

STATEMENT OF WORK
FOR
DESIGN-BUILD SUPPORT SERVICES
FOR THE
ENERGY SYSTEMS INTEGRATION FACILITY

National Renewable Energy Laboratory
1617 Cole Boulevard
Golden, Colorado 80401

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ENERGY SYSTEMS INTEGRATION FACILITY
TABLE OF CONTENTS**

Section No.	Section Title	Page No.
1	General Requirements	2
2	Project Definition Assistance	4
3	Project Analysis/Validation	4
4	RFP Package Preparation Support	4
5	Competition Assistance	8
6	Project Implementation Assistance	9
7	Design Assistance	10
8	Construction Assistance	14
9	Commissioning Assistance	15

Attachment No.	Attachment Title	Page No.
1	Focused Preliminary Design Review Elements	25
2	Focused 60% and 95% Design Review Elements	26
3	Commissioning Facilitation Review	27
4	Commissioning for Indoor Air Quality Review Checklist - Design Phase	28



**STATEMENT OF WORK
FOR
DESIGN-BUILD SUPPORT SERVICES
Energy Systems Integration Facility**

9/10/08

SECTION 1 - GENERAL REQUIREMENTS

1.1 SCOPE

This statement of work defines the Design-Build Support Services required by NREL for the Energy Systems Integration Facility (ESIF). The ESIF will provide the research, engineering, design, testing and analysis of components and systems to enable economic, reliable integration of renewable electricity generation, fuel production, storage, and building efficiency technologies with the U.S. fuels and electricity delivery infrastructures. The ESIF will also include a state-of-the-art high performance computing data center. It will support improved and expanded capabilities in modeling and simulation of renewable energy and energy efficient technologies. The ESIF will provide laboratory and research capabilities for a broad range of renewable energy generation capabilities. The facility is planned to have approximately 30 separate research and specialty areas with a staffing level of approximately 200. The value of the design-build work for the ESIF is approximately \$70,000,000 – \$80,000,000.

The ESIF is required to be a sustainable high-performance design, which demonstrates the integration of high performance building design and practices and utilizes the latest in technological advances. The ESIF is required to incorporate the best in energy efficiency, environmental performance, and advanced controls using a “whole building” integrated design approach. Energy costs shall be at least 30% less than ASHRAE 90.1-2004 baseline equivalent building performance and real time energy use monitoring shall be incorporated into the design to demonstrate these savings. The ESIF is required to achieve the U.S. Green Building Council’s (USGBC) LEED™ “Gold” level of certification as a minimum and the Subcontractor will be required to complete a study to see how “Platinum” can be achieved for the building.

NREL plans to enter into a subcontract for a design-build partnership to fast track the completion of the ESIF. The solicitation for the services of the Design-Builder is currently underway. The purpose of this Statement of Work is to enter into a subcontract to provide support services to NREL during the ESIF design-build contract life cycle.

This scope of work for the Design-Build Support Services Subcontractor includes the following general categories:

- Project Definition Assistance
- Project Analysis/Validation
- Request for Proposal (RFP) Package Preparation Support
- Competition Assistance
- Project Implementation Assistance
- Design Assistance
- Construction Assistance
- Commissioning Assistance

The work effort will support the NREL staff and shall include the services necessary to complete the work. All Subcontractor services shall be performed as expeditiously as is consistent with professional skill and care and the orderly progress of the work.

1.2 NREL'S RESPONSIBILITIES

NREL staff shall lead the effort of all activities described here and provide the Subcontractor with supplemental information, comments, objectives, constraints, clarifications, and approvals as required for timely completion of the work.

1.3 ADMINISTRATION, MANAGEMENT, AND GENERAL SERVICES

The NREL ESIF Project Manager is the primary point of contact for technical issues and will perform day-to-day coordination and communication with the Subcontractor. This includes direction and approval of technical actions and resolution of questions and conflicts as well as communication with NREL staff and management. Contractual issues shall be directed to the NREL Subcontract Administrator. The Subcontractor, at the beginning of the design, shall designate a Project Manager who shall be the principal point of contact with NREL throughout the project.

1.3.1 Project Management

The Subcontractor shall provide services necessary for complete coordination and administration of all phases of the work including related research, correspondence, travel, etc. These services shall include coordination of all Subcontractor's work of in-house personnel and outside consultants. All meetings will be held at the NREL's offices unless otherwise agreed.

