SECTION 15991 - COMMISSIONING PLAN SPECIFICATION

PART 1 GENERAL

This specification provides the basis and criteria for creating the system commissioning plan in accordance with the 2012 International Energy Conversation Code (2012 IECC), sections C403.2.9 and C408.2. The commissioning agent shall have a commissioning plan prepared by a registered design professional registered in the state of Utah per IECC Section C408.2.1.

This specification only applies to jurisdictions where 2012 IECC is required.

1.1 SUMMARY

A. Section includes:
1. Building commissioning of the following systems:
   a. HVAC components and equipment.
   b. HVAC system: interaction of cooling, heating, and comfort delivery systems.
   c. Lighting Control System and interface with day-lighting.
   d. Domestic hot water systems.

B. The Owner, Architect/Engineer, and Commissioning Agent are not responsible for construction means, methods, job safety, or management function related to commissioning on the job site.

C. Related Sections:
1. 15050 - Common Work Results for Plumbing/HVAC
2. 15990 - Testing, Adjusting and Balancing for HVAC
3. 16050 - Common Work Results for Electrical

1.2 DEFINITIONS

A. **Basis of Design -** The basis of design is the documentation of the primary thought processes and assumptions behind design decisions that were made to meet the Owner's Project Requirements. The basis of design describes the systems, components, conditions and methods chosen to meet the intent. Some reiterating of the Owner's Project Requirements may be included.

B. **Commissioning -** Commissioning is a comprehensive and systematic process to verify that the building systems perform as designed to meet the Owner's requirements. Commissioning during the construction, acceptance, and warranty phases is intended to achieve the following specific objectives:
- Verify and document that equipment is installed and started per manufacturer's recommendations, industry accepted minimum standards, and the Contract Documents.
- Verify and document that equipment and systems receive complete operational checkout by installing contractors.
- Verify and document equipment and system performance.
- Verify the completeness of operations and maintenance materials.
- Ensure that the Owner's operating personnel are adequately trained on the operation and maintenance of building equipment.

The commissioning process does not take away from or reduce the responsibility of the system designers or installing contractors to provide a finished and fully functioning product.

C. **Commissioning Plan** - an overall plan that provides the structure, schedule and coordination planning for the commissioning process. The plan will be developed by

D. **Deficiency** - a condition in the installation or function of a component, piece of equipment or system that is not in compliance with the Contract Documents, does not perform properly or is not complying with the Owner's Project Requirements.

E. **Owner's Project Requirements** - a dynamic document that provides the explanation of the ideas, concepts and criteria that are considered to be very important to the Owner. It is initially the outcome of the programming and conceptual design phases.

F. **Functional Performance Test** - test of the dynamic function and operation of equipment and systems using manual (direct observation) or monitoring methods. Functional 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 setpoint). Systems are tested under various modes, such as during low cooling or heating loads, high loads, component failures, unoccupied, varying outside air temperatures, fire alarm, power failure, etc. The systems are run through all the control system's sequences of operation and components are verified to be responding as the sequences state. Traditional air or water test and balancing (TAB) is not functional testing, in the commissioning sense of the word. TAB's primary work is setting up the system flows and pressures as specified, while functional testing is verifying that which has already been set up. The Commissioning Agent develops the functional test procedures in a sequential written form, coordinates, oversees and documents the actual testing, which is usually performed by the installing contractor or vendor. Functional Performance Tests are performed after prefunctional checklists and startup are complete.

Functional testing to be provided per 2012 IECC Section C408.2.3.

G. **Manual Test** - using hand-held instruments, immediate control system readouts or direct observation to verify performance (contrasted to analyzing monitored data taken over time to make the "observation").

H. **Monitoring** - the recording of parameters (flow, current, status, pressure, etc.) of equipment operation using dataloggers or the trending capabilities of control systems.

