues
	Record the initial operating conditions:	**Setpoints**		
		Zone Temperature SP:		
		Supply Air Temperature SP:		
		Supply Air Humidity SP:		
		Exhaust Air Temperature SP:		
		Exhaust Air Humidity SP:		
		Supply Air Temperature (DHC-1) SP:		
		Heating Coil Discharge Air Temperature SP:		
		Outside Air Temperature SP:		
		Outside Air Humidity SP:		
		Exhaust Air from Bldg. Temperature SP:		
		Exhaust Air from Bldg. Humidity SP:		

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2		**As-Found Conditions**		
		SF VFD Speed		
		SF Staus		
		EF Status		
		EF VFD Speed		
		Supply Air Temperature		
		Supply Air Humidity		
		Exhaust Air Temperature		
		Exhaust Air Humidity		
		Supply Air Temperature (DHC-1)		
		Heating Coil Discharge Air Temperature		
		Outside Air Temperature		
		Outside Air Humidity		
		Return Air Temperature		
		Return Air Humidity		
		Pre-heat Air Temperature		
		Exhaust Air from Bldg. Temperature		
		Exhaust Air from Bldg. Humidity		
		Heating Valve Position		
		Cooling Valve Position		
		Enthalpy Wheel Status		
		Exhaust Air Damper Position		
		Outside Air Damper Position		
		Outside Air Bypass Damper Position		
		Exhaust Air Bypass Damper Position		
		Return Air Bypass Damper Position		

Record Issues:	**Initial**	**Date**

SAMPLE

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B.OCCUPIED COOLING MODE

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments / Issues
3	Override Zone Temperature Cooling Setpoint so that its is below the current zone temperature.	Outside Air Damper opens		
		Exhaust Air Damper No. 1 opens		
		ERV is energized		
		Exhaust fan turns on after a 10-second delay		
		Supply fan starts 5 seconds after exhaust fan		
		SF and EF maintain supply airflow.		
		Chilled Water Control Valve maintains a SAT of 55°F		
		Hot Water Control Valve modulates to maintain a SAT of 55°F		
		Duct Mounted Reheat Coil is energized to maintain a leaving air temperature of 73°F		
		Zone temperature decreases to meet the zone temperature setpoint.		

Record Issues:	Initial	Date

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments / Issues
4	Remove all cooling overrides.	Outside Air Damper remains open		
		Exahust Air Damper No. 1 remains open		
		ERV remains energized		
		Exhaust fan remains on		
		Supply fan remains on		
		SF and EF maintain supply airflow.		
		Chilled Water Control Valve and Hot Water Control valve modulate to maintain SAT		
		Duct Mounted Reheat Coil is energized to maintain the leaving air temperature setpoint		
		Zone Cooling setpoint returns to previous value.		

Record Issues:	Initial	Date

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Task #	Action Item	Expected Response	Passed (Yes/No)	Comments / Issues
5	Override the ERV so that it is de-energized	ERV is de-energized		
		SF and EF de-energize		
6	Release overrides	ERV is energized		
		SF and EF are energized		

Record Issues:	Initial	Date

C. OCCUPIED HEATING MODE

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments / Issues
7	Override Zone Temperature Heating Setpoint so that its is above the current zone temperature and goes into heating mode	Outside Air Damper opens		
		Exahust Air Damper No. 1 opens		
		ERV is energized		
		Exhaust fan turns on after a 10-second delay		
		Supply fan starts 5 seconds after exhaust fan		
		SF and EF maintain supply airflow.		
		Chilled Water Control Valve and Hot Water Control valve modulate to maintain SAT		
		Duct Mounted Reheat Coil is energized to maintain the leaving air temperature setpoint		
		Zone temperature increases to meet the zone temperature setpoint.		

Record Issues:	Initial	Date

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Task #	Action Item	Expected Response	Passed (Yes/No)	Comments / Issues
8	Remove all overrides.	Outside Air Damper remains open		
		Exhaust Air Damper No. 1 remains open		
		ERV remains energized		
		Exhaust fan remains on		
		Supply fan remains on		
		SF and EF maintain supply airflow.		
		Chilled Water Control Valve and Hot Water Control valve modulate to maintain SAT		
		Duct Mounted Reheat Coil is energized to maintain the leaving air temperature setpoint		
		Zone Heating setpoint returns to previous value.		

Record Issues:	Initial	Date

D. HUMIDITY CONTROL

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments / Issues
9	Override Zone Temperature Heating Setpoint so that its is above the current zone temperature and goes into heating mode	Outside Air Damper opens		
		Exahust Air Damper No. 1 opens		
		ERV is energized		
		Exhaust fan turns on after a 10-second delay		
		Supply fan starts 5 seconds after exhaust fan		
		SF and EF maintain supply airflow.		
		Chilled Water Control Valve and Hot Water Control valve modulate to maintain SAT		
		Duct Mounted Reheat Coil is energized to maintain the leaving air temperature setpoint		
		Zone temperature increases to meet the zone temperature setpoint.		

Record Issues:	Initial	Date

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Task #	Action Item	Expected Response	Passed (Yes/No)	Comments / Issues
10	Override the Supply Air Humidity sensor to show a relative humidity higher than 55%	Duct mounted reheat coil is activated		
		DHC-1 starts to dehumidify the Supply Air		
		Once the Supply Air reaches a 55% RH reading the DHC-1 shall de-energize		

Record Issues:	Initials	Date

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments / Issues
11	Remove the Supply Air Humidity sensor override.	DHC-1 returns to normal operation under the BAS		
		Supply Air Humidity senor returns to normal operation under the BAS		

Record Issues:	Initials	Date

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments / Issues
12	Remove all overrides.	Outside Air Damper remains open		
		Exhaust Air Damper No. 1 remains open		
		ERV remains energized		
		Exhaust fan remains on		
		Supply fan remains on		
		SF and EF maintain supply airflow.		
		Chilled Water Control Valve and Hot Water Control valve modulate to maintain SAT		
		Duct Mounted Reheat Coil is energized to maintain the leaving air temperature setpoint		
		Zone Heating setpoint returns to previous value.		

Record Issues:	Initial	Date

SAMPLE

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E. HEAT RECOVERY WHEEL OPERATION

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments / Issues
13	Override the OAT so that it is less than the RAT and override the SAT so it is greater than the SAT setpoint	Economizer cooling is enabled		
		Heat Recovery Wheel stops		
		OA bypass damper opens		
		EA bypass damper opens		
		RA bypass damper opens		

Record Issues:	Initials	Date

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments / Issues
14	Remove overrides	Economizer cooling is disabled		
		Heat Recovery Wheel returns to normal operation		
		OA bypass damper return to normal operation under the BAS		
		EA bypass damper returns to normal operation under the BAS		
		RA bypass damper returns to normal operation under the BAS		

Record Issues:	Initials	Date

F. SMOKE DETECTOR ACTIVATION

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments / Issues
15	Enable the smoke detector in the supply duct to generate an alarm.	Supply Fan shuts OFF.		
		Exhaust Fan shuts OFF.		
		Outside air damper fully closes.		
		ERV unit shuts down		
		A Supply Air Smoke Alarm is generated at the BAS.		