1.3.2 General

The Subcontractor shall cooperate fully with NREL and furnish such information and advice to NREL as it may reasonably require with respect to the development and management of the work.

1.3.3 Quality Assurance

The Subcontractor shall provide all services consistent with generally accepted industry practice for the competitive design-build subcontract preparation.

1.3.4 Schedule Control

The Subcontractor will develop the schedule that will complete their deliverables to NREL. The Subcontractor shall be responsible for planning and scheduling all work and is expected to provide all services in a timely manner as required for the orderly progress of the work.

1.3.5 Management and Coordination Meetings

The Subcontractor shall conduct periodic management and coordination meetings with NREL, as mutually agreed, for the administration of this subcontract scope. The Subcontractor may also be requested to attend meetings conducted by NREL for the purpose of providing technical support for the NREL ESIF Project Manager. For these meetings, either formal or informal, the Subcontractor shall take and transcribe the minutes for the portions of the meetings relating to this work. A copy of the meeting minutes shall be furnished to participants, the NREL ESIF Project Manager, and the Subcontract Administrator.

1.3.6 Telephone Communications

All phone conversations related to the work between the Subcontractor and NREL staff or other outside organizations shall be summarized on a log sheet and a copy furnished to the participants, the NREL ESIF Project Manager, and the NREL Subcontract Administrator.

SECTION 2 – PROJECT DEFINITION ASSISTANCE

2.1 REQUIREMENTS

Provide NREL with assistance in defining project expectations, risk management planning, budget requirements, operational requirements and programmatic requirements.

2.2 Deliverable: Project Definition Report due within 30 calendar days from subcontract award.

SECTION 3 – PROJECT ANALYSIS/VALIDATION

3.1 REQUIREMENTS

Review, analyze and advise on project risks, budget management, operational aspects, scope, program development and performance criteria development.

3.2 Deliverable: Project Analysis/Validation Report due within 30 calendar days from subcontract award.

SECTION 4 – RFP PACKAGE PREPARATION SUPPORT

4.1 REQUIREMENTS

Provide NREL with design-build support services in the preparation of a Request for Proposal (RFP) package for the planned design-build acquisition. The support shall include the following items to be included in the RFP package.

4.1.1 Subcontract Documents

The Subcontractor shall provide NREL with assistance in preparing design-build front end subcontract documents. The Subcontractor shall provide NREL with all documentation and/or forms to support the RFP package including but not limited to instructions, programming and performance specifications, quality assurance documentation, schedule information, submittal procedures, environment, safety and health requirements, temporary construction facilities, reuse/recycle/sustainability requirements, commissioning and closeout submittals.

4.1.2 Project Programming Documents.

The Subcontractor shall provide a review of and update project programming documents for the office and laboratory space (provided separately) and shall be responsible for the incorporation of these documents into the RFP. The Subcontractor shall build upon the existing work and prepare project programming documents for functions/facilities to be located within the new laboratory space. The program requirements shall describe the functional requirements and needs of the project. This shall be worked in coordination with the proposed building occupants and NREL's Subject Matter Experts for the specific laboratories. A majority of this work has already been accomplished by NREL. The Subcontractor's task is to review the work accomplished to date and make recommendations for changes, if required, and incorporate these documents into the RFP.

The programming sections shall include, but are not limited to:

1. The GIS Laboratory
2. Manufacturing Laboratory
3. Highbay Main Laboratory and its control room
4. The VSHOT Highbay Laboratory
5. Power Electronics Laboratory
6. Loads Laboratory
7. Numerous outdoor and roof test areas
8. Data Processing Laboratory

9. PEC Lab, Fuels Laboratory
10. High Pressure Test Facility
11. Components Laboratory
12. Hydrogen Production Laboratory
13. Fuel Cell Laboratory
14. Machine Shop
15. Electrical Shop
16. Metrology Laboratory
17. Energy Storage Laboratory
18. Energy Storage Laboratory
19. Hydrogen Storage Area
20. ZEB Sim Laboratory
21. Residential Buildings Area Laboratory
22. Thermal Storage Materials Laboratory
23. High Voltage/High Current Laboratory
24. Eight separate specialty spaces
25. Office space for 200 staff and associated support areas

The Subcontractor shall facilitate up to twenty-four hours of laboratory space programming workshops to verify the type of areas required and associated adjacency requirements for each identified area with the appropriate user group(s) at NREL. The Subcontractor shall provide documentation detailing the results of the workshops and incorporate them into the RFP.