I. **Non-Compliance** - see Deficiency.

J. **Non-Conformance** - see Deficiency.

K. **Prefunctional Checklist** - a list of items to inspect and elementary component tests to conduct to verify proper installation of equipment, provided by the Commissioning Agent to the contractor. Prefunctional checklists are primarily static inspections and procedures to prepare the equipment or system for initial operation (e.g., belt tension, oil levels OK, labels affixed, gages in place, sensors calibrated, etc.). However, some prefunctional checklist items entail simple testing of the function of a component, a piece of equipment or system (such as measuring the voltage imbalance on a three-phase pump motor of a chiller system). The word "prefunctional" refers to before functional testing. Prefunctional checklists augment and are combined with the manufacturer's start-up checklist.

L. **Seasonal Performance Tests** - Functional Performance Test that are deferred until the system(s) will experience conditions closer to their design conditions.

M. **Warranty Period** - warranty period for entire project, including equipment components. Warranty begins at Substantial Completion and extends for at least one year, unless specifically noted otherwise in the Contract Documents and accepted submittals.

1.3 COORDINATION

A. Perform commissioning services to expedite the testing process and minimize unnecessary delays, while not compromising the integrity of the procedures.

B. Commissioning Agent shall provide overall coordination and management of the commissioning program as specified herein.

C. Commissioning Team: The commissioning process will require cooperation of the Contractor, subcontractors, vendors, Architect/Engineer, Commissioning Agent, and Owner. The commissioning team shall be comprised of the following.
1. Contractor
   a. Project Manager
   b. Test Engineer
2. Subcontractors: As appropriate to product or system being commissioned.
3. Commissioning Agent
   a. Project Manager
   b. Project Engineers
4. Owner Representative(s) (OAR)
5. Architect/Engineer
   a. Architect
   b. MEP engineers
   c. Specialty Consultant(s)

D. Progress Meetings: Attend construction job-site meetings, as necessary, to monitor construction and commissioning progress. Coordinate with contractor to address coordination, deficiency resolution and planning issues.
1. Plan and coordinate additional meetings as required to progress the work.

E. Site Observations: Perform site visits, as necessary, to observe component and system installations.

F. Functional Testing Coordination:
1. Equipment shall not be "temporarily" started for commissioning.
2. Functional performance testing shall not begin until pre-functional, start-up and TAB is completed for a given system.
3. The controls system and equipment it controls shall not be functionally tested until all points have been calibrated and pre-functional checklists are completed.

G. Indoor Air Quality (IAQ) baseline evaluation: Coordinate with IAQ baseline evaluation as specified in Section 01352 - Indoor Air Quality (IAQ) Management.

1.4 QUALITY CONTROL

A. Qualifications for Commissioning Agents: Engage commissioning service personnel, that specialize in the types of inspections and tests to be performed.
1. Inspection and testing service agencies shall be members of the Building Commissioning Association (BCA).

1.5 SUBMITTALS

A. Commissioning Agent shall submit the following:
1. Basis of Design and Owner's Project Requirements.
   a. Update as necessary during the work to reflect the progress on the components and systems.
2. Scoping Meeting Minutes.
3. Commissioning Plan: Submit within 30 calendar days of authorization to proceed.
   a. Update as necessary during the work to reflect the progress on the components and systems.

4. **Commissioning Schedule**: Submit with Commissioning Plan.

   a. Update as necessary during the work to reflect the progress on the components and systems.

5. **Functional performance test forms**: Submit minimum 30 calendar days prior to testing.

6. **Deficiency Report and Resolution Record**: Document items of non-compliance in materials, installation or operation. Document the results from start-up/pre-functional checklists, functional performance testing, and short-term diagnostic monitoring. Include details of the components or systems found to be non-compliant with the drawings and specifications. Identify adjustments and alterations required to correct the system operation, and identify who is responsible for making the corrective changes.

   a. Update as necessary during the work to reflect the progress on the components and systems.

7. **Preliminary Commissioning Report**: Compile a preliminary Commissioning Report per 2012 IECC Section C408.2.4 and provide to the owner.