Record Issues:	Initials	Date

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Task #	Action Item	Expected Response	Passed (Yes/No)	Comments / Issues
16	Remove the smoke detector override.	ERV returns to normal operation.		
		Alarm is removed from the BAS.		

Record Issues:	Initials	Date

G. FREEZESTAT ACTIVATION

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments/ Issues
17	Trip the freezestat sensor (either via test button or with compressed air can)	ERV is de-energized		
		Supply Fan is de-energized		
		Exhaust Fan is de-energized		
		Chilled Water Control Valve opens to 10%		
		Hot Water Control Valve opens to 100%		
		OAD fully closes		
		EAD fully closes		
		A Freezestat alarm is generated		

Record Issues:	Initials	Date

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments/ Issues
18	Release/reset the freezestat sensor.	The Freezestat alarm is cleared		
		ERV is energized		
		Supply Fan is energized		
		Exhaust Fan is energized		
		The CHW and Heating valves are enabled and modulate to maintain the SAT set point.		
		OAD resumes normal DDC control		
		EAD resumes normal DDC control		

Record Issues:	Initials	Date

SAMPLE

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H. SAFETIES AND ALARMS

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments/ Issues
19	Override the supply fan failure settings to initiate an SF failure alarm.	ERV is shutdown and alarm is generated on the BAS		
	Remove all overrides.	Alarm is cleared from the BAS.		

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments/ Issues
20	Manually fail the exahust fan	The exhaust fan is de-energized		
		ERV is shutdown and alarm is generated on the BAS showing fan failure		
21	Re-enable the failed exhaust fan	Alarm is cleared from the BAS.		
		Exhaust fan is energized		
		ERV returns normal conditions under control of the BAS		

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments/ Issues
22	Simulate an emergency shutdown for the ERV	ERV shuts down an alarm is generated on the BAS.		
		EAD and OAD fully close		
	Remove all overrides.	Alarm is cleared from the BAS.		

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments/ Issues
23	Simulate a power loss to the ERV	ERV shuts down		
	Restore power to ERV	Unit automatically resets and starts operating according to normal operating sequence		

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments/ Issues
24	Manually disable the OAD	An Outside Air Damper alarm is shown on the BAS		
	Reset OAD and return to intial conditions	The alarm is cleared and the system is operational		

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments/ Issues
25	Override energy wheel DPS to indicate frosting.	ERV cycles the enthalpy wheel for 5 minutes every 1/2 hour. A DPS alarm is generated at the BAS.		
	Remove all overrides.	Alarm is cleared from the BAS.		

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I. EMERGENCY SHUTDOWN

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments/ Issues
26	Simulate an emergency shutdown for the ERV	ERV shuts down an alarm is generated on the BAS.		
		EAD No.1 and OAD shall fully close		
27	Manually clear alarm at shutdown switches on both floors	Alarm is cleared from the BAS.		
		Unit starts automatically in accordance to normal operating sequence		

J. RETURN TO INITIAL CONDITIONS

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments / Issues
28	Release all overrides to the system, returning to initial conditions.	DDC resumes normal control of the fans, valves, and dampers.		
		All equipment is operational.		

Record Issues:	Initial	Date

Final Sign-Off

Commissioning Agent	Printed Name	Initials	Date

Contractor	Printed Name	Initials	Date
General Contractor (GC)			
Mechanical Contractor (MC)			
Electrical Contractor (EC)			
TAB Contractor (TAB)			
Controls Contractor (CC)			
Owner's O&M Personnel			

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Energy Recovery Ventilator
Functional Performance Test

Project:	VA CT West Haven EHRM Infrastructure upgrade
Building:	
Project Location:	West Haven, CT
Equipment ID:	
Equipment Location:	
Manufacturer:	
Model #:	
Serial #:	
Service:	

System Description

Description: The test procedure is intended to verify that the ERV/DOAS is functioning properly per the control sequence of operations.

Operational Assumptions: All associated building heating and cooling systems are currently functional and operating normally.

* No faults or alarms associated with the equipment being tested are present.
* BAS shows no major alarms that would affect the testing.

Initial Test			Start Date	End Date	Initials
Results		**Explanation**			
Pass					
Fail					
Partial Test w/Corrective Actions					
Complete Test w/Corrective Actions					
Other					

TEST PARTICIPANTS

Organization	Required	Optional
General Contractor		
Mechanical Contractor		
TAB Contractor		
Controls Contractor		
Owner's O&M Personnel		

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System Readiness Summary Checklist

	Description	Yes/No	Date
1	Tools available for everyone including earplugs, flashlights as needed, access keys, radios, other communication devices.		
2	Access/security to equipment location		
3	Radios, cell phones, public address and/or fire alarm intercom available for communications.		
4	Initial Start-Up testing has been completed by the GC/Mechanical Contractor		
5	System Ready for Test		
6	Required Personnel Notified		
7	All Electrical and Mechanical verification testing complete.		

SYSTEM TRENDING REQUIREMENTS

	Description	*Frequency*	*Trending Established (Y/N)*
1	Supply Air Temperature (°F)	15 min	
2	Exhaust Air From Building Temperature (°F)	15 min	
3	Cooling Coil Discharge Air Temperature (°F)	15 min	
4	Exhaust Air From Building Filter Status	15 min	
5	Chilled Water Control Valve	COV	
6	Heating Water Control Valve	COV	
7	Freezestat	15 min	
8	Duct Smoke Detector	COV	
9	Supply Fan Status	COV	
10	Exhaust Fan Start/Stop	COV	
11	Exhaust Fan Status	COV	
12	Exhaust Air From Building Humidity (%)	15 min	
13	Enthalpy Wheel Status	COV	
14	Supply Air Humidity (%)	15 min	
15	Exhaust Air Temperature (°F)	15 min	
16	Outside Air Humidity (%)	15 min	
17	Supply Fan VFD Speed	15 min	
18	Outside Air Damper (%)	15 min	
19	Outside Air Damper Position	COV	
20	Exhaust Air Damper Position	COV	
21	Outside Air Bypass Damper (%)	15 min	
22	Exhaust Air Bypass Damper (%)	15 min	
23	Return Air Bypass Damper (%)	COV	
24	Outside Air Bypass Damper Position	COV	
25	Exhaust Air Bypass Damper Position	COV	
26	Return Air Bypass Damper Position	COV	

