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UFGS-23 08 00.00 20 (February 2021)

Change 1 - 05/21

Preparing Activity: NAVFAC

UNIFIED FACILITIES GUIDE SPECIFICATIONS

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UNIFIED FACILITIES GUIDE SPECIFICATIONS

SECTION 23 08 00.00 20

COMMISSIONING OF MECHANICAL[AND PLUMBING] SYSTEMS

02/21, CHG 1: 05/21

NOTE: This specification covers commissioning requirements for HVAC[and plumbing] systems. Use this specification for Navy projects only. Choose only NAVY tailoring. ARMY tailoring is for future consolidation and not valid at this time.

Adhere to UFC 1-300-02 Unified Facilities Guide Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections. Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable item(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Comments, suggestions and recommended changes for this guide specification are welcome and should be submitted as a Criteria Change Request (CCR).

PART 1 GENERAL

NOTE: This section contains tailoring options for KTR HIRED COMMISSIONING PROVIDER, GOVT HIRED COMMISSIONING PROVIDER, ARMY, and NAVY.

Select KTR HIRED COMMISSIONING PROVIDER tailoring for projects that require the Commissioning Provider to be provided by the Construction Contractor.

Select GOVT HIRED COMMISSIONING PROVIDER tailoring for projects where the Commissioning Provider is retained under a separate contract with the Government.

Select ARMY tailoring for projects that will report the real property asset for Air Force or Army. (Do not use at this time - for future section consolidation with Army.)

Select NAVY tailoring for projects that will report the real property asset for Navy or Marine Corps.

Total Building Commissioning (TBCx) is a systematic, quality-focused process for enhancing the delivery of a project that focuses on verifying and documenting that all of the commissioned systems and assemblies are planned, designed, installed, tested, operated, and maintained to meet the project requirements. The purpose is to reduce the cost and performance risks associated with delivering facilities projects, and to increase value to owners, occupants, and users.

1.1 DEFINITIONS

Commissioning Process (Cx) - a quality-focused process for enhancing the delivery of a project. Refer to ASHRAE 202 for a comprehensive description of the commissioning process.

NOTE: The following paragraph contains tailoring for GOVT-HIRED COMMISSIONING PROVIDER.

Commissioning Provider (CxC)- The entity **hired by the Government**, who leads, plans, and coordinates the Commissioning Team. The terms Commissioning Provider, Commissioning Firm, Lead Commissioning Specialist, Commissioning Specialist, and Commissioning Authority (CA or CxA) when used by sustainable Third Party Certification (TPC) programs, are interchangeable.

Commissioning Authority - The Government retains the authority for oversight and assurance of the entire commissioning process, and final approval of all commissioning deliverables.

NOTE: The following paragraph is tailored for NAVY. For Navy projects, refer to NAVFAC Instruction 3960.1 "Technical Oversight and Acceptance Testing of Critical Systems" for information on Acceptance Testing Representatives' roles and responsibilities.

Government Acceptance Testing Representatives - Government Acceptance Testing Representatives perform the inherently Governmental function of technical oversight and quality assurance for critical systems, and is distinctly separate from the commissioning process. Government Acceptance Testing Representatives witness final testing of critical systems and report systems' acceptance to the COR. Submittals to be surveilled and approved by Government Acceptance Testing Representatives are identified in Section 01 33 00 SUBMITTAL PROCEDURES. Testing required to be witnessed by Government Acceptance Testing Representatives are identified in system level sections.

1.2 SEQUENCING AND SCHEDULING

NOTE: The following paragraph contains tailoring
for ARMY and NAVY. Tailoring and deletions to this
list will require renumbering the list items.

Complete functional performance testing prior to performance verification
testing required by Section 23 09 00 INSTRUMENTATION AND CONTROL FOR
HVAC. Complete the following prior to starting Functional Performance
Tests of mechanical systems:

- a. All equipment and systems completed, cleaned, flushed, disinfected,
calibrated, tested, and operate in accordance with contract documents
and construction plans and specifications
- b. Final DALT Report submitted and approved in accordance with Section
23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC

NOTE: This item contains tailoring for ARMY.