   Commissioning agent must provide proof that the preliminary Commissioning Report has been provided to the owner and verification provided to the city prior to final inspection of mechanical equipment.

   This report will identify:
   a. Itemization of deficiencies found during testing that have not been corrected at the time of the report preparation.
   b. Deferred tests that cannot be performed at the time of the report preparation because of climatic conditions.
   c. Climatic conditions required for the performance of the deferred tests.

8. **Final Commissioning Report**: Compile a final Commissioning Report.

   Summarize all of the tasks, findings, conclusions, and recommendations of the commissioning process. Indicate the actual performance of the building systems in reference to the Owner's Project Requirements and contract documents. Include completed pre-functional inspection checklists, functional performance testing records, diagnostic monitoring results, identified deficiencies, recommendations, and a summary of commissioning activities.

9. **O&M Submittals**:

   a. Training plan: Training plan shall include for each training session:
      Dates, start and finish times, and locations;
      Outline of the information to be presented;
      Names and qualifications of the presenters;
      List of texts and other materials required to support training.

   b. O&M Database.

PART 2 PRODUCTS

2.1 TEST EQUIPMENT

A. 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 manufacturer's recommended intervals with calibration tags permanently affixed to the instrument being used.
3. Be maintained in good repair and operation condition throughout the duration of use on this project.

B. All standard testing equipment required to perform startup and initial checkout and required functional performance testing shall be provided by the contractor for the equipment being tested.

C. Datalogging equipment or software required to test equipment will be provided by the Commissioning Agent, but shall not become the property of the Owner.

D.

PART 3 EXECUTION

3.1 COMMISSIONING PROCESS

A. The following activities outline the commissioning tasks and the general order in which they occur. The Commissioning Agent shall coordinate all activities.
1. Design Review and Documentation.
   a. Documentation of Basis of Design and Owner's Project Requirements.
   b. Design Development Review.
   c. Construction Document Review.
2. Commissioning Scoping Meeting.
3. Commissioning Plan.
4. Submittals Review.
5. Start-Up/Pre-Functional Checklists.
6. Functional Performance Testing.
7. Short-Term Diagnostic Testing.
8. Deficiency Report and Resolution Record.
9. Operations and Maintenance Training.
   a. O&M Manual.
   b. Training.
   c. O&M Database.
10. Record Documents Review.
11. Final Commissioning Report
12. Deferred Testing.
   a. Unforeseen Deferred Tests.
   b. Seasonal Testing.
   c. End-of-Warranty Review.

3.2 DESIGN REVIEW AND DOCUMENTATION

A. Documentation of Basis of Design and Owner's Project Requirements: Document basis of design and Owner's Project Requirements as they relate to environmentally responsive characteristics, including: functionality, energy performance, water efficiency, maintainability, system cost, indoor environmental quality and local environmental impacts.

B. Design Development Review: Review design documents to verify that each commissioned system meets the Owner's Project Requirements.

C. Construction Document Review: Review construction documents to verify that commissioning is adequately specified, that each commissioned system can be commissioned and is likely to meet the Owner's Project Requirements.

3.3 COMMISSIONING SCOPING MEETING

A. Commissioning Scoping Meeting:
1. Schedule, coordinate, and facilitate a scoping meeting.
2. Review each building system to be commissioned, including its intended operation, commissioning requirements, and completion and start-up schedules.
3. Establish the scope of work, tasks, schedules, deliverables, and responsibilities for implementation of the Commissioning Plan.

B. Attendance: Commissioning Team members.

3.4 COMMISSIONING PLAN

A. Commissioning Plan: Develop a commissioning plan to identify how commissioning activities will be integrated into general construction and trade activities. The commissioning plan shall identify how commissioning responsibilities are distributed. The intent of this plan is to evoke questions, expose issues, and resolve them with input from the entire commissioning team early in construction.
1. Identify who will be responsible for producing the various procedures, reports, Owner notifications and forms.
2. Include the commissioning schedule.
3. Describe the test/acceptance procedure.

