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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

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Preparing Activity: NASA

New

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2023

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SECTION 01 91 00.00 98

COMMISSIONING
08/12

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NOTE: This specification covers the requirements for Sustainability and U.S. Green Building Council (USGBC) requirements for Commissioning.

Adhere to http://www.wbdg.org/ffc/dod/unified-facilities-criteria-ufc **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 items(s) or insert appropriate information.**

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

Recommended changes to a NASAKSC Master Specification Section should be submitted to the appropriate Technical Proponent (TP) through the SpecsIntact Help Desk**.**

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PART 1 GENERAL

The requirements of this Section apply to, and are a component part of, each section of the specifications.

This Section includes:

a. Building commissioning of the following systems:

(1) HVAC components and equipment

(2) HVAC system: interaction of cooling, heating, and comfort delivery systems

(3) Building Automation System (BAS): control hardware and software, sequence of operations, and integration of factory controls with BAS

(4) Lighting Control System and interface with daylighting

(5) Domestic hot water systems

(6) Renewable energy generation systems

b. Building commissioning activities and documentation in support of the U.S. Green Building Council (USGBC) LEED BD+C™ rating program. Commissioning activities and documentation include the section on "Energy and Atmosphere" prerequisite of "Fundamental Building Systems Commissioning" and the section on "Additional Commissioning."

c. Building commissioning activities and documentation in support of the Building Research Establishment (BRE) GBI Green Globes for NC - US rating system.

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

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.

The following Sections are an integral part of this project Commissioning:

a. Section 01 30 00 ADMINISTRATIVE REQUIREMENTS

b. Section 01 57 19.00 20 TEMPORARY ENVIRONMENTAL CONTROLS

c. Section 01 45 00.00 40 QUALITY CONTROL

[d. Section 01 45 35 SPECIAL INSPECTION FOR SEISMIC-RESISTING SYSTEMS]

g. Section 01 78 23 OPERATION AND MAINTENANCE DATA

[h. Section 02 62 16.16 10 COMMISSIONING AND DEMONSTRATION FOR SOIL VAPOR EXTRACTION (SVE) SYSTEMS

] i. Section 22 00 00 PLUMBING, GENERAL PURPOSE

j. Section 23 30 00 HVAC AIR DISTRIBUTION SYSTEMS

k. Section 23 03 00.00 20 BASIC MECHANICAL MATERIALS AND METHODS

j. Section 26 05 00.00 40 COMMON WORK RESULTS FOR ELECTRICAL

1.1 REFERENCES

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NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date,

and title.

Use the Reference Wizard's Check Reference feature when you add a RID outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

References not used in the text will automatically be deleted from this section of the project specification when you choose to reconcile references in the publish print process.

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The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D6245	(2012) Using Indoor Carbon Dioxide Concentrations to Evaluate Indoor Air Quality and Ventilation
ASTM D6345	(2010) Standard Guide for Selection of Methods for Active, Integrative Sampling of Volatile Organic Compounds in Air

GREEN BUILDING INITIATIVE (GBI)

GBI Green Globes for NC	(2017) Green Globes(tm) for New Construction Technical Reference Manual

U.S. GREEN BUILDING COUNCIL (USGBC)

LEED BD+C	(2009; R 2010) Leadership in Energy and Environmental Design(tm) Building Design and Construction (LEED-NC)
LEED GBDC Ref Guide	(2009; R 2010) LEED Reference Guide for Green Building Design, Construction and Major Renovations of Commercial and Institutional Buildings including Core & Shell and K-12 Projects

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 Project Requirements. The basis of design describes the systems, components, conditions and methods chosen to meet the intent. Some reiterating of the 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 requirements. Commissioning during the construction, acceptance, and warranty phases intends to achieve the following

specific objectives:

(1) Verify and document that equipment is installed and started per manufacturer's recommendations, industry accepted minimum standards, and the Contract Documents.

(2) Verify and document that equipment and systems receive complete operational checkout by the installing Contractors.

(3) Verify and document equipment and system performance.

(4) Verify the completeness of Operations and Maintenance materials.

(5) Ensure that the operating personnel are adequately trained on the operation and maintenance of the building equipment.

c. 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 pre-functional checklists and startup are complete.

d. Commissioning Plan - an overall plan that provides the structure, schedule and coordination planning for the commissioning process.

e. 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 Project Requirements.