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POINT-TO-POINT CHECKOUT

	CONTROL SENSORS (ANALOG/DIGITAL INPUTS)	Measured	BAS	Cal Off-Set	Notes
1	Supply Air Temperature (°F)				
2	Supply Air Humidity (%)				
3	Supply Air Flow Measuring Station				
4	Supply Air Temperature (DHC-1) (°F)				
5	Return Air Temperature (°F)				
6	Return Air Humidity (%)				
7	Pre-heat Air Temperature (°F)				
8	Outside Air Temperature (°F)				
9	Outside Air Humidity (%)				
10	Outside Air Flow Measuring Station				
11	Exhaust Air Temperature (°F)				
12	Exhaust Air Humidity (%)				
13	Exhaust Air from Bldg. Temperature (°F)				
14	Exhaust Air from Bldg. Humidity (%)				
15	Cooling Coil Discharge Air Temperature (°F)				
16	Heating Coil Air Discharge Temperature (°F)				

Record Issues:	Initial	Date

	DAMPERS / ACTUATOR INFORMATION:	0%	50%	100%	CONDITION / COMMENT
1	SF Speed (0%/50%/100%)				
2	EF Speed (0%/50%/100%)				
3	Heating Water Control Valve (0%/50%/100%)				
4	Chilled Water Control Valve (0%/50%/100%)				
5	Outside Air Damper Position (0%/50%/100%)				
6	Exhaust Air Damper Position (0%/50%/100%)				
7	Outside Air Bypass Damper Position (0%/50%/100%)				
8	ExhaustAir Bypass Damper Position (0%/50%/100%)				
9	Return Air Bypass Damper Position (0%/50%/100%)				

Record Issues:	Initial	Date

OCCUPANCY SCHEDULE

	Record the Occupancy Schedule below	Occupied Hours	Unoccupied Hours
1	Weekday		
2	Weekend		
3	Holiday		

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Initial Ambient Conditions

Dry Bulb Temperature		**Precipitation**	
Wet Bulb Temperature		**Relative Humidity**	

Functional Performance Agenda:

PRE-TEST CHECKLIST
COOLING MODE
HEATING MODE
HUMIDITY CONTROL
HEAT RECOVERY WHEEL OPERATION
SMOKE DETECTOR ACTIVATION
FREEZESTAT ACTIVATION
SAFETIES AND ALARMS
EMERGENCY SHUTDOWN
RETURN TO INITIAL CONDITIONS

Functional Performance Test:

A. PRE-TEST CHECKLIST

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments / Issues
1	Verify that the ERV is operating under normal conditions and is ready to test.	No alarms are present.		
		ERV is in occupied mode and is maintaining operational temperature, RH, and static pressure set points.		

Record Issues:	Initial	Date

Task #	Action Item	Set Points and As Found Conditions	Record Data	Comments / Issues
	Record the initial operating conditions:	**Setpoints**		
		Zone Temperature SP:		
		Supply Air Temperature SP:		
		Supply Air Humidity SP:		
		Exhaust Air Temperature SP:		
		Exhaust Air Humidity SP:		
		Supply Air Temperature (DHC-1) SP:		
		Heating Coil Discharge Air Temperature SP:		
		Outside Air Temperature SP:		
		Outside Air Humidity SP:		
		Exhaust Air from Bldg. Temperature SP:		
		Exhaust Air from Bldg. Humidity SP:		

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2		**As-Found Conditions**		
		SF VFD Speed		
		SF Staus		
		EF Status		
		EF VFD Speed		
		Supply Air Temperature		
		Supply Air Humidity		
		Exhaust Air Temperature		
		Exhaust Air Humidity		
		Supply Air Temperature (DHC-1)		
		Heating Coil Discharge Air Temperature		
		Outside Air Temperature		
		Outside Air Humidity		
		Return Air Temperature		
		Return Air Humidity		
		Pre-heat Air Temperature		
		Exhaust Air from Bldg. Temperature		
		Exhaust Air from Bldg. Humidity		
		Heating Valve Position		
		Cooling Valve Position		
		Enthalpy Wheel Status		
		Exhaust Air Damper Position		
		Outside Air Damper Position		
		Outside Air Bypass Damper Position		
		Exhaust Air Bypass Damper Position		
		Return Air Bypass Damper Position		

Record Issues:	**Initial**	**Date**

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B.OCCUPIED COOLING MODE

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments / Issues
3	Override Zone Temperature Cooling Setpoint so that its is below the current zone temperature.	Outside Air Damper opens		
		Exhaust Air Damper No. 1 opens		
		ERV is energized		
		Exhaust fan turns on after a 10-second delay		
		Supply fan starts 5 seconds after exhaust fan		
		SF and EF maintain supply airflow.		
		Chilled Water Control Valve maintains a SAT of 55°F		
		Hot Water Control Valve modulates to maintain a SAT of 55°F		
		Duct Mounted Reheat Coil is energized to maintain a leaving air temperature of 73°F		
		Zone temperature decreases to meet the zone temperature setpoint.		

Record Issues:	Initial	Date

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments / Issues
4	Remove all cooling overrides.	Outside Air Damper remains open		
		Exahust Air Damper No. 1 remains open		
		ERV remains energized		
		Exhaust fan remains on		
		Supply fan remains on		
		SF and EF maintain supply airflow.		
		Chilled Water Control Valve and Hot Water Control valve modulate to maintain SAT		
		Duct Mounted Reheat Coil is energized to maintain the leaving air temperature setpoint		
		Zone Cooling setpoint returns to previous value.		

Record Issues:	Initial	Date

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Task #	Action Item	Expected Response	Passed (Yes/No)	Comments / Issues
5	Override the ERV so that it is de-energized	ERV is de-energized		
		SF and EF de-energize		
6	Release overrides	ERV is energized		
		SF and EF are energized		

Record Issues:	Initial	Date

C. OCCUPIED HEATING MODE

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments / Issues
7	Override Zone Temperature Heating Setpoint so that its is above the current zone temperature and goes into heating mode	Outside Air Damper opens		
		Exahust Air Damper No. 1 opens		
		ERV is energized		
		Exhaust fan turns on after a 10-second delay		
		Supply fan starts 5 seconds after exhaust fan		
		SF and EF maintain supply airflow.		
		Chilled Water Control Valve and Hot Water Control valve modulate to maintain SAT		
		Duct Mounted Reheat Coil is energized to maintain the leaving air temperature setpoint		
		Zone temperature increases to meet the zone temperature setpoint.		

Record Issues:	Initial	Date

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Task #	Action Item	Expected Response	Passed (Yes/No)	Comments / Issues
8	Remove all overrides.	Outside Air Damper remains open		
		Exhaust Air Damper No. 1 remains open		
		ERV remains energized		
		Exhaust fan remains on		
		Supply fan remains on		
		SF and EF maintain supply airflow.		
		Chilled Water Control Valve and Hot Water Control valve modulate to maintain SAT		
		Duct Mounted Reheat Coil is energized to maintain the leaving air temperature setpoint		
		Zone Heating setpoint returns to previous value.		