3.5 SUBMITTALS REVIEW

A. Submittal Review: Review the contractor submittals to verify that the equipment and systems provided meet the requirements of the Contract Documents and Owner's Project Requirements.

3.6 START-UP / PRE-FUNCTIONAL CHECKLISTS

A. Start-Up/Pre-Functional Checklists: Coordinate start-up plans and documentation formats, including providing contractor with pre-functional checklists to be completed during the startup process.
1. Manufacturer's start-up checklists and other technical documentation guidelines may be used as the basis for pre-functional checklists.

B. Start-Up/Pre-Functional Checklist shall help verify that the systems are complete and operational, so that the functional performance testing can be scheduled.

3.7 FUNCTIONAL PERFORMANCE TESTING

A. Functional Performance Testing: Test procedures shall fully describe system configuration and steps required for each test; appropriately documented so that another party can repeat the tests with virtually identical results.
1. Test Methods; Functional performance testing and verification may be achieved by direct manipulation of system inputs (i.e. heating or cooling sensors), manipulation of system inputs with the building automation system (i.e. software override of sensor inputs), trend logs of system inputs and outputs using the building automation system, or short-term monitoring of system inputs and outputs using stand alone data loggers. A combination of methods may be required to completely test the complete sequence of operations. The Commissioning Agent shall determine which method, or combination, is most appropriate.
2. Setup: Each test procedure shall be performed under conditions that simulate normal operating conditions as closely as possible. Where equipment requires integral safety devices to stop/prevent equipment operation unless minimum safety standards or conditions are met, functional performance test procedures shall demonstrate the actual performance of safety shutoffs in a real or closely-simulated conditions of failure.
3. Sampling: Multiple identical pieces of non-life-safety or non-critical equipment may be functionally tested using a sampling strategy. The sampling strategy shall be developed by the Commissioning Agent. If, after three attempts at testing the specified sample percentage, failures are still present, then all remaining units shall be tested at the contractors' expense.

B. Develop functional performance test procedures for equipment and systems. Identify specific test procedures and forms to verify and document proper operation of each piece of equipment and system. Coordinate test procedures with the contractor for feasibility, safety, equipment and warranty protection. Functional performance test forms shall include the following information:
1. System and equipment or component name(s).
2. Equipment location and ID number.
3. Date.
4. Project name.
5. Participating parties.
6. Instructions for setting up the test, including special cautions, alarm limits, etc.
7. Specific step-by-step procedures to execute the test.
8. Acceptance criteria of proper performance with a Yes / No check box.
9. A section for comments.

C. Coordinate, observe and record the results of contractor's functional performance testing.
1. Coordinate retesting as necessary until satisfactory performance is verified.
2. Verify the intended operation of individual components and system interactions under various conditions and modes of operation.

3.8 SHORT-TERM DIAGNOSTIC TESTING

A. Short-Term Diagnostic Testing: After initial occupancy, perform short-term diagnostic testing, using data acquisition equipment or the building automation system to record system operation over a two to three week period.
1. Investigate the dynamic interactions between components in the building system.
2. Evaluate the scheduling, the interaction between heating and cooling, and the effectiveness of the HVAC system in meeting the comfort requirements.

