

CONSTRUCTION SPECIAL SPECIFICATION

SECTION 01810_S

FACILITY COMMISSIONING REQUIREMENTS

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SPECIAL SPECIFICATION**SECTION 01810S****FACILITY COMMISSIONING REQUIREMENTS****PART 1 - GENERAL****1.01 SUMMARY**

- A. This Section specifies the administrative and procedural requirements for Sandia National Laboratories (SNL) Facility Commissioning.
- B. SNL Facility Commissioning is a quality focused process for enhancing the delivery of a project. This systematic process of verification and documentation ensures Facility equipment and systems perform interactively in compliance with SNL design intent, contract documentation, and operational needs.
- C. SNL Facility Commissioning is intended to be a working partnership between SNL and the General Contractor (GC).
- D. SNL Facility Commissioning activities and milestones shall be identified in the GC's Construction Schedule.
- E. The GC shall include line items for the commissioning activities and milestones, as identified in the Design Phase Commissioning Plan, in the schedule of values with the Contract Pay Application. Approval of construction progress payments will be evaluated on meeting scheduled commissioning milestones, as applicable.
- F. The requirements for documentation, training, adjustment, testing, and verification are described in detail throughout the contract documents. The intention of this section is not to define any additional requirements; rather, it is intended to define the requirements for management and coordination of those activities such that a logical and trackable commissioning process is achieved.
- G. The purpose of the commissioning process for this project is to provide SNL assurance that systems have been provided as approved, installed in the prescribed manner and will operate as designed. Commissioning is intended to enhance the quality of system start-up and aid in the orderly and timely transfer of fully functioning systems.
- H. The Contractor (or appropriate sub-contractors, suppliers, and manufacturers representatives) verifies installation, provides scheduling and coordination of

equipment startups and prescribed tests, performs training, corrects deficiencies, performs re-tests, and provides documentation of the process.

- I. The SNL designated Owner Representatives (Inspectors, EOR, Facility Engineers, CxA, etc.) will observe commissioning procedures. The Contractor is expected to verify the functional readiness of systems to be tested prior to performing the tests in the presence of the Owner Representatives.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Divisions 2 through 16 specification sections requiring documentation, training, adjustment, testing, and verification
- B. Section 13995S – Special Construction Systems Commissioning
- C. Section 15995S – Mechanical Systems Commissioning
- D. Section 16995S – Electrical Systems Commissioning

1.03 DEFINITIONS AND ABBREVIATIONS

- A. Commissioning Authority (CxA): The CxA is the SNL point of contact that will lead the overall implementation of the commissioning process and verify that all of SNL's performance requirements are achieved.
- B. Construction Commissioning Lead (CCL): The person designated by the Prime Contractor to act as a single point of contact and to coordinate the testing and verification requirements as outlined in the contract documents. The CCL will plan, coordinate, schedule, and facilitate the execution of the required commissioning activities.
- C. Construction Observer (CO): The CO witnesses on-site construction and commissioning activities, ensures compliance with the contract documents, determines code compliance, coordinates independent tests as deemed necessary, monitors construction safety, and helps determine the monthly cumulative construction progress.
- D. Engineer of Record (EOR): The team responsible for the design and development of the contract drawings and specifications. The EOR shall be responsible for all changes to the contract documents. The EOR shall also be involved throughout the construction process to include construction observations and inspections, the witnessing of tests, answering request for information, and supporting SNL in the development and design of all change orders affecting the design.
- E. Facility Control System (FCS): The FCS Department provides controls commissioning performance design criteria on Direct Digital Control systems. During construction, the FCS Department provides controls programming code

and graphics, checkout of code, and performs controls system functional performance tests.