The Subcontractor shall work with NREL to conduct interviews and programming sessions with the various user groups at NREL to gather their knowledge of similar facilities and use other means to gather relevant information needed for programming. The program shall verify desired functional and adjacent relationships. The Subcontractor shall verify the spatial adequacy and utilization rate.

4.1.3 Performance Criteria Development

The performance criteria development shall include the program requirements and the performance requirements.

The performance requirements shall be described in the specifications and shall include the owner's expectation for the performance of the facility and its component parts, building assemblies and materials. These specifications shall include design standards, codes, quality levels, performance criteria, and methods to substantiate that these requirements have been met. These specifications shall be written and organized in standard design-build industry format.

The Subcontractor shall complete the performance criteria for the ESIF in support of the planned design-build acquisition. Performance criteria development shall include the following as a minimum:

- A. Review of existing performance based requirements (owner expectations);
- B. Review of Existing Statement of Work (SOW);
- C. Review of existing NREL design and construction standards;
- D. Review of space programming documentation;
- E. Conduct Interviews/Workshops as required;
- F. Issue draft performance criteria;
- G. Review of draft performance criteria by NREL;
- H. Incorporate comments; and
- I. Issue final performance criteria.

4.1.4 Pre-RFP Discussion with the short-listed firms

NREL intends to have discussions with the short-listed firms prior to the issuance of the RFP. NREL intends to meet with all firms as a group to discuss performance requirements and obtain their expertise on key elements/mission critical aspects of the project. This discussion is intended to help assure all parties have a mutual understanding of the project and aid in the preparation of a comprehensive statement of work. Assistance shall be provided to NREL in the planning, execution and documentation of this meeting.

4.1.5 Risk Management Plan

Facilitate three Risk Management Plan meetings with NREL staff and complete a Risk Management Plan that serves to educate both NREL and the prospective Design-Builders of potential cost, quality, and schedule risk issues. A risk-scoring matrix shall be included in the report that lists the project's risk elements with a numerical assignment of the likelihood of occurrence (probability) and the associated impact.

4.2 Deliverable: Final RFP Package is due within 60 calendar days of subcontract award.

SECTION 5 – COMPETITION ASSISTANCE

5.1 REQUIREMENTS

Provide NREL with design-build support services during the competition for final selection.

By the time of award of this subcontract for design-build support services, NREL intends to have issued a Request for Qualifications (RFQ) to initiate the short listing process of potential design-builders. Assistance shall be provided to NREL for the RFP selection process.

5.1.1 Technical and Administrative Support for face-to-face meetings

NREL intends to schedule the RFP proposal date approximately ten to twelve weeks after the issue of the RFP to allow the offerors sufficient time to develop their concept design for the ESIF design-build solution. NREL also intends to have interactions with each of the offerors during the RFP preparation. It is envisioned to meet with the firms approximately 2 - 3 weeks after the RFP is issued and 2 weeks prior to the submittal date to assure that all parties have an understanding of the key elements/mission critical aspects of the project and to permit the offerors maximum opportunity to provide high quality proposals. The Subcontractor shall provide assistance to NREL in the interview process.

NREL intends to have oral presentations by the offerors at the end of the RFP submittal process. The Subcontractor shall provide assistance to NREL in support of the oral presentations.

5.1.2 Evaluation Support

NREL has plans to have the evaluation criteria and weighting completed by the time of this subcontract award. The Subcontractor shall provide assistance to NREL in the review and applicability of the criteria and weighting to the design-build selection process.

5.1.3 RFP Submittal Review/Selection Recommendation

The Subcontractor shall provide assistance to NREL by providing support to answer questions provided by the offerors and by reviewing the RFP submittals with the NREL evaluation team for completeness and providing recommendation of selection.

SECTION 6 – PROJECT IMPLEMENTATION ASSISTANCE

6.1 REQUIREMENTS

Following final award of the design-build subcontract, provide NREL with the following:

6.1.1 Subcontract Assistance

Provide assistance to NREL in the development of modifications to the design-build RSF subcontract. Provide support assistance in subcontract negotiation planning, risk assessment, and value engineering to NREL.

6.1.2 Compliance Auditing

Review all measurement results for compliance with design-build subcontract requirements, conduct substantiation and performance reviews, and provide documentation of deviations to NREL.

6.1.3 Award Fee/Incentives Assistance

Assist the NREL ESIF Project Manager in the administration of the incentive pool as initially described in Section 4 above.