Record Issues:	Initial	Date

D. HUMIDITY CONTROL

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments / Issues
9	Override Zone Temperature Heating Setpoint so that its is above the current zone temperature and goes into heating mode	Outside Air Damper opens		
		Exahust Air Damper No. 1 opens		
		ERV is energized		
		Exhaust fan turns on after a 10-second delay		
		Supply fan starts 5 seconds after exhaust fan		
		SF and EF maintain supply airflow.		
		Chilled Water Control Valve and Hot Water Control valve modulate to maintain SAT		
		Duct Mounted Reheat Coil is energized to maintain the leaving air temperature setpoint		
		Zone temperature increases to meet the zone temperature setpoint.		

Record Issues:	Initial	Date

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Task #	Action Item	Expected Response	Passed (Yes/No)	Comments / Issues
10	Override the Supply Air Humidity sensor to show a relative humidity higher than 55%	Duct mounted reheat coil is activated		
		DHC-1 starts to dehumidify the Supply Air		
		Once the Supply Air reaches a 55% RH reading the DHC-1 shall de-energize		

Record Issues:	Initials	Date

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments / Issues
11	Remove the Supply Air Humidity sensor override.	DHC-1 returns to normal operation under the BAS		
		Supply Air Humidity senor returns to normal operation under the BAS		

Record Issues:	Initials	Date

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments / Issues
12	Remove all overrides.	Outside Air Damper remains open		
		Exhaust Air Damper No. 1 remains open		
		ERV remains energized		
		Exhaust fan remains on		
		Supply fan remains on		
		SF and EF maintain supply airflow.		
		Chilled Water Control Valve and Hot Water Control valve modulate to maintain SAT		
		Duct Mounted Reheat Coil is energized to maintain the leaving air temperature setpoint		
		Zone Heating setpoint returns to previous value.		

Record Issues:	Initial	Date

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E. HEAT RECOVERY WHEEL OPERATION

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments / Issues
13	Override the OAT so that it is less than the RAT and override the SAT so it is greater than the SAT setpoint	Economizer cooling is enabled		
		Heat Recovery Wheel stops		
		OA bypass damper opens		
		EA bypass damper opens		
		RA bypass damper opens		

Record Issues:	Initials	Date

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments / Issues
14	Remove overrides	Economizer cooling is disabled		
		Heat Recovery Wheel returns to normal operation		
		OA bypass damper return to normal operation under the BAS		
		EA bypass damper returns to normal operation under the BAS		
		RA bypass damper returns to normal operation under the BAS		

Record Issues:	Initials	Date

F. SMOKE DETECTOR ACTIVATION

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments / Issues
15	Enable the smoke detector in the supply duct to generate an alarm.	Supply Fan shuts OFF.		
		Exhaust Fan shuts OFF.		
		Outside air damper fully closes.		
		ERV unit shuts down		
		A Supply Air Smoke Alarm is generated at the BAS.		

Record Issues:	Initials	Date

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Task #	Action Item	Expected Response	Passed (Yes/No)	Comments / Issues
16	Remove the smoke detector override.	ERV returns to normal operation.		
		Alarm is removed from the BAS.		

Record Issues:	Initials	Date

G. FREEZESTAT ACTIVATION

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments/ Issues
17	Trip the freezestat sensor (either via test button or with compressed air can)	ERV is de-energized		
		Supply Fan is de-energized		
		Exhaust Fan is de-energized		
		Chilled Water Control Valve opens to 10%		
		Hot Water Control Valve opens to 100%		
		OAD fully closes		
		EAD fully closes		
		A Freezestat alarm is generated		

Record Issues:	Initials	Date

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments/ Issues
18	Release/reset the freezestat sensor.	The Freezestat alarm is cleared		
		ERV is energized		
		Supply Fan is energized		
		Exhaust Fan is energized		
		The CHW and Heating valves are enabled and modulate to maintain the SAT set point.		
		OAD resumes normal DDC control		
		EAD resumes normal DDC control		

Record Issues:	Initials	Date

SAMPLE

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H. SAFETIES AND ALARMS

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments/ Issues
19	Override the supply fan failure settings to initiate an SF failure alarm.	ERV is shutdown and alarm is generated on the BAS		
	Remove all overrides.	Alarm is cleared from the BAS.		

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments/ Issues
20	Manually fail the exahust fan	The exhaust fan is de-energized		
		ERV is shutdown and alarm is generated on the BAS showing fan failure		
21	Re-enable the failed exhaust fan	Alarm is cleared from the BAS.		
		Exhaust fan is energized		
		ERV returns normal conditions under control of the BAS		

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments/ Issues
22	Simulate an emergency shutdown for the ERV	ERV shuts down an alarm is generated on the BAS.		
		EAD and OAD fully close		
	Remove all overrides.	Alarm is cleared from the BAS.		

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments/ Issues
23	Simulate a power loss to the ERV	ERV shuts down		
	Restore power to ERV	Unit automatically resets and starts operating according to normal operating sequence		

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments/ Issues
24	Manually disable the OAD	An Outside Air Damper alarm is shown on the BAS		
	Reset OAD and return to intial conditions	The alarm is cleared and the system is operational		

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments/ Issues
25	Override energy wheel DPS to indicate frosting.	ERV cycles the enthalpy wheel for 5 minutes every 1/2 hour. A DPS alarm is generated at the BAS.		
	Remove all overrides.	Alarm is cleared from the BAS.		

SAMPLE

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Direct: (619) 770-8552

I. EMERGENCY SHUTDOWN

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments/ Issues
26	Simulate an emergency shutdown for the ERV	ERV shuts down an alarm is generated on the BAS.		
		EAD No.1 and OAD shall fully close		
27	Manually clear alarm at shutdown switches on both floors	Alarm is cleared from the BAS.		
		Unit starts automatically in accordance to normal operating sequence		

J. RETURN TO INITIAL CONDITIONS

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments / Issues
28	Release all overrides to the system, returning to initial conditions.	DDC resumes normal control of the fans, valves, and dampers.		
		All equipment is operational.		

Record Issues:	Initial	Date

Final Sign-Off

Commissioning Agent	Printed Name	Initials	Date

Contractor	Printed Name	Initials	Date
General Contractor (GC)			
Mechanical Contractor (MC)			
Electrical Contractor (EC)			
TAB Contractor (TAB)			
Controls Contractor (CC)			
Owner's O&M Personnel			

SAMPLE

2207 Garnet Avenue Suite I
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Fuel Oil Pump
Functional Performance Test

Project:	**VA CT West Haven EHRM Infrastructure upgrade**
Building:	
Project Location:	**West Haven**
Equipment ID:	
Equipment Location:	
Manufacturer:	
Model #:	
Serial #:	
Service:	

System Description

Description: The test procedure is intended to verify that the fuel oil pump is functioning properly.

Operational Assumptions: All associated building heating and cooling systems are currently functional and operating normally.
*No faults or alarms associated with the equipment being tested are present.
*BAS shows no major alarms that would affect the testing.