- F. Heating System Modernization (HSM)
- G. Owner: The owner for the HSM project will be SNL.
- H. Owners Representative: All persons authorized by SNL to interface with the Contractor in various capacities on SNL's behalf.
- I. Sandia National Laboratories (SNL)
- J. SNL Building Manager (BM): The BM serves as Landlord for a Facility. The BM is responsible for daily customer/occupant satisfaction for the life of a Facility.
- K. SNL Building Mechanic/Electrician (BM/E): The BM/E provides mechanical and electrical commissioning performance criteria input, receives training, and ultimately operates the commissioned systems for the life of a Facility.
- L. SNL Construction Manager (CM)
- M. SNL Contract Representative (SCR): The SNL purchasing agent in charge of the HSM contracts.
- N. SNL Delegated Representative (SDR): The SDR, on behalf of the SNL Construction Procurement Agent, reviews, inspects, and accepts the work in accordance with the applicable codes, specifications, and drawings.
- O. SNL Inspectors: The persons authorized by SNL to witness construction activities to ensure that construction is accomplished in a safe manner according to the contract documents. They are to ensure that safety procedures are followed, be present for witnessing tests, conduct independent tests as deemed necessary, review and monitor contractor certifications, and stop work if required to ensure the safety of personnel and the compliance of the Contractor to the contract documents.
- P. SNL Project Manager (PM): The PM manages overall performance, cost, and schedule for a project. The PM authorizes the CxA and any other CxA delegates.
- Q. SNL Systems Engineer (SE): The SE manages the commissioning performance criteria for the mechanical, electrical, civil, architectural, or structural systems for a project. The SE is responsible for the performance of these systems for the life of a Facility.
- R. Test, Adjust, Balance (TAB): The work performed by a certified Test and Balance Contractor, directly under contract to SNL, that tests and balances the air

and water side of the building systems as well as the vibration and balance requirements.

1.04 COMMISSIONING TEAM

- A. The SNL commissioning process is based on developing partnership cooperation between SNL, the Contractor, and the Subcontractors (Subs) by forming a Commissioning Team. The principle points of contact are the Commissioning Authority and the Construction Commissioning Lead.
1. Commissioning Authority (CxA)
 2. Construction Commissioning Lead (CCL)
- B. The SNL CxA will be supported by the following SNL Commissioning Team members, as applicable:
1. Project Manager (PM)
 2. Building Manager (BM)
 3. Systems Engineer (SE)
 4. Building Mechanic/Electrician (BM/E)
 5. Sandia Delegated Representative (SDR)
 6. Construction Observer (CO)
 7. Facilities Controls System (FCS)
 8. Test, Adjust, Balance (TAB)
 9. Engineer of Record (EOR)
- C. The CCL will be supported by the following contracted Commissioning Team members, as applicable:
1. Subcontractors (Subs): The Subs are contractually responsible to the Contractor for delivering and installing specific equipment and/or systems.
 2. Manufacturer's Representatives (MR): MR are responsible to the Contractor or Sub for the correct installation, operation, and training of specific equipment and/or systems.
 3. Others: Specialty Contractors are responsible for performing special testing as required by the Contract Documents.

1.05 BUILDING SYSTEMS & COMPONENTS TO BE COMMISSIONED

- A. The following systems, equipment and their components shall be included in the scope of the commissioning activities and shall be considered to be commissioned systems and equipment.
1. Section 13100 – Lightning Protection
 2. Section 13852 – Intelligent Fire Alarm System
 3. Section 13943 – Facilities Control Systems
 4. Section 15051 – Piping Systems
 5. Section 15122S – Expansion Tanks
 6. Section 15123S – Water Storage Tanks
 7. Section 15140S – Plumbing Specialties
 - a. Backflow Preventers
 - b. Trap Primers
 8. Section 15310 – Automatic Sprinklers and Water Based Fire Protection Systems
 9. Section 15510S – Boilers
 10. Section 15540S – Pumps
 11. Section 15685S – Water-Cooled Centrifugal Chillers
 12. Section 15730S – Unitary Air Conditioning Equipment
 13. Section 15755S – Heat Exchangers
 14. Section 15790S – Air Coils
 15. Section 15810 – Ductwork
 16. Section 15858S – Fan Coil Units
 17. Section 15860S – Centrifugal Fans
 18. Section 15870S – Power Ventilators
 19. Section 16001 – Electrical Work
 20. Section 16269 – Variable Frequency Controllers