- A. Assist the NREL ESIF Project Manager in the development of an award fee/incentive plan.
- B. Evaluate design-build Subcontractor performance self-assessment and consolidate input from the Award Fee Review Board at the end of each evaluation period.
- C. Present period findings and final evaluation recommendations for the 5 evaluation periods to Fee Determining Official.
- D. Assist NREL with providing written monthly feedback to design-build Subcontractor.

6.1.4 Project Document Development

A. Project Charter

Develop a project charter that defines the roles and responsibilities of the owner, owner's team, and the design-build team. Incorporate design-build teaming agreements into charter.

B. Quality Assurance Plan

Develop a project quality assurance (QA) plan consistent with the owners QA plan and performance criteria substantiation. Define the design-build team's QA and quality control (QC) responsibilities for the design, construction and commissioning phases of the project. Define the owner's role relative to reviews and inspections.

6.2 Deliverables

A. Provide the following deliverables:

No.	Description	Due Date
1.	Compliance Auditing deviation documentation	Provide initial/update with monthly report
2.	Award Fee findings	2 weeks after the end of each of the 5 award periods defined by the design-build Subcontractors key milestone schedule
3.	Project Charter	60 days after subcontract award
4.	Quality Assurance Plan	60 days after subcontract award

SECTION 7 – DESIGN ASSISTANCE

7.1 REQUIREMENTS

Act as NREL's owner representative during the design phase of the project.

7.1.1 Preliminary Design

Provide assistance to NREL in the management of the preliminary design effort. The design assistance shall include the following:

A. Regular on-going design review at the Design-Builder's offices.

Provide on-going review of the preliminary design. Provide review of systems, subsystem and components of the preliminary design as detailed in sketches, cut sheets, drawings, specifications, calculations, value engineering and cost benefit analysis.

B. Attendance at Bi-Weekly Meetings

Attend bi-weekly preliminary design meetings to be held at NREL's offices.

C. Monthly Design Status Report

Provide a monthly preliminary design status report. Include the following information:

- Narrative highlights of the month
- Summary of completed issues
- Status of drawings
- Percentage completion, overall and by discipline
- Open issues and assignments
- Budget status
- Schedule status
- Problems/Open issues

D. Review of Design-Builder's pay applications

Review all Design-Builder pay applications. Resolve differences with the Design-Builder and recommend payment.

E. 60% Review

Complete a review of the preliminary design at the 60% completion point. Document the results of the review with the owner's comment resolution sheet and coordinate with other owner comments. Track the comment resolution to completion and document the closure of the comment.

F. 95% Review

Complete a review of the preliminary design at the 95% completion point. Document the results of the review with the owner's comment resolution sheet and coordinate with other owner comments. Track the comment resolution to completion and document the closure of the comment.

G. Verification of Comment Review and Incorporation into the Design

Upon the submittal of the 100% preliminary design to the owner verify all comment resolution has been completed. Review the preliminary design package for completeness and recommend acceptance to owner.

H. Independent Cost Estimate

Complete an independent Title I cost estimate at the completion of preliminary design. Resolve any issues with the Design-Builder and recommend acceptance of cost estimate to owner.

I. Independent Schedule Review

Complete an independent schedule review for the project at the end of preliminary design. Resolve any issues with the Design-Builder and recommend acceptance of project schedule to owner.

7.1.2 Final Design

Provide assistance to NREL in the management of the final design effort. The design assistance shall include the following:

A. Regular on-going design review at design-build Subcontractor's offices

Provide on going review of the final design. Provide review of systems, subsystems, and components of the final design as detailed in sketches, cut sheets, drawings, specifications, calculations, value engineering, and cost benefit analysis.

B. Attendance at Bi-Weekly Meetings

Attend bi-weekly final design meetings to be held at NREL's office.

C. Monthly Design Status Report

Provide a monthly final design status report. Include the following information:

- Narrative highlights of the month
- Summary of completed issues
- Status of drawings
- Percentage completion, overall and by discipline
- Open issues and assignments
- Budget status
- Schedule status
- Problems/Open issues

D. Review of Design-Builder's pay applications

Review all Design-Builder pay applications. Assist NREL with resolving differences with the Design-Builder and recommend payment.

E. 60% Review

Complete a review of the final design at the 60% completion point. Document the results of the review with the owner's comment resolution sheet and coordinate with other owner comments. Track the comment resolution to completion and document the closure of the comment.