3.9 DEFICIENCY REPORT AND RESOLUTION RECORD

A. Deficiency Report and Resolution Record: Document items of non-compliance in materials, installation or operation.

B. Non-Conformance. Non-conformance and deficiencies observed shall be addressed immediately, in terms of notification to responsible parties, and providing recommended actions to correct deficiencies.
1. Corrections of minor deficiencies identified may be made during the tests at the discretion of the Commissioning Agent. In such cases the deficiency and resolution shall be documented on the procedure form.
2. For identified deficiencies:
   a. If there is no dispute on the deficiency and the responsibility to correct it:
      1) The Commissioning Agent documents the deficiency and the adjustments or alterations required to correct it. The contractor corrects the deficiency and notifies the Commissioning Agent that the equipment is ready to be retested.
      2) The Commissioning Agent reschedules the test and the test is repeated.
   b. If there is a dispute about a deficiency or who is responsible:
      1) The deficiency is documented on the non-compliance form and a copy given to the Green Consultant.
      2) Resolutions are made at the lowest management level possible. Additional parties are brought into the discussions as needed. Contractor shall have responsibility for resolving construction deficiencies. If a design revision is deemed necessary and approved by Owner, Architect/Engineer shall have responsibility for providing design revision.
      3) The Commissioning Agent documents the resolution process.
      4) Once the interpretation and resolution have been decided, the appropriate party corrects the deficiency and notifies the Commissioning Agent that the equipment is ready to be retested. The Commissioning Agent reschedules the test and the test is repeated until satisfactory performance is achieved.
3. Cost of Retesting: Costs for retesting shall be charged to the Contractor.

3.10 OPERATIONS AND MAINTENANCE TRAINING

A. O&M Manual: Review the operation and maintenance manuals compiled by the contractor for completeness and for adherence to the requirements of the specifications.
1. Obtain additional materials from contractor as necessary to stress and enhance the importance of system interactions, troubleshooting, and long-term preventative maintenance and operation.

B. Training: Develop a Training Plan. Coordinate and review the training programs for Owner's personnel.
1. Obtain additional materials from contractor as necessary to stress and enhance the importance of system interactions, troubleshooting, and long-term preventative maintenance and operation.

C. O&M Database: Develop a database from the O&M manual that contains the information required to start a preventative maintenance program.

3.11 RECORD DOCUMENTS REVIEW

A. Record Documents: Review record documents to verify accuracy.

3.12 FINAL COMMISSIONING REPORT

A. Final Commissioning Report: Compile final commissioning report. Summarize all of the tasks, findings, conclusions, and recommendations of the commissioning process.

3.13 DEFERRED TESTING

A. Unforeseen Deferred Tests: If a test cannot be completed due to the building structure, required occupancy condition, or other deficiency, the functional testing may be delayed upon recommendation of the Commissioning Agent and the approval of the Owner. These tests are conducted in the same manner as the seasonal tests as soon as possible.

B. Seasonal Testing;
1. Schedule, coordinate, observe, and document additional testing for seasonal variation in operations and control strategies during the opposite season to verify performance of the HVAC system and controls. Complete testing during the warranty period to fully test all sequences of operation.
2. Update O&M manuals and Record Documents as necessary due to the testing.

C. End-of-Warranty Review: Conduct end of warranty review prior to the end of the warranty period. Review the current building operation with the facility maintenance staff. The review shall include outstanding issues from original or seasonal testing. Interview facility staff to identify concerns with building operation. Provide suggestions for improvements and assist owner in developing reports or documentation to remedy problems.
1. Update O&M manuals and Record Documents as necessary due to the testing.

3.14 EQUIPMENT & SYSTEM SCHEDULE

A. The following equipment shall be commissioned in this project.

System	Equipment	Check
Rooftop Units	AC-1	
	AC-2	
	AC-3	
	AC-4	
Ductless Split Systems		
	DS-1A, DS-1B	
	DS-2, DS-2A, DS-2B, DS-2C, DS-2D	
	DS-3, DS-3A, DS-3B, DS-3C, DS-3D	
	HP-1	
Kitchen HVAC Systems		
	MAU-1	
	EF-1	
Furnace Systems		
	F-1/CU-1	
Fan Coil Unit		
	FCU-1, FCU-2	
	EDH-1	
Exhaust Fans		
	EF-2	
	EF-3	
	EF-4	
	EF-5	
	EF-6	
	EF-6A	
	EF-7	
	EF-8	
	EF-9	
	EF-10	
Domestic Hot Water		
	WH-1	
	WH-2	
	WH-3	

END OF SECTION

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MECHANICAL SPECIFICATIONS

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