- c. Performance Verification Tests of the controls systems have been
completed and the Performance Verification Test Report has been
submitted and approved in accordance with Section 23 09 00
INSTRUMENTATION AND CONTROL FOR HVAC.
- d. The Certificate of Readiness submitted and approved in accordance with
Section 01 91 00.15 20 TOTAL BUILDING COMMISSIONING
- e. Pre-final Testing, Adjusting, and Balancing Report submitted in
accordance with Section 23 05 93 TESTING, ADJUSTING, AND BALANCING FOR
HVAC
- [f. Air Leakage Test Reports and Diagnostic Test Reports submitted and
approved in accordance with Section 07 05 23 PRESSURE TESTING AN AIR
BARRIER SYSTEM FOR AIR TIGHTNESS
-] [g. Tests, Flushing, and Disinfection in accordance with Section [22 00 00
PLUMBING, GENERAL PURPOSE][22 00 70 PLUMBING FOR HEALTHCARE FACILITIES]
-] [h. Inspection and Testing in accordance with Section 22 33 30.00 10 SOLAR
WATER HEATING EQUIPMENT

]1.3 SUBMITTALS

NOTE: Review Submittal Description (SD) definitions
in Section 01 33 00 SUBMITTAL PROCEDURES and edit
the following list, and corresponding submittal
items in the text, to reflect only the submittals
required for the project. The Guide Specification
technical editors have classified those items that
require Government approval, due to their complexity
or criticality, with a "G." Generally, other
submittal items can be reviewed by the Contractor's
Quality Control System. Only add a "G" to an item

if the submittal is sufficiently important or complex in context of the project.

For Army projects, fill in the empty brackets following the "G" classification, with a code of up to three characters to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy, Air Force, and NASA projects.

The "S" classification indicates submittals required as proof of compliance for sustainability Guiding Principles Validation or Third Party Certification and as described in Section 01 33 00 SUBMITTAL PROCEDURES.

Choose the first bracketed item for Navy, Air Force, and NASA projects, or choose the second bracketed item for Army projects.

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are [for Contractor Quality Control approval.][for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Test Equipment; G[, [_____]]

SD-06 Test Reports

Pipe Flushing, Testing, And Water Treatment Reports; G[, [_____]]

[Seasonal Test Report; G[, [_____]]

][Full-Load Test Report; G

1.4 ACCESSIBILITY REQUIREMENTS

Equipment, systems, and devices for commissioned systems must be accessible. Make necessary modifications if systems and devices are not accessible for inspections and testing.

Assist commissioning team in testing by removing equipment covers, opening access panels, and other required activities that assist with visual oversight. Furnish ladders, flashlights, meters, gauges, or other inspection equipment as necessary.

1.5 COORDINATION

**NOTE: This paragraph contains tailoring options for
ARMY and NAVY.**

Refer to Section 01 91 00.15 10 01 91 00.15 20 TOTAL BUILDING COMMISSIONING for requirements pertaining to coordination during the commissioning process. Coordinate with the Commissioning Provider in accordance with Section 01 91 00.15 10 01 91 00.15 20 and in accordance with the Commissioning Plan to schedule inspections as required to support the commissioning process. Furnish additional information requested by the Commissioning Provider. Coordinate scheduling of Functional Performance Testing with the commissioning team. Upload plans, reports, notes, and other documentation to the Commissioning Provider's web-based commissioning software, or as specified in the commissioning plan, as it is completed.

1.6 PIPE FLUSHING, TESTING, AND WATER TREATMENT REPORTS

Test requirements are specified in Division [22 and]23 piping Sections. Prepare a pipe system cleaning, flushing, and hydrostatic testing log. Provide cleaning, flushing, testing, and water treatment log and final reports.

Include the following in the pipe system cleaning, flushing, and hydrostatic testing log:

- a. Minimum flushing water velocity.
- b. Water treatment reports.
- c. Tracking checklist for managing and ensuring that all pipe sections have been cleaned, flushed, hydrostatically tested, and chemically treated.