Initial Test			Start Date	End Date	Initials
Results	**Yes/No**	**Explanation**			
Pass					
Fail					
Partial Test w/ Corrective Actions					
Complete Test w/ Corrective Actions					
Other					

SAMPLE

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POINT-TO-POINT CHECKOUT

	Description	Yes/No	Date
1	Pump Status		

Record Issues:	Initials	Date

OCCUPANCY SCHEDULE

	Record the Occupancy Schedule below	Occupied Hours	Unoccupied Hours
1	Weekday		
2	Weekend		
3	Holiday		

Initial Ambient Conditions

Dry Bulb Temperature		**Precipitation**	
Wet Bulb Temperature		**Relative Humidity**	

Functional Performance Agenda:

PRE-TEST CHECKLIST
FUNCTIONAL OPERATION

Functional Performance Test:

The Commissioning Authority will make and document any changes/addition/deletions to this test procedure required by current system conditions (i.e. weather, system load, utility availability, etc.).

SAMPLE

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A. Pre-Test Checklist

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments/ Issues
1	Verify that the fuel oil pump is operating under normal conditions.	No alarms are present.		
		fuel oil pump is off and ready for operation.		

Record Issues:	Initials	Date

B. FUNCTIONAL OPERATION

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments/ Issues
2	Set the day tank below 50% capacity	The fuel oil transfer pump shall start		
		when the day tank is at 80% capacity the FQTP shall stop		

Record Issues:	Initials	Date

SAMPLE

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2207 Garnet Avenue Suite I
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Lighting Controls
Functional Performance Test

Project:	VA CT West Haven EHRM Infrastructure upgrade
Building:	
Project Location:	West Haven, CT
Equipment ID:	**Lighting Controls**
Equipment Location:	
Manufacturer:	
Model #:	
Serial #:	
Service:	

System Description

Description: The test procedure is intended to verify that the Lighting Controls are functioning properly.
The following procedure is used to validate controls for a sample of rooms in the building.

Operational Assumptions: All associated electrical equipment and systems are operating normally.

***** No faults or alarms associated with the equipment being tested are present.
***** BAS shows no major alarms that would affect the testing.

Initial Test			*Start Date*	*End Date*	*Initials*
Results	**Yes/No**	**Explanation**			
Pass					
Fail					
Partial Test w/Corrective Actions					
Complete Test w/Corrective Actions					
Other					

Functional Performance Agenda:

LIGHTING OPERATION - GROUP #1
LIGHTING OPERATION - GROUP #2
LIGHTING OPERATION - GROUP #3
NORMAL OPERATION

Functional Performance Test:

A. PRE-TEST CHECKLIST

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments / Issues
1	Verify that lighting controls are operating under normal conditions.	No alarms are present.		

Record Issues:	Initial	Date

SAMPLE

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Lighting Controls
Functional Performance Test

Project:	VA CT West Haven EHRM Infrastructure upgrade
Building:	
Project Location:	West Haven, CT
Equipment ID:	**Lighting Controls**
Equipment Location:	
Manufacturer:	
Model #:	
Serial #:	
Service:	

B. LIGHTING OPERATION - GROUP #1

Task #	Action Item	Expected Response	Room-a	Room-b	Room-c	Room-d	Room-e	Room-f
2	Verify light fixtures, light switches, daylight harvesting and occupancy sensors are installed and operational.	Equipment is operational						

Record Issues:	Initial	Date

Task #	Action Item	Expected Response	Room-a	Room-b	Room-c	Room-d	Room-e	Room-f
3	Verify room lights are off. Enter room to activate occupancy sensor.	Occupancy sesnor activates lights.						

Record Issues:	Initial	Date

Task #	Action Item	Expected Response	Room-a	Room-b	Room-c	Room-d	Room-e	Room-f
4	Verify whether occupancy sensor is integrated into BAS for mechanical systems and whether system responds appropriately.	VAV / FCU enters into occupied mode						

Record Issues:	Initial	Date

Task #	Action Item	Expected Response	Room-a	Room-b	Room-c	Room-d	Room-e	Room-f
5	Verify if room has daylight sensor. Cover daylight sensor to block light.	Lights in the room brighten						

Record Issues:	Initial	Date

SAMPLE

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Lighting Controls
Functional Performance Test

Project:	VA CT West Haven EHRM Infrastructure upgrade
Building:	
Project Location:	West Haven, CT
Equipment ID:	**Lighting Controls**
Equipment Location:	
Manufacturer:	
Model #:	
Serial #:	
Service:	

Task #	Action Item	Expected Response	Room-a	Room-b	Room-c	Room-d	Room-e	Room-f
6	Verify if room has daylight sensor. Shine light into daylight sensor	Lights in the rooms darken						

Record Issues:	Initial	Date

Task #	Action Item	Expected Response	Room-a	Room-b	Room-c	Room-d	Room-e	Room-f
7	Verify manual light switch turns lights on / off.	Lights respond to light switch						

Record Issues:	Initial	Date

C. LIGHTING OPERATION - GROUP #2

Task #	Action Item	Expected Response	Room-a	Room-b	Room-c	Room-d	Room-e	Room-f
8	Verify light fixtures, light switches, daylight harvesting and occupancy sensors are installed and operational.	Equipment is operational						

Record Issues:	Initial	Date

Task #	Action Item	Expected Response	Room-a	Room-b	Room-c	Room-d	Room-e	Room-f
9	Verify room lights are off. Enter room to activate occupancy sensor.	Occupancy sesnor activates lights.						

Record Issues:	Initial	Date

SAMPLE

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Lighting Controls
Functional Performance Test

Project:	VA CT West Haven EHRM Infrastructure upgrade
Building:	
Project Location:	West Haven, CT
Equipment ID:	**Lighting Controls**
Equipment Location:	
Manufacturer:	
Model #:	
Serial #:	
Service:	

Task #	Action Item	Expected Response	Room-a	Room-b	Room-c	Room-d	Room-e	Room-f
10	Verify whether occupancy sensor is integrated into BAS for mechanical systems and whether system responds appropriately.	VAV / FCU enters into occupied mode						

Record Issues:	Initial	Date

Task #	Action Item	Expected Response	Room-a	Room-b	Room-c	Room-d	Room-e	Room-f
11	Verify if room has daylight sensor. Cover daylight sensor to block light.	Lights in the room brighten						

Record Issues:	Initial	Date

Task #	Action Item	Expected Response	Room-a	Room-b	Room-c	Room-d	Room-e	Room-f
12	Verify if room has daylight sensor. Shine light into daylight sensor	Lights in the rooms darken						

Record Issues:	Initial	Date

Task #	Action Item	Expected Response	Room-a	Room-b	Room-c	Room-d	Room-e	Room-f
13	Verify manual light switch turns lights on / off.	Lights respond to light switch						

Record Issues:	Initial	Date

SAMPLE

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Lighting Controls
Functional Performance Test

Project:	VA CT West Haven EHRM Infrastructure upgrade
Building:	
Project Location:	West Haven, CT
Equipment ID:	**Lighting Controls**
Equipment Location:	
Manufacturer:	
Model #:	
Serial #:	
Service:	

D. LIGHTING OPERATION - GROUP #3

Task #	Action Item	Expected Response	Room-a	Room-b	Room-c	Room-d	Room-e	Room-f
14	Verify light fixtures, light switches, daylight harvesting and occupancy sensors are installed and operational.	Equipment is operational						

Record Issues:	Initial	Date

Task #	Action Item	Expected Response	Room-a	Room-b	Room-c	Room-d	Room-e	Room-f
15	Verify room lights are off. Enter room to activate occupancy sensor.	Occupancy sesnor activates lights.						