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

g. 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.

h. 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").

i. Monitoring - the recording of parameters (flow, current, status, pressure, etc.) of equipment operation using data loggers or the trending capabilities of control systems.

j. Pre-functional 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. Pre-functional 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 pre-functional 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 "pre-functional" refers to before functional testing. Pre-functional checklists augment and are combined with the manufacturer's start-up checklist.

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

l. 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 ADMINISTRATIVE REQUIREMENTS

Perform commissioning services for the system. Expedite the testing process and minimize unnecessary delays, while not compromising the integrity of the procedures. The commissioning requires cooperation of the Contractor, Subcontractors, vendors, Architect/Engineer, Commissioning Agent, Green Consultant, and Contracting Officer.

1.3.1 Co-ordination

Provide a Commissioning Agent for overall co-ordination and management of the commissioning program. The commissioning team comprises the following groups:

a. Contractors Project Manger and Test Engineer

b. Sub-Contractor for the System being Commissioned

c. Commissioning Agents Project Manager and Project Engineers

d. Contracting Officers Representative

e. Green Consultant

f. Architect/Engineer and Specialty Consultant

Coordinate with IAQ baseline evaluation in conformance with ASTM D6245, and ASTM D6345.

1.3.2 Progress Meetings

Plan and co-ordinate meetings as required to monitor construction and commissioning progress the work. Notify the Contracting Officer of construction job-site meetings to address co-ordination, deficiency resolution and planning issues.

1.3.3 Functional Testing Co-ordination

Do **not** "temporarily" start equipment for commissioning. Do not conduct

functional performance testing until a pre-functional, start-up and TAB is completed for a given system. Do not functionally test the controls system and equipment it controls until all points have been calibrated and the pre-functional checklists are completed.

1.4 SUBMITTALS

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NOTE: EO 13423 directs Federal agencies to "provide reports on agency implementation of this order to the Chairman of the Council [on Environmental Quality] on such schedule and in such format as the Chairman of the Council may require; and … provide information and assistance to the Director of the Office of Management and Budget, the Chairman of the Council, and the Federal Environmental Executive. Refer to http://www.wbdg.org/sustainableEO

Additionally, under the Sustainable Building requirements per Guiding Principle No. 2 Optimize Energy Performance, EO 13423 directs Federal agencies to "Enter data and lessons learned from sustainable buildings into the High Performance Buildings Database." http://femp.buildinggreen.com/

EO 13514; Federal Leadership in Environmental, Energy, and Economic Performance; was signed on October 5, 2009.
http://www.epa.gov/oaintrnt/documents/fleetguidance_13514.pdf
It expands upon the environmental performance requirements of EO 13423.
http://www1.eere.energy.gov/femp/regulations/printable_versions/eo13423.html

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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.

A “G” following a submittal item indicates that the submittal requires Government approval. Some submittals are already marked with a “G”. Only delete an existing “G” if the submittal item is not complex and can be reviewed through the Contractor’s Quality Control system. Only add a “G” if the submittal is sufficiently important or complex in context of the project.

An "S" following a submittal item indicates that the submittal is required for the Sustainability Notebook to fulfill federally mandated sustainable requirements in accordance with Section 01 33 29 SUSTAINABILITY REPORTING.

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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-01 Preconstruction Submittals

Commissioning Plan[; G]

Commissioning Schedule[; G]

SD-05 Design Data

Basis Of Design[; G]

SD-06 Test Reports

Functional Performance Testing Results[; G]

Seasonal Testing[; G]

Short-Term Diagnostic Testing[; G]

Deficiency Report and Resolution Record[; G]

SD-07 Certificates

Commissioning Agents Qualifications[; G]

SD-10 Operation and Maintenance Data

Operations and Maintenance manuals[; G]

Training plan[; G]

Operations and Maintenance Database[; G]

SD-11 Closeout Submittals

Final Commissioning Report[; G]

[LEED™ Documentation[; G]

][Green Globes - US Documentation[; G]

] Warranty[; G]

1.5 QUALITY CONTROL

Commissioning Agents Qualifications: Engage commissioning service personnel, that specialize in the types of inspections and tests to be performed.

[Inspection and testing service agencies are members of the Building Commissioning Association (BCA)[_____].