1.7 CERTIFICATE OF READINESS DOCUMENTATION

**NOTE: This paragraph contains tailoring options for
ARMY and NAVY.**

Submit Certificate of Readiness documentation in accordance with Section 01 91 00.15 10 01 91 00.15 20 TOTAL BUILDING COMMISSIONING for all equipment and systems including start-up reports; completed Pre-Functional Checklists; Testing, Adjusting, and Balancing (TAB) Report; HVAC Controls Start-Up Reports. Do not schedule Functional Performance Tests for the system until the Certificate of Readiness for that system receives approval by the Contracting Officer. The Mechanical, Electrical, Controls, and TAB subcontractor representatives must sign and date the Certificate of Readiness.

PART 2 PRODUCTS

2.1 TEST EQUIPMENT

Provide all testing equipment required to perform testing for the systems to be commissioned, except for equipment specific to and used by TAB as required by Section 23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC. Provide a sufficient quantity of two-way radios for each subcontractor.

Submit list of Test Equipment and instrumentation to be used for testing including equipment/instrument identification number, equipment application or planned use, manufacturer, make, model, and serial number, and calibration history with certificates. Also list special equipment and proprietary tools specific to a piece of equipment required for testing.

2.1.1 Proprietary Equipment

Provide manufacturer's proprietary test equipment and software required by any equipment manufacturer for programming and/or start-up, whether specified or not. Provide manufacturer test equipment, demonstrate its use, and assist in the commissioning process as needed. Provide data logging equipment and software required to test equipment.

2.1.2 Calibration and Accuracy

Comply with equipment manufacturer's test equipment calibration procedures and intervals. Recalibrate test instruments immediately after instruments have been repaired resulting from being dropped or damaged. Affix calibration tags to test instruments. Furnish calibration records to Contracting Officer upon request.

Provide all testing equipment of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified. Unless otherwise noted, the following minimum requirements apply: Provide temperature sensors and digital thermometers with a certified calibration within the past year to an accuracy of 0.5 degrees F and a resolution of plus or minus 0.1 degrees F. Provide pressure sensors with an accuracy of plus or minus 2.0 percent of the value range being measured (not full range of meter) and calibrated within the last year.

PART 3 EXECUTION

3.1 MEETINGS

**NOTE: This paragraph contains tailoring options for
ARMY and NAVY.**

Attend all meetings in accordance with Section 01 91 00.15 10
01 91 00.15 20 TOTAL BUILDING COMMISSIONING.

Provide timely updates on construction schedule changes so Commissioning Provider has scheduling information needed to execute commissioning process efficiently. Notify Contracting Officer of anticipated construction delays to commissioning activities not yet performed or not yet scheduled.

3.2 PREFUNCTIONAL CHECKS

Complete and sign Pre-Functional Checklists using the Commissioning Provider's web-based commissioning software, or as specified by the commissioning plan. Provide manufacturer's installation manual for each type of unit. Perform all work in accordance with the manufacturer's published diagrams, recommendations, and equipment warranty requirements.

3.3 STARTUP AND INITIAL CHECKOUT

Document start-up and initial testing procedures including:

- a. Startup tests and factory testing reports.
- b. Manufacturer's representative start-up, operating, troubleshooting and maintenance procedures.
- [c. Additional documentation necessary for third party certification programs.
-] d. Perform and clearly document system operational checks and quality control checks as they are completed, and providing a copy to the commissioning team.
- e. Correct deficiencies and sign the Certificate of Readiness for each system before functional performance testing

3.4 COMMISSIONING TESTING

**NOTE: This paragraph contains tailoring options for
ARMY and NAVY.**

Conduct Functional Performance Testing in accordance with Section
01 91 00.15 10 01 91 00.15 20 TOTAL BUILDING COMMISSIONING and
requirements in this section. Prior to Functional Performance Testing,
complete all prerequisites in accordance with paragraph SEQUENCING AND
SCHEDULING.

3.4.1 Preparation

Put equipment and systems into operation and continue operation during each working day of commissioning, as required. Verify temperature and pressure taps in accordance with Contract Documents. Provide a pressure/temperature plug at each water sensor which is an input point to control system.

Perform minor adjustments to equipment and systems during Functional Performance Tests as deemed necessary by the commissioning team. Where calibrated DDC sensors cannot be used to record test data, provide measuring instruments, logging devices, and data acquisition equipment to record data for the complete range of test data for the required test period.