Record Issues:	Initial	Date

Task #	Action Item	Expected Response	Room-a	Room-b	Room-c	Room-d	Room-e	Room-f
16	Verify whether occupancy sensor is integrated into BAS for mechanical systems and whether system responds appropriately.	VAV / FCU enters into occupied mode						

Record Issues:	Initial	Date

Task #	Action Item	Expected Response	Room-a	Room-b	Room-c	Room-d	Room-e	Room-f
17	Verify if room has daylight sensor. Cover daylight sensor to block light.	Lights in the room brighten						

Record Issues:	Initial	Date

SAMPLE

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Lighting Controls
Functional Performance Test

Project:	VA CT West Haven EHRM Infrastructure upgrade
Building:	
Project Location:	West Haven, CT
Equipment ID:	**Lighting Controls**
Equipment Location:	
Manufacturer:	
Model #:	
Serial #:	
Service:	

Task #	Action Item	Expected Response	Room-a	Room-b	Room-c	Room-d	Room-e	Room-f
18	Verify if room has daylight sensor. Shine light into daylight sensor	Lights in the rooms darken						

Record Issues:	Initial	Date

Task #	Action Item	Expected Response	Room-a	Room-b	Room-c	Room-d	Room-e	Room-f
19	Verify manual light switch turns lights on / off.	Lights respond to light switch						

Record Issues:	Initial	Date

E. NORMAL OPERATION

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments / Issues
20	Ensure system is restored to normal operation and release any overrides.	All systems will return to normal operation		
		Alarms are cleared		

Record Issues:	Initial	Date

SAMPLE

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Loss of Power Response
Functional Performance Test

Project:	VA CT West Haven EHRM Infrastructure Upgrade
Building:	
Project Location:	West Haven, CT
Equipment ID:	
Equipment Location:	
Manufacturer:	
Model #:	
Serial #:	
Service:	

System Description

Description: The test procedure is intended to verify that all building systems intended to operate on standby generator power automatically restart after loss of normal utility power.

Operational Assumptions: All other commissioning testing is essentially complete and functional issues/deficiencies have been corrected.
*All building systems are operating normally on utility power.
*BAS shows no major alarms that would affect the testing.

Initial Test			Start Date	End Date	Initials
Results	**Yes/No**	**Explanation**			
Pass					
Fail					
Partial Test w/ Corrective Actions					
Complete Test w/ Corrective Actions					
Other					

Re-Test 1			Start Date	End Date	Initials
Results	**Yes/No**	**Explanation**			
Pass					
Fail					
Partial Test w/ Corrective Actions					
Complete Test w/ Corrective Actions					

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Other		

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Re-Test 2			Start Date	End Date	Initials
Results	**Yes/No**	**Explanation**			
Pass					
Fail					
Partial Test w/ Corrective Actions					
Complete Test w/ Corrective Actions					
Other					

Deferred/ Seasonal Test			Start Date	End Date	Initials
Results	**Yes/No**	**Explanation**			
Pass					
Fail					
Partial Test w/ Corrective Actions					
Complete Test w/ Corrective Actions					
Other					

Test Participants

	Description	Required	Optional
1	General Contractor		
2	Mechanical Contractor		
3	Electrical Contractor		
4	Owner's Representative		
5	Controls Contractor		
6	Owner's O&M Personnel		
7	Commissioning Agent (CxA)		
8	MEP Design Engineer (MEP)		
9	Security Contractor (SC)		

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System Readiness Summary Checklist

	Description	Yes/No	Date
1	Tools available for everyone including earplugs, flashlights as needed, access keys, radios, other communication devices.		
2	Access/security to critical rooms obtained prior to “pull the plug”.		
3	Normal power system energized by providing power to Main Switchboard and their disconnects are closed.		
4	Generators are available to be operate.		
5	Automatic Transfer switch settings are provided and have been installed.		
6	Radios, cell phones, public address and/or fire alarm intercom available for communications.		
7	Phase checking at main switchgears are complete.		
8	Interlock at GEN Switchboard has been demonstrated.		
9	All Electrical and Mechanical verification testing complete.		
10	Notify fire alarm monitoring company that the fire alarm will be activated during this test.		

Initial Ambient Conditions

Dry Bulb Temperature		**Precipitation**	
Wet Bulb Temperature		**Relative Humidity**	

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Functional Performance Agenda:

ACTIVITIES PRIOR TO LOSS OF POWER
LOSS OF PREFERRED SOURCE POWER TEST
LOSS OF ALTERNATE SOURCE POWER TEST
LOSS OF BOTH SOURCES OF UTILITY POWER TEST
RETURN TO INITIAL CONDITIONS

Functional Performance Test:

The Commissioning Authority will make and document any changes/addition/deletions to this test procedure required by current system conditions (i.e. weather, system load, utility availability, etc.).

A. ACTIVITIES PRIOR TO LOSS OF POWER

Task #	Action Item	Expected Response	Passed (Yes/No)	Retest (Yes/No)	Issue Log #
1	Verify that key system components such as generators, circuit breaker, PLC controller and relays are configured properly. Attach following reports to FPT: Coordination Study with breaker settings.	Confirm breakers are set in accordance to with coordination study.			
		Generators are ready with sufficient fuel and in auto.			
		Fuel Oil system is full and ready to support generator operations.			
		PLC's are in auto.			

Record Issues:	Initials	Date

2	BAS review to confirm System operating in normal mode.	Review of BAS systems shows no equipment in manual override.			
		No unusual alarms on BAS.			

Record Issues:	Initials	Date

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Task #	Action Item	Expected Response	Passed (Yes/No)	Retest (Yes/No)	Issue Log #
3	Prior to loss of power, walk space to confirm all equipment and lighting from Page EP701 is ready and functional.	All equipment and lighting from Page EP701 confirmed to be ready for test.			

Record Issues:	Initials	Date

Task #	Action Item	Expected Response	Passed (Yes/No)	Retest (Yes/No)	Issue Log #
4	Safety Precautions	Local Utility has been notified.			
		Fire Alarm monitoring company has been notified.			
		Security has been notified.			

Record Issues:	Initials	Date

B. LOSS OF SOURCE POWER TEST

Initial Conditions: Switchgear and Breakers are configured per “Standard Configuration” Detail.