]1.6 DESIGN REVIEW AND DOCUMENTATION

Document basis of design and Project Requirements as they relate to

environmentally responsive characteristics, including:

a. Functionality

b. Energy performance

c. Water efficiency

d. Maintainability

e. System cost

f. Indoor environmental quality

g. Local environmental impacts

Review design documents to verify that each commissioned system meets the Project Requirements, including conformance with ASTM D6245, ASTM D6345 [.][, and LEED GBDC Ref Guide for new construction.]

Review construction documents to verify that commissioning is adequately specified, that each commissioned system can be commissioned and is likely to meet the Project Requirements.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

[_____]

2.2 TEST EQUIPMENT

Ensure instrumentation used for testing meets the following standards:

a. Sufficient quality and accuracy to test and measure system performance within the tolerances required to determine adequate performance.

b. Calibrated on the manufacturer's recommended intervals with calibration tags permanently affixed to the instrument being used.

c. Maintained in good repair and operating condition throughout the duration of use on this project.

Provide all standard testing equipment required for performing startup and initial checkout and required functional performance testing for the system. Datalogging equipment or software required to test equipment will be provided by the Commissioning Agent, and not become the property of the Government.

2.2.1 Commissioning Plan

Develop a Commissioning Plan to identify how commissioning activities will be integrated into general construction and trade activities. The commissioning plan identifies 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.

The Plan identifies who is responsible for producing the various

procedures, reports, forms, and notifications. It will include the Commissioning Schedule and describe the test/acceptance procedure.

2.3 START-UP/PRE-FUNCTIONAL CHECKLISTS

Coordinate start-up plans and documentation formats, including pre-functional checklists to be completed during the startup process. Manufacturer's start-up checklists and other technical documentation guidelines can be used as the basis for pre-functional checklists.

PART 3 EXECUTION

3.1 COMMISSIONING PROCESS

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NOTE: Executive Order 13514; Federal Leadership in Environmental, Energy, and Economic Performance; was signed by President Obama on October 5, 2009. It expands upon the environmental performance requirements of EO 13423.
http://www.epa.gov/oaintrnt/documents/fleetguidance_13514.pdf
Additionally, Federal Agencies are required, per "DOE guidelines issued under section 103 of the Energy Policy Act of 2005 (EPAct), to install building level utility meters in new major construction and renovation projects to track and continuously optimize performance."

The Federal Real Property Council was established under EO 13327, Federal Real Property Asset Managed, issued February 4, 2004. The FRPC annual guidance and FRPP reporting instructions can be found at:
http://www.whitehouse.gov/omb/financial/fia_asset.html
The reporting of data for the "sustainability" data element is required for FY 2009 and beyond.

Commissioning, including the Commissioning Report, can assist agencies in meeting the commitments outlined in the MOU.

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The Commissioning Agent coordinates all activities. The following activities outline the commissioning tasks and the general order in which they occur.

a. Design Review and documentation consisting of:

(1) Documentation of Basis of Design and Project Requirements

(2) Design Development Review

(3) Construction Document Review

b. Commissioning Scoping Meeting

c. Commissioning Plan

d. Submittals Review

e. Start-Up/Pre-Functional Checklists

f. Functional Performance Testing

g. Short-Term Diagnostic Testing

h. Deficiency Report and Resolution Record

i. Operations and Maintenance Training

j. Record Documents Review

k. Final Commissioning Report and [LEED™] [Green Globes - US] [_____] Documentation

l. Deferred testing due to unforeseen deferred tests, seasonal testing or end of Warranty review.

3.2 FUNCTIONAL PERFORMANCE TESTING

Fully describe system test procedures identifying configuration and steps required for each test. Provide appropriate documents so that another party can repeat the tests with virtually identical results.

Submit documentation to the Contracting Officer verifying conformance with the following standards:

3.2.1 Functional Performance Test Procedures

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.

Include the following information on the functional performance test forms:

a. System and equipment or component name(s)

b. Equipment location and ID number

c. Date

d. Project name

e. Participating parties

f. Instructions for setting up the test, including special cautions, alarm limits, etc

g. Specific step-by-step procedures to execute the test

h. Acceptance criteria of proper performance with a Yes / No check box

i. Comment section

3.2.2 Test Methods

Methods for functional performance testing and verification include 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. The Commissioning Agent determines which method, or combination of methods, is most appropriate.