21. Section 16410S – Enclosed Switches and Circuit Breakers
22. Section 16440 – Electrical Panelboards
23. Others Systems
 - a. Make Up Air Handling Units – Gas
 - b. Humidifiers – Electric Indirect Type
 - c. Steam Boilers & Make-up Water Components
 - d. Refrigerant Alarm System
 - e. Seismic Bracing
 - f. Unit Heaters
 - g. Evaporative Coolers
 - h. Hot Water Storage Tanks
 - i. Reverse Osmosis Water Treatment Systems

1.06 CCL QUALIFICATIONS AND RESPONSIBILITIES

- A. The CCL shall meet the following minimum qualifications:
 1. Excellent communication and writing skills, organizational skills, and ability to work well with management and trades contractors.
 2. A good working understanding of contracting and general construction methodology.
 3. Competent with e-mail, on-line collaboration, revision tracking and use of schedules.
- B. The CCL shall execute the following responsibilities as specified in this document and include, but are not limited to:
 1. Coordinate and manage the Contractor's documentation, training, adjustment, testing, startup, and verification activities for the commissioned systems as defined in Part 1.04 of this specification section.
 2. Coordinate directly with each subcontractor, supplier, and manufacturers representative with respect to responsibilities and contractual obligations and ensure that equipment startup checklists have been completed and accepted.
 3. Obtain, assemble, and submit commissioning verification documentation.
 4. Attend on-site meetings associated with the commissioning efforts.
 5. Coordinate Owner's Representative (Commissioning Authority, EOR, Inspectors, etc.) test witnessing, after verifying that pretests and startups

have been satisfactorily conducted and final tests are ready to be performed.

6. Track deficiencies identified during startup, inspections, training, point verification testing, and functional performance testing until correction and re-testing are successfully completed.
7. The identity of the CCL shall be submitted with the GC's Contract Proposal.

1.07 COMMISSIONING AUTHORITY (INFORMATION ONLY)

- A. This section is provided for the Contractor's information only. The Contractor is not responsible for the hiring of the Commissioning Authority and the Commissioning Authority has no control over the construction activities.
- B. The Owner will appoint a Commissioning Authority.
- C. The duties of the Commissioning Authority may include, but are not limited to, the following:
 1. Develop a Commissioning Plan for the project. The intent of this plan is to expose issues and resolve them with input from the entire commissioning team early in construction. The Commissioning Plan will identify how commissioning responsibilities are distributed. This plan will include the following information.
 - a. Include an organizational chart showing lines of communication between the commissioning team members.
 - b. Coordinate and identify and coordinate who will be responsible for producing the various procedures, reports, owner notifications, and forms required for the commissioning process.
 - c. Coordinate and identify which subcontractors, suppliers, and manufacturers representatives will participate in each of the tests.
 - d. Coordinate and identify instrumentation required for each test.
 - e. Coordinate and identify who will provide instrumentation for each test.
 2. Oversight and reporting on the point verification and functional performance testing for the FCS.
 3. To archive all Contractor submitted test reports, startup reports, startup checklists, FCS point and functional performance test reports, operating and maintenance manuals, etc using Quickplace or otherwise approved document retrieval system that provides easy future document identification and retrieval, for example provide all operation and maintenance documentation on a searchable CD.

- D. The Commissioning Authority is expected to communicate as follows:
1. The Commissioning Authority will formally communicate with the Contractor via approved project channels. It is expected, however, that informal communication and coordination will be conducted directly with the CCL.
 2. The Commissioning Authority will keep SNL, PM and SDR advised regarding commissioning activities, progress, and problems that may develop.

PART 2 - PRODUCTS

2.01 TEST EQUIPMENT

- A. Provide industry standard test equipment required for performing the tests specified herein.
- B. Instrumentation shall meet the following standards:
1. Be of sufficient quality and accuracy to test and measure system performance within the tolerances required to determine adequate performance.
 2. Be calibrated on the manufacturers' recommended intervals with calibration tags permanently affixed to the instrument being used.
 3. Be maintained in good repair and operating condition throughout the duration of use on this project.
 4. Be re-calibrated/repared if dropped or damaged in any way since last calibrated.
- C. Immersion temperature measuring instruments, liquids:
1. Range, -40°F to 120°F; type, glass partial stem immersion; minimum accuracy, within 1/2 of scale division; resolution, 1°F.
 2. Range, 0°F to 220°F; type, glass partial stem immersion; minimum accuracy, within 1/2 of scale division; resolution, 1°F.
- D. Air temperature measuring instruments:
1. Range, -40°F to 120°F; type, glass partial stem immersion; minimum accuracy, within 1/2 of scale division; resolution, 1°F.
 2. Range, 0°F to 220°F; type, glass partial stem immersion; minimum accuracy, within 1/2 of scale division; resolution, 1°F.