Task #	Action Item	Expected Response	Passed (Yes/No)	Retest (Yes/No)	Issue Log #
5	Simulate a loss of incoming utility power by opening incoming utility power.	Generator energizes the associated Main Distribution Panel			
		The associated Automatic Transfer Switch engages and switches from normal			
		Equipment and lighting installed by project is powered and ready to run.			

Record Issues:	Initials	Date

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6	Simulate a restoration of incoming utility power by closing incoming utility power.	The associated Automatic Transfer Switch timer functions and initiates restoration of incoming power.			
		Generator initiates retransfer timer operation after Automatic Transfer Switch restores to normal operation.			
		Generator restores to normal utility operation when retransfer timer expires.			
		Equipment installed by project is powered and ready to run.			

Record Issues:	**Initials**	**Date**

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C. RETURN TO INITIAL CONDITIONS

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments/ Issues
7	Release all overrides to the system, returning to initial conditions.	DDC resumes normal control of the fans, valves, and dampers.		
		All equipment is operational.		
		The system maintains the chilled water set points		

Record Issues:	Initials	Date

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2207 Garnet Avenue Suite I
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Supply Fans
Functional Performance Test

Project:	**VA CT West Haven EHRM Infrastructure upgrade**
Building:	
Project Location:	**West Haven, CT**
Equipment ID:	
Equipment Location:	
Manufacturer:	
Model #:	
Serial #:	
Service:	

System Description

Description: The test procedure is intended to verify that the Exhaust Fans are functioning properly.

Operational Assumptions: Start-Up testing of the main air handling equipment and systems has been completed.

***** No faults or alarms associated with the equipment being tested are present.
***** BAS shows no major alarms that would affect the testing.

Initial Test			Start Date	End Date	Initials
Results	**Yes/No**	**Explanation**			
Pass					
Fail					
Partial Test w/Corrective Actions					
Complete Test w/Corrective Actions					
Other					

SYSTEM TRENDING REQUIREMENTS

	Description	Frequency	Trending Established	
1	Fan Status	15 min	Yes	No
2	Fan Control	15 min	Yes	No
3	Damper Control	15 min	Yes	No
4	Damper Status	15 min	Yes	No
5	Duct Pressure Sensor (if applicable)	15 min	Yes	No
6	Space Temperature (if applicable)	15 min	Yes	No
7	Space Pressure (if applicable)	15 min	Yes	No

POINT-TO-POINT CHECKOUT

	CONTROL SENSORS (ANALOG/DIGITAL INPUTS)	Measured	BAS	Cal Off-Set	Notes
1	Fan Status				
2	Duct Pressure Sensor (if applicable)				
3	Space Temperature (if applicable)				
4	Space Pressure (if applicable)				

Record Issues:	Initial	Date

SAMPLE

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2207 Garnet Avenue Suite I
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Supply Fans
Functional Performance Test

Project:	**VA CT West Haven EHRM Infrastructure upgrade**
Building:	
Project Location:	**West Haven, CT**
Equipment ID:	
Equipment Location:	
Manufacturer:	
Model #:	
Serial #:	
Service:	

	DAMPERS / ACTUATOR INFORMATION:	0%	50%	100%	CONDITION / COMMENT
1	Damper Control (0%/50%/100%)				
2	Fan Control (0%/50%/100%)				

Record Issues:	Initial	Date

SAMPLE

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2207 Garnet Avenue Suite I
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DX Split Cooling System
Functional Performance Test

Project:	VA CT West Haven EHRM Infrastructure upgrade
Building:	
Project Location:	West Haven, CT
Equipment ID:	SS-1
Equipment Location:	
Manufacturer:	
Model #:	
Serial #:	
Service:	

System Description

Description: The test procedure is intended to verify that the split systems are functioning properly per the control sequence of operations. Equipment is cooling only.

Equipment included in this FPT: CU-#/AC-#, CU-#/AC-#, CU-#/AC-#

Operational Assumptions: All associated building heating and cooling systems are currently functional and operating normally.

***** No faults or alarms associated with the equipment being tested are present.
***** BAS shows no major alarms that would affect the testing.

Initial Test			***Start Date***	***End Date***	***Initials***
Results	**Yes/No**	**Explanation**			
Pass					
Fail					
Partial Test w/Corrective Actions					
Complete Test w/Corrective Actions					
Other					

SAMPLE

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SYSTEM TRENDING REQUIREMENTS

	Description	Frequency	Trending Established (Circle)	
1	Zone Temperature (°F)	15 min	Yes	No
2	Zone Temperature Setpoint (°F)	15 min	Yes	No
3	Discharge Temperture (°F)	15 min	Yes	No
4	Command On/Off	15 min	Yes	No

POINT-TO-POINT CHECKOUT

	CONTROL SENSORS (ANALOG/DIGITAL INPUTS)	Measured	BAS	Cal Off-Set	Notes
1	Zone Air Temperature				

Record Issues:	Initial	Date

OCCUPANCY SCHEDULE

	Record the Occupancy Schedule below	Occupied Hours	Unoccupied Hours
1	Weekday		
2	Weekend		
3	Holiday		

Initial Ambient Conditions

Dry Bulb Temperature		**Precipitation**	
Wet Bulb Temperature		**Relative Humidity**	

Functional Performance Agenda:

PRE-TEST CHECKLIST
ZONE TEMPERTURE
SAFETIES AND ALARMS
RETURN TO INITIAL CONDITIONS

Functional Performance Test:

SAMPLE

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A. PRE-TEST CHECKLIST

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments / Issues
1	Verify that the Split System is operating under normal conditions and is ready to test	No alarms are present		
		Split System is in occupied mode and is maintaining temperature setpoint		

Record Issues:	Initial	Date

Task #	Action Item	Set Points and As Found Conditions	Record Data	Comments / Issues
2	Record the initial operating conditions:	**Setpoints**		
		Zone Temperature Setpoint		
		As-Found Conditions		
		Zone Temperature		

Record Issues:	Initial	Date

SAMPLE

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B. ZONE TEMPERTURE

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments / Issues
3	Decrease Zone Temperature Setpoint below current Zone Temperature	The unit will operate on internal controls to enable and provide cooling to the space		

Record Issues:	Initial	Date

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments / Issues
4	Record Split System discharge temperature	The unit will operate on internal controls to enable and provide cooling to the space		

Record Issues:	Initial	Date

C. SAFETIES AND ALARMS

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments/ Issues
5	Override Zone Temperature Alarm setpoint below current Zone temperature	Zone High Limit Alarm is shown on BAS		
	Release override to setpoint	Alarm is cleared at BAS		

SAMPLE

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D. RETURN TO INITIAL CONDITIONS

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments / Issues
6	Release all overrides to the system, returning to initial conditions.	DDC resumes normal control of the system		
		All equipment is operational.		