3.4.2 Test Setup

Perform each test under conditions that simulate actual conditions as close as is practically possible. Provide all necessary materials and system modifications to produce the necessary flows, pressures, temperatures, and other conditions necessary to execute the test according to the specified conditions. At completion of the test, return the affected building equipment and systems to their pre-test condition.

3.4.3 Manufacturer's Representative

NOTE: A factory trained representative is recommended for major equipment. Add equipment as required by scope of work.

Choose the bracketed paragraph below for systems with package controls.

Provide a factory trained representative authorized by the equipment manufacturer to perform Functional Performance Testing for the following equipment:

- [Chillers
-][Cooling towers and evaporatively cooled condensers
-][Boilers
-][Packaged Direct-Expansion Refrigeration Equipment, including variable refrigerant flow (VRF) systems
-][Packaged Computer Room [Air Handlers (CRAH)] [Air Conditioners (CRAC)]
-][Booster Pumps
-][Packaged Air Compressors
-][Water Quality and Chemical Treatment Systems
-][Solar Water Heating Systems
-][Ensure the test representative reviews, approves, and signs the completed field test report. Include person's name with signatures.

]3.4.4 Sample Strategy

NOTE: This paragraph contains tailoring options for ARMY and NAVY.

Perform Functional Performance Tests using the sample strategy described in Section 01 91 00.15 10 01 91 00.15 20 TOTAL BUILDING COMMISSIONING. Prepare and complete a Functional Performance Test for each item of equipment or system to be tested. During testing, Government representatives may select the specific equipment or system to be tested for sample sizes less than 100 percent.

3.4.5 Simulating Conditions

Functional performance testing is conducted by simulating conditions at control devices to initiate a control system response. Before testing, calibrate all sensors, transducers and devices. Over-writing control input values through the control system is not acceptable unless approved by the Contracting Officer. Specific examples of simulating conditions are provided below. Do not simulate conditions when damage to the system or building may result.

- a. When varying static pressures inside ductwork cannot be simulated

within the duct, and where a sensor signals the controls system to initiate sequences at various duct static pressures, it is acceptable to simulate the various pressures with a Pneumatic Squeeze-Bulb Type Signaling Device with gauge temporarily attached to the sensing tube leading to the transmitter. It is not acceptable to reset the various set-points, nor to simulate an electric analog signal (unless approved as noted above).

- b. Dirty filter pressure drops can be simulated by partially blocking filter face.
- c. Freeze-stat safeties can be simulated by packing portion of sensor with ice.
- d. High outside air temperatures can be simulated with a hair blower.
- e. Raising entering cooling coil temperatures by activating a heating/preheat coil can be used to simulate entering cooling coil conditions.
- f. Do not use signal generators to simulate sensor signals unless approved by the Contracting Officer, as noted above, for special cases.
- g. Control set points can be altered. For example, to see the air conditioning compressor lockout work at an outside air temperature below 55 degrees F, when the outside air temperature is above 55 degrees F, temporarily change the lockout set point to be 0 degrees F above the current outside air temperature. Caution: Set points are not to be raised or lowered to a point to cause damage to the components, systems, or the building structure and/or contents.
- h. Test duct mounted smoke detectors in accordance with the manufacturer's recommendations. Perform the tests with air system at minimum airflow condition.
- i. Test current sensing relays used for fan and pump status signals to control system to indicate unit failure and run status by resetting the set point on the relay to simulate a lost belt or unit failure while the unit is running. Confirm that the failure alarm was generated and received at the control system. After the test is conducted, return the set point to its original set-point or a set-point as indicated by the Contracting Officer.

[3.4.6 Duct Air Leakage Test (DALT) Report Review

NOTE: Coordinate with project team to determine if CxC review of DALT report is necessary. For Navy projects, in-house personnel are responsible for technical oversight and final acceptance of DALT work. CxC may be leveraged to support DALT report review as necessary. This paragraph contains tailoring options for KTR HIRED COMMISSIONING PROVIDER and GOVT HIRED COMMISSIONING PROVIDER.

The Mechanical System Technical Commissioning Specialist must review the pre-final TAB Report required by Section 23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC. Identify any deficiencies to the Contracting

Officer's Representative and the Contractor's Quality Control Personnel and include in the issues log. The Commissioning Specialist is responsible for reviewing the pre-final TAB Report required by Section 23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC and identifying any deficiencies to the Contracting Officer's Representative and the Contractor's Quality Control Personnel. All deficiencies must be resolved prior to DALT Report approval.