- E. Hydronic pressure measuring instruments:
 - 1. Range, indicated pressure shall be in the middle half of the instrument range; type, minimum Grade A gauge with stainless steel, alloy steel, monel or bronze Bourdon tube; minimum accuracy, within $\pm 0.25\%$ of full scale; resolution, 0.5 psi subdivisions on a 4.5 dial with a mirrored scale and knife-edge pointer.
- F. Hydronic differential pressure measuring instruments:
 - 1. Range, indicated pressure shall be in the middle half of the instrument range; type, dual inlet, minimum Grade A gauge with dual stainless steel, alloy steel, monel or bronze Bourdon tubes and a single pointer; minimum accuracy, within $\pm 0.25\%$ of full scale; resolution, 0.5 psi subdivisions on a 4.5 dial with a mirrored scale and knife-edge pointer.
- G. Air pressure measuring instruments:
 - 1. Range, indicated pressure shall be in the inclined portion of the scale; type, inclined/vertical manometer; resolution: if air velocity less than 1,000 fpm, then 0.005 inch graduations; if air velocity between 1,000 and 4,000 fpm, then 0.01 inch graduations; if air velocity greater than 4,000 fpm, then 0.1 inch graduations.

2.02 MEAN OF ACCESS

- A. The Contractor shall provide means for the CxA and Owner Representatives to access, observe and visually confirm proper operation of all equipment and systems. These means shall be in compliance with all OSHA and DOE regulations and the project specific Safety Plan.

PART 3 - EXECUTION

3.01 COMMUNICATION RESPONSE TIMES

- A. Timeliness in delivering information or providing responses to the CxA are essential to providing the construction product on time, as well as facilitating the commissioning process.
- B. The Contractor shall adhere to the following are guidelines to meet this objective:
 - 1. Delivery of draft O&M manuals: Ninety (90) days prior to the scheduled training
 - 2. Delivery of proposed training material: Sixty (60) days prior to the scheduled training

3. Delivery of start-up plan for each piece of equipment: Six (6) weeks after approved submittals
4. Delivery of final approved checklist: One (1) week from actual completion of the checklist.
5. Written response to a site observation comment: Two (2) weeks or less from receipt of comment
6. Written response regarding the acceptability of the functional testing procedures: Four (4) weeks from receipt of the testing procedures
7. Time to correct discrepancies noted in Record Drawings during construction phase: Two (2) weeks from the date the discrepancy was noted

3.02 COMMISSIONING MEETINGS

- A. The CxA assisted by the CCL shall determine the need for specific commissioning meeting as necessary to plan for the required commissioning activities.
- B. The CxA shall determine who should attend the meetings and shall provide written notice of these meetings with as much advance notice as possible but in no case less than three (3) working days.

3.03 SUBMITTALS

- A. Submit the following electronically in accordance with general and supplemental conditions of the contract and Division 1 specification section 013330 for equipment and systems to be commissioned:
 1. Detailed product data for each piece of equipment including capacities, electrical components and requirements, start-up procedures, etc.
 2. Full and part load performance curves over the expected operated ranges for each piece of equipment that will operate at variable loads
 3. Manufacturers' certified equipment test reports, where applicable
 4. Manufacturers' detailed installation requirements
 5. Manufacturers' detailed start-up requirements
 6. Control system diagrams and sequences of operation
 7. Operation instructions

8. Warranty and Owner's obligations to maintain warranty
9. Manufacturers' recommended maintenance and troubleshooting procedures, including tools and replacement parts lists