Record Issues:	Initial	Date

SAMPLE

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2207 Garnet Avenue Suite I
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Direct: (619) 770.8552

VRF FCU
Functional Performance Test

Project:	VA CT West Haven EHRM Infrastructure upgrade
Building:	
Project Location:	West Haven, CT
Equipment ID:	**VRF FCU**
Equipment Location:	
Manufacturer:	
Model #:	
Serial #:	
Service:	

System Description

Description: The test procedure is intended to verify that the VRF VAVs are functioning properly.

Operational Assumptions: Start-Up testing of the main air handling equipment and systems has been completed.

***** No faults or alarms associated with the equipment being tested are present.
***** BAS shows no major alarms that would affect the testing.

Initial Test			Start Date	End Date	Initials
Results	**Yes/No**	**Explanation**			
Pass					
Fail					
Partial Test w/Corrective Actions					
Complete Test w/Corrective Actions					
Other					

SYSTEM TRENDING REQUIREMENTS

	Description	Frequency	Trending Established	
1	VAV Damper Position (%)	15 min	Yes	No
2	VAV Discharge Air Flow (CFM)	15 min	Yes	No
3	Heating Hot Water Heating Valve Position (%)	15 min	Yes	No
4	Space Temperature Sensor (°F)	15 min	Yes	No
5	Discharge Air Temperature (°F)	15 min	Yes	No

POINT-TO-POINT CHECKOUT

	CONTROL SENSORS (ANALOG/DIGITAL INPUTS)	Measured	BAS	Cal Off-Set	Notes
1	Space Temperature Sensor				
2	Discharge Air Temperature Sensor				
3	Discharge Air Flow Sensor				

Record Issues:	Initial	Date

SAMPLE

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VRF FCU
Functional Performance Test

Project:	VA CT West Haven EHRM Infrastructure upgrade
Building:	
Project Location:	West Haven, CT
Equipment ID:	**VRF FCU**
Equipment Location:	
Manufacturer:	
Model #:	
Serial #:	
Service:	

	DAMPERS / ACTUATOR INFORMATION:	0%	50%	100%	CONDITION / COMMENT
1	VAV Damper Position (0%/50%/100%)				
2	Heating Hot Water Valve (0%/50%/100%)				

Record Issues:	Initial	Date

Functional Performance Agenda:

PRE-TEST CHECKLIST
FUNCTIONAL OPERATION - GROUP #1
FUNCTIONAL OPERATION - GROUP #2
FUNCTIONAL OPERATION - GROUP #3
FUNCTIONAL OPERATION - GROUP #4
OVERRIDE RELEASE

Functional Performance Test:

A. PRE-TEST CHECKLIST

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments / Issues
1	Verify that any air handling unit(s) and the VRF FCUs are operating under normal conditions.	No alarms are present.		
		Air handling units are operational and maintaining temperature and system pressure set points.		
		The VRF FCUs being tested are operational and ready for functional testing.		

Record Issues:	Initial	Date

B. FUNCTIONAL OPERATION - GROUP #1

Task #	Action Item	Expected Response	FCU-2-1	FCU-2-2	FCU-3-1	FCU-3-2	FCU-4-1	FCU-4-2
2	Record the initial zone temeprature, airflows, damper position, and setpoints	Room(s) served						
		Zone Temperature						
		Zone Temp Cooling Setpoint						
		Zone Temp Heating Setpoint						
		Cooling Airflow Setpoint						

Record Issues:	Initial	Date

SAMPLE

2207 Garnet Avenue Suite I
San Diego, CA 92109
Direct: (619) 770.8552

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Task #	Action Item	Expected Response	FCU-2-1	FCU-2-2	FCU-3-1	FCU-3-2	FCU-4-1	FCU-4-2
3	Override zone setpoints to enable heating mode	FCU goes into heating						

Record Issues:	Initial	Date

Task #	Action Item	Expected Response	FCU-2-1	FCU-2-2	FCU-3-1	FCU-3-2	FCU-4-1	FCU-4-2
4	Override zone setpoints to enable cooling mode	FCU goes into cooling						

Record Issues:	Initial	Date

SAMPLE

DAVENERGY SOLUTIONS
ENGINEERING | CONSTRUCTION MANAGEMENT

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C. FUNCTIONAL OPERATION - GROUP #2

Task #	Action Item	Expected Response	FCU-4-3	FCU-4-4	FCU-4-5	FCU-4-6	FCU-4-7	FCU-4-8
5	Record the initial zone temeprature, airflows, damper position, and setpoints	Room(s) served						
		Zone Temperature						
		Zone Temp Cooling Setpoint						
		Zone Temp Heating Setpoint						
		Cooling Airflow Setpoint						

Record Issues:	Initial	Date

Task #	Action Item	Expected Response	FCU-4-3	FCU-4-4	FCU-4-5	FCU-4-6	FCU-4-7	FCU-4-8
6	Override zone setpoints to enable heating mode	FCU goes into heating						

Record Issues:	Initial	Date

Task #	Action Item	Expected Response	FCU-4-3	FCU-4-4	FCU-4-5	FCU-4-6	FCU-4-7	FCU-4-8
7	Override zone setpoints to enable cooling mode	FCU goes into cooling						

Record Issues:	Initial	Date

D. FUNCTIONAL OPERATION - GROUP #3

Task #	Action Item	Expected Response	FCU-5-1	FCU-5-2	FCU-5-3	FCU-5-4	FCU-5-5a	FCU-5-5b
8	Record the initial zone temeprature, airflows, damper position, and setpoints	Room(s) served						
		Zone Temperature						
		Zone Temp Cooling Setpoint						
		Zone Temp Heating Setpoint						
		Cooling Airflow Setpoint						

Record Issues:	Initial	Date

Task #	Action Item	Expected Response	FCU-5-1	FCU-5-2	FCU-5-3	FCU-5-4	FCU-5-5a	FCU-5-5b
9	Override zone setpoints to enable heating mode	FCU goes into heating						

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Record Issues:	Initial	Date

Task #	Action Item	Expected Response	FCU-5-1	FCU-5-2	FCU-5-3	FCU-5-4	FCU-5-5a	FCU-5-5b
10	Override zone setpoints to enable cooling mode	FCU goes into cooling						

Record Issues:	Initial	Date

E. FUNCTIONAL OPERATION - GROUP #4

Task #	Action Item	Expected Response	FCU-R-1					
11	Record the initial zone temeprature, airflows, damper position, and setpoints	Room(s) served						
		Zone Temperature						
		Zone Temp Cooling Setpoint						
		Zone Temp Heating Setpoint						
		Cooling Airflow Setpoint						

Record Issues:	Initial	Date

Task #	Action Item	Expected Response	FCU-R-1					
12	Override zone setpoints to enable heating mode	FCU goes into heating						

Record Issues:	Initial	Date

Task #	Action Item	Expected Response	FCU-R-1					
13	Override zone setpoints to enable cooling mode	FCU goes into cooling						

Record Issues:	Initial	Date

F. OVERRIDE RELEASE

Task #	Action Item	Expected Response	Passed (Yes/No)	Comments / Issues
14	Release overrides	Units will return to normal operation		
		Alarms are cleared		

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