][3.4.7 Duct Air Leakage Test (DALT) Report Verification

NOTE: Coordinate with project team to determine if CxC witnessing DALT verification is necessary. For Navy projects, in-house personnel are responsible for technical oversight and final acceptance of DALT work. CxC may be leveraged to support DALT verification as necessary. This paragraph contains tailoring options for KTR HIRED COMMISSIONING PROVIDER and GOVT HIRED COMMISSIONING PROVIDER.

The Mechanical System Technical Commissioning Specialist must witness the DALT Field Acceptance Testing specified by Section 23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC and identify any deficiencies to the Contracting Officer's Representative and the Contractor's Quality Control Personnel and include in the issues log. The Commissioning Specialist is responsible for witnessing the DALT Field Acceptance Testing specified by Section 23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC and identifying any deficiencies to the Contracting Officer's Representative and the Contractor's Quality Control Personnel. All deficiencies must be resolved prior to DALT Report approval.

][3.4.8 Testing, Adjusting, and Balancing (TAB) Report Review

NOTE: Coordinate with project team to determine if CxC review of TAB report is necessary. For Navy projects, in-house personnel are responsible for technical oversight and final acceptance of TAB work. CxC may be leveraged to support TAB report review as necessary. This paragraph contains tailoring options for KTR HIRED COMMISSIONING PROVIDER and GOVT HIRED COMMISSIONING PROVIDER.

The Mechanical System Technical Commissioning Specialist must review the pre-final TAB Report required by Section 23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC and identify any deficiencies to the Contracting Officer's Representative and the Contractor's Quality Control Personnel and include in the issues log. The Commissioning Specialist is responsible for reviewing the pre-final TAB Report required by Section 23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC and identifying any deficiencies to the Contracting Officer's Representative and the Contractor's Quality Control Personnel. All deficiencies must be resolved prior to TAB Report approval.

][3.4.9 Testing, Adjusting, and Balancing (TAB) Report Verification

NOTE: Coordinate with project team to determine if CxC witnessing TAB verification is necessary. For Navy projects, in-house personnel are responsible for technical oversight and final acceptance of TAB work. CxC may be leveraged to support TAB verification as necessary. This paragraph contains tailoring options for KTR HIRED COMMISSIONING PROVIDER and GOVT HIRED COMMISSIONING PROVIDER.

The Mechanical System Technical Commissioning Specialist must witness the TAB Field Acceptance Testing specified by Section 23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC and identify any deficiencies to the Contracting Officer's Representative and the Contractor's Quality Control Personnel and include in the issues log. The Commissioning Specialist is responsible for witnessing the TAB Field Acceptance Testing specified by Section 23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC and identifying any deficiencies to the Contracting Officer's Representative and the Contractor's Quality Control Personnel. All deficiencies must be resolved prior to TAB Report approval.

]3.4.10 HVAC Controls Test Procedures, Reports, and Trends Review

NOTE: Coordinate with project team to determine if CxC controls submittal review is necessary. For Navy projects, in-house personnel are responsible for technical oversight and final acceptance of HVAC controls work. CxC may be leveraged to support controls submittal review as necessary. This paragraph contains tailoring options for KTR HIRED COMMISSIONING PROVIDER and GOVT HIRED COMMISSIONING PROVIDER.

The Mechanical System Technical Commissioning Specialist must review the Start-Up Testing Report, PVT Procedures and PVT Reports including endurance testing trend submittals required by Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC[and Section 25 10 10 UTILITY MONITORING AND CONTROL SYSTEM (UMCS) FRONT END AND INTEGRATION]. The Mechanical System Technical Commissioning Specialist must review each submittal and identify any deficiencies to the Contracting Officer's Representative and the Contractor's Quality Control Personnel and include in the issues log. The Commissioning Specialist is responsible for reviewing the Start-Up Testing Report, PVT Procedures and PVT Reports including endurance testing trend data required by Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC[and Section 25 10 10 UTILITY MONITORING AND CONTROL SYSTEM (UMCS) FRONT END AND INTEGRATION] and identifying any deficiencies to the Contracting Officer's Representative and the Contractor's Quality Control Personnel. All deficiencies must be resolved prior to final acceptance.