3.04 SCHEDULE

- A. The Contractor shall integrate commissioning activities, including pre-start up meetings, completion of pre-startup checklists, equipment start-up, test & balance, functional performance testing and training for those systems identified in Part 1.04 into the master construction schedule.
- B. The Contractor shall incorporate the sequence of commissioning activities into its schedule of values. Payments will be contingent upon submittal of the required commissioning documentation.
- C. Commissioning of systems shall proceed per the criteria established in the specific sections, with activities to be performed on a timely basis. The CCL must be available to respond promptly to avoid delay to the schedule.
- D. Problems observed shall be addressed immediately, in terms of notification to responsible parties and actions to correct deficiencies.
- E. The Contractor shall update the schedule of commissioning-related activities at least monthly until the beginning of start-up activities and/or functional performance testing.
- F. The CCL shall update the schedule of commissioning-related activities at least every two weeks once start-up activities and/or functional performance testing have begun.

3.05 EQUIPMENT CHECKLISTS

- A. The CCL shall ensure that all equipment checklists are completed correctly and on a timely basis.
- B. The CCL shall provide a copy of all in process checklists to SNL in conjunction with each pay request. SNL will use this information to substantiate the Contractor's indicated percentage completion for the project.
- C. The CCL shall provide a copy of all completed checklists to SNL within one (1) week of the completion of the checklist.

- D. The following equipment checklists will be provided by the CxA for each commissioned equipment.
1. Receipt Inspection Checklist
 - a. Purpose: This checklist will document the condition of the equipment when it is received by the Vendor.
 - b. Responsible Party: Equipment Vendor
 2. Equipment Transfer Checklist
 - a. Purpose: This checklist will document the condition of the equipment when it is received by the Contractor. This document will serve as a record of transfer of responsibility for the safe-keeping of the equipment until it is turned over to SNL at project closeout.
 - b. Responsible Party: Contractor
 3. Pre-functional Checklist
 - a. Purpose: This checklist will not require any additional procedures but will summarize the current requirements specified throughout the project specifications that are necessary prior to the startup of any equipment or systems.
 - b. Responsible Party: Contractor

3.06 INSTALLATION VERIFICATION

- A. During construction, SNL Inspectors and SNL Engineers will observe the work of the Prime Contractor and subcontractors to ensure that all installations are being made in accordance with the intent of the contract documents, insofar as the installation impacts the goals of commissioning.
- B. Before system start-up begins, the Contractor shall conduct a final installation verification audit and complete the system pre-startup checklist. The pre-startup checklists are included in these contract specifications.
- C. If any work is found to be incomplete, inaccessible, incorrect, or non-functional, the Contractor shall make note of deficiencies and correct the deficiencies before system start-up work proceeds.

3.07 COORDINATION WITH OWNER'S REPRESENTATIVE WITNESS

- A. SNL will witness all start-up and test activities specified for those systems identified in Part 1.04. SNL will designate the witnesses and will communicate this to the CCL. The SNL witnesses may include any or all of the following:
1. SNL PM
 2. SNL CM
 3. SNL SDR
 4. SNL Inspectors
 5. EOR
 6. CxA

- B. The CCL shall notify the SNL CM in writing a minimum of ten (10) days in advance of the date, time, location, and anticipated duration of start-up and test activities.
- C. The CCL shall obtain the signature of designated Witnesses on all data forms. If a Witness is unavailable at the scheduled time and location of the activity, so note, and proceed per schedule without the Witness.
- D. The Contractor shall not reschedule any test without receiving approval by the SNL CM.

3.08 FUNCTIONAL PERFORMANCE TEST PROCEDURES

- A. General Procedures
 - 1. The Contractor shall demonstrate that the commissioned equipment and systems operate properly in all modes of operation.
 - 2. Sequence of testing: Commissioning shall proceed from lower to higher levels of complexity. For each discrete subsystem or system, testing at the lower level shall be completed prior to starting the next higher level of tests. In general, the order of testing from lowest to highest is as follows.
 - a. Static tests (such as duct leakage tests).
 - b. Component functional tests (of motors, actuators, sensors, etc.) and start-up.
 - c. Point verification tests of Facility Control System (performed by Controls Installation Contractor).
 - d. Balancing (Coordinated with SNL's T&B Contractor).
 - e. System functional performance tests
 - f. Intersystem functional performance tests
- B. In accordance with the construction schedule, the CCL shall manage the completion of the functional performance tests. The completed and accepted test forms shall be returned to SNL via Quickplace collaboration.
- C. Functional Performance Test (FPT) Procedures
 - 1. The CxA will develop functional performance test procedures which will verify the integrated functionality of the FCS as described in the sequence of operations as stated on the contract drawings.
 - 2. The FPT procedures are provided in these contract specifications.
 - 3. The Contractor shall review the FPT procedures and reply, in writing, whether the tests as written are acceptable, meet the installed conditions, and will not void any warranties. The Contractor shall provide any requested modifications to the test procedures in writing. No reply from