3.2.3 Setup

Perform each test procedure 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, have functional performance test procedures demonstrate the actual performance of safety shutoffs in a real or closely-simulated conditions of failure.

3.2.4 Sampling

The Commissioning Agent develops a sampling strategy when multiple identical pieces of non-life-safety or non-critical equipment may be functionally tested. If, after three test attempts at testing the specified sample percentage, failures are still present, then test all remaining units at the Contractors' expense.

3.2.5 Functional Performance Testing Results

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

3.3 SHORT-TERM DIAGNOSTIC TESTING

After initial occupancy, perform short-term diagnostic testing, using [data acquisition equipment] [the building automation system] to record system operation over a [two] [three] [_____] week period.

[Investigate the dynamic interactions between components in the building system. Evaluate the scheduling, the interaction between heating and cooling, and the effectiveness of the HVAC system in meeting the comfort requirements.

]3.4 DEFICIENCY REPORT AND RESOLUTION RECORD

Document items of non-compliance in materials, installation or operation.

3.4.1 Non-Conformance

Immediately address observed non-conformance and deficiencies in terms of notification to responsible parties, and provide recommended actions to correct deficiencies.

Corrections of minor deficiencies identified may be made during the tests at the discretion of the Commissioning Agent. In such cases document the deficiency and resolution on the procedure form.

3.4.1.1 Identified Deficiencies Correction Procedure

If there is no dispute on the deficiency and the responsibility to correct it:

a. 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.

b. The Commissioning Agent reschedules the test and the test is repeated.

If there is a dispute about a deficiency or who is responsible:

a. The deficiency is documented on the non-compliance form and a copy given to the Green Consultant.

b. Resolutions are made at the lowest management level possible. Additional parties are brought into the discussions as needed. Contractor has responsibility for resolving construction deficiencies. If a design revision is deemed necessary and approved by the Contracting Officer, the Architect/Engineer has responsibility for providing a design revision.

c. The Commissioning Agent documents the resolution process.

d. 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.

The Contractor is responsible for retesting costs.

3.5 OPERATIONS AND MAINTENANCE TRAINING

Provide complete Operations and Maintenance manuals, a Training Plan and an Operations and Maintenance Database.

Coordinate and review with the Contracting Officers' representative the training program[s] for O&M personnel.

Develop the database from the O&M manual containing the information required to start a preventative maintenance program.

Provide additional materials as necessary to stress and enhance the importance of system interactions, troubleshooting, and long-term preventative maintenance and operation.

3.6 FINAL COMMISSIONING REPORT AND LEED™ DOCUMENTATION

Compile and submit a Final Commissioning Report. Summarize all of the tasks, findings, conclusions, and recommendations of the commissioning process.

Compile and submit [LEED™ Documentation] [Green Globes - US Documentation] [_____]. Format as required by [USGBC] [GBI] [_____] for submittal under the referenced green building rating system.

3.7 DEFERRED TESTING

3.7.1 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 Contracting Officer. Conduct these tests in the same manner as the seasonal tests as soon as possible.

3.7.2 Deferred Tests

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.

3.7.3 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. Include in the review all outstanding issues from original or seasonal testing. Interview facility staff to identify concerns with building operation. Provide suggestions for improvements and assist Contracting Officer in developing reports or documentation to remedy problems.

Update O&M manuals and Record Documents as necessary due to the testing.

3.8 EQUIPMENT AND SYSTEM SCHEDULE

Commission the following equipment in this project.

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NOTE: Edit below to suit project.
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System	Equipment	Check
HVAC System	Chillers	
	Pumps	
	Cooling Tower	
	Variable frequency drives	
	Air Handlers	
	Packaged AC units	
	Terminal units	

System	Equipment	Check
	Unit heaters	
	Heat exchangers	
	Fume hoods	
	Lab room pressures	
	Exhaust fans	
	Supply fans	
Lighting Controls	Sweep or scheduled lighting controls	
	Day light dimming controls	
	Lighting occupancy sensors	
BAS System		
Domestic Hot Water		
Renewable Energy	Solar energy electrical power generation	
	Wind energy electrical power generation	
	Biomass energy electrical power generation	

-- End of Section --