]3.5 RETESTING REQUIREMENTS

Abort tests if any deficiency prevents successful completion of the test or if any required commissioning team member is not present for the test. Re-test only after all deficiencies identified during the original tests have been corrected.

If sequence of operation in any of Functional Performance Tests fails, the Government's costs for witnessing further demonstration of that test procedure may be assigned to the Contractor as a deduct to their contracted price, including salary, travel costs, and per diem for Government commissioning team members. Correct deficiencies as identified by the commissioning team and retest the systems to be commissioned.

3.6 SYSTEM ACCEPTANCE

NOTE: Partial acceptance is acceptance of those parts of the system that could be tested and verified to function in conformance with the construction contract during initial Functional Performance Tests.

Systems may be partially accepted prior to seasonal testing if they comply with all construction contract and accepted design requirements that can be tested during initial Functional Performance Tests. All test procedures must be successful completed prior to full systems acceptance.

[3.7 SEASONAL TESTS

NOTE: Performing seasonal testing under maximum heating or cooling conditions is recommended for mission critical and/or humidity controlled facilities such as hospitals, laboratories, armories, mission operations, or other essential (RCIV) and strategic asset (RCV) facilities.

Perform Initial Functional Performance Tests as soon as all contract work is completed, but prior to facility turnover, regardless of the season.

In addition to the Initial Functional Performance Tests, perform Functional Performance Tests of HVAC systems during season of maximum [heating][and][cooling] as defined by Section 23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC. Schedule Seasonal Functional Performance Tests in coordination with the Contracting Officer. Submit [Seasonal Test Report](#) within 14 days of test completion.

Execute seasonal functional performance testing, witnessed by the Contracting Officer. Correct deficiencies and make adjustments to O&M manuals and as-built drawings for applicable issues identified in any seasonal testing.

]3.8 FULL-LOAD TESTS

NOTE: Performing full-load testing for equipment serving process loads is recommended for facilities where tight environmental control is required such as simulators, electronic equipment facilities, and industrial process facilities.

When full-load testing cannot be performed under actual loading, retain the bracketed sentence to

require artificial loading.

Perform Initial Functional Performance Tests as soon as all contract work is completed, but prior to facility turnover. In addition to the Initial Functional Performance Tests, perform Functional Performance Tests of HVAC systems under full-load conditions.[Develop and implement means of artificial loading to demonstrate the ability of the process cooling systems to handle peak process loads.] Schedule Full-Load Functional Performance Tests in coordination with the Contracting Officer. Submit [Full-Load Test Report](#) within 14 days of test completion.

Execute full-load functional performance testing, witnessed by the Contracting Officer. Correct deficiencies and make adjustments to O&M manuals and as-built drawings for applicable issues identified in any full load testing.

]3.9 TRAINING

**NOTE: This paragraph contains tailoring options for
KTR HIRED COMMISSIONING PROVIDER and GOVT HIRED
COMMISSIONING PROVIDER.**

The Mechanical Systems Technical Commissioning Specialist must review the training plan required by Section 01 78 00 OPERATION AND MAINTENANCE DATA and identify any deficiencies to the Contracting Officer's Representative and the Contractor's Quality Control Personnel.

The Commissioning Provider is responsible for overseeing and approving the training plan required by Section 01 78 00 OPERATION AND MAINTENANCE DATA and identifying any deficiencies to the Contracting Officer's Representative and the Contractor's Quality Control Personnel.

Coordinate, schedule, and document all required training. At a minimum, include the following items in the training report for commissioned systems:

- a. Complete commissioning documentation
- b. Complete O&M data
- c. Complete Training
- d. Purpose of equipment.
- e. Principle of how the equipment works.
- f. Important parts and assemblies.
- g. How the equipment achieves its purpose and necessary operating conditions.
- h. Most likely failure modes, causes and corrections.

- i. On site demonstration.
- j. Provide updates to O&M manuals based on field modifications.
- k. Provide training of the post-occupancy operations and maintenance staff.

-- End of Section --