the Contractor within four (4) weeks of its receipt of the FPT procedures signifies the Contractor's concurrence that the procedures are acceptable.

4. The FPT procedures will provide step-by-step instructions in a pass/fail format.
- D. The Contractor shall complete and submit all applicable Equipment Checklists prior to scheduling of testing.
 - E. When the equipment and systems are ready to test, the FPT will be scheduled for a time mutually convenient to the Contractor and the CxA.
 - F. The CxA will orchestrate the Functional Performance Test. The Contractor shall be responsible to provide personnel and equipment to perform the testing and to correct problems found during the testing. The Contractor shall provide means of access to the CxA to visually verify all aspects of the specified test.
 - G. If the total time required to correct minor problems during testing is greater than fifteen (15) minutes, the test shall be considered failed and must be repeated in its entirety.
 - H. If a major problem is discovered during the test, the Contractor shall correct the problem. Prior to retesting, the Contractor shall submit to the CxA the required data indicating that the deficient items have been corrected. After review of this information by the CxA, a retest will be scheduled.
 1. A major problem is any problem or group of problems that require more than fifteen minutes to correct.
 2. Any deficiency (major or minor) shall be recorded on the Functional Performance Test form.
 - I. Re-testing: Repeat, at no additional cost to SNL, any test for which acceptable results are not achieved. Repeat tests until acceptable results are achieved.
 - J. Correction of deficiencies:
 1. Correct test deficiencies promptly and schedule retest.
 2. Corrections during functional performance tests are generally prohibited to avoid consuming the time of personnel waiting for the test, but not involved in making the correction. Exceptions will be allowed if the cause of the failure is obvious and corrective action can be completed in less than five minutes. If corrections are made under this exception, the failure shall be noted on the test data form. A new functional performance test data form, marked "retest", shall be initiated after the correction has been made. The entire test procedure shall be repeated.

3.09 REPORTS

- A. The CCL shall ensure that all test reports, pre-startup checklists, verification forms, etc. as specified for those systems to be commissioned are completed and delivered to SNL via standard lines of communication.

3.10 TRAINING

- A. The CCL shall prepare and submit a training plan for approval. The plan shall include training as required in the specifications and as otherwise deemed appropriate by the Contractor and the SNL CM. The training plan shall include for each training session:
 - 1. Dates, start and finish times, and locations.
 - 2. Outline of the information to be presented.
 - 3. Names and qualifications of presenters.
 - 4. List of texts and other materials required to support training.
- B. The Contractor shall provide final Operation and Maintenance (O&M) manuals and training materials to the Government and CxA prior to training.
- C. At a minimum, the Contractor shall provided the following material at the time of training:
 - 1. Detailed agenda
 - 2. Contractor contact information sheet
 - 3. Detailed training material (divided by sections where appropriate)
 - 4. Log sheets and maintenance checklists
 - 5. Manufacturer training videos that are used to educate the factory-trained service technicians for this equipment
- D. At a minimum, training topics shall include the following:
 - 1. Description of equipment and systems
 - 2. Warranties and guarantees
 - 3. Equipment start-up and shutdown
 - 4. Normal and emergency operation

5. Seasonal changeover
6. Maintenance schedules
7. Health and safety issues
8. Special tools and spare parts
9. Emergency procedures
10. Hands-on operation
11. Troubleshooting
12. O&M manuals
13. Facilities control system and sequences of operation

3.11 PROJECT CLOSEOUT

- A. See standard specification 01700 for additional information not specific to this commissioning specification.

END OF SECTION