F. 95% Review

Complete a review of the final design at the 95% completion point. Document the results of the review with the owner's comment resolution sheet and coordinate with other owner comments. Track the comment resolution to completion and document the closure of the comment.

G. Verification of Comment Review and Incorporation into the Design

Upon the submittal of the 100% final design to the owner verify all comment resolution has been completed. Review the final design package for completeness and recommend acceptance to owner.

H. Independent Cost Estimate

Complete an independent Title II (detailed) cost estimate at the completion of final design. Resolve any issues with the design-build Subcontractor and recommend acceptance of cost estimate to owner.

I. Independent Schedule Review

Complete and independent schedule review for the project at the end of final design. Resolve any issues with the Design-Builder and recommend acceptance of the project schedule to owner.

7.2 Deliverables

A. Provide the following deliverables:

No.	Description	Due Date
1.	Monthly Design Status Report	Last working day of the month
2.	Preliminary Design 60% Review documentation	2 weeks after Design-Builder's submission to NREL
3.	Preliminary Design 95% Review documentation	2 weeks after Design-Builder's submission to NREL
4.	Preliminary Design 100% submittal review and acceptance	2 weeks after Design-Builder's submission to NREL
5.	Preliminary Design independent cost estimate	1 month after Design-Builder's 95% submission to NREL
6.	Preliminary Design independent schedule review	1 month after Design-Builder's 95% submission to NREL
7.	Final Design 60% Review documentation	2 weeks after Design-Builder's submission to NREL

8.	Final Design 95% Review documentation	2 weeks after Design-Builder's submission to NREL
9.	Final Design 100% submittal review and acceptance	2 weeks after Design-Builder's submission to NREL
10.	Final Design independent cost estimate	1 month after Design-Builder's 95% submission to NREL
11.	Final Design independent schedule review	1 month after Design-Builder's 95% submission to NREL

SECTION 8 – CONSTRUCTION ASSISTANCE

8.1 REQUIREMENTS

Act as NREL's owner representative during the construction phase of the project. Provide assistance to NREL in the management of the construction effort. The construction assistance shall include the following:

8.1.1. Construction field observation.

Inspect the work in-progress at the job-site as required. These inspections shall be in accordance with industry and building standards (i.e. prior to work being covered). Additional inspections shall be performed by the Subcontractor to ensure work is being performed in a professional manner. The Subcontractor shall become familiar with the progress and quality of the work and shall determine if the work is being performed in accordance with the subcontract documents. The Subcontractor shall endeavor to protect NREL against defects and deficiencies in the work. Prepare a weekly inspection report, which informs NREL of the progress and quality of work. This work will be in support of and coordinated by the NREL Construction Manager.

8.1.2 System readiness reviews and operational testing.

Attend and participate as needed in system readiness reviews and operational testing including monitoring and documenting results.

8.1.3 Meetings, submittals and document review.

Attend weekly construction coordination meeting. Review all requests for information and advise NREL of acceptability. Review all design corrections and advise NREL of acceptability. Review all lower-tiered Design-Builder's submittals, including shop drawings, product data and samples, and other Design-Builder's documents as required for the timely progress of construction. Advise NREL of acceptability of submittals. Coordinate with NREL submittal review. Review all supplemental documents and advise NREL of acceptability.

8.1.4 Invoice review.

Review of Design-Builder's invoices to ensure compliance with the subcontract terms and conditions and verification of actual progress.

8.1.5 Inspections and acceptance review.

Perform inspections of completed work. Prepare a punch list of outstanding items to complete. Coordinate with NREL's punch list. Verify completion and NREL acceptance of all punch list items. Prepare a Recommendation of Final Acceptance.

8.1.6 As-built drawings and changes.

Review and approval of Design-Builder's maintenance of record drawings to ensure proper identification of actual progress, field routed placements, and changes. Provide cost estimating as required for owner changes. Complete review of Record Drawings submittal from design-build Subcontractor. Resolve differences with Design-Builder. Recommend acceptance to NREL.

8.1.7 Complete a Monthly Project Status Report. Include the following information:

- Narrative highlights of the month
- Summary of completed issues
- Status of drawings
- Percentage completion, overall and by discipline
- Open issues and assignments
- Budget status
- Schedule status
- Problems/Open issues

8.2 Deliverables

A. Provide the following deliverables:

No.	Description	Due Date
1.	Construction Punch list	2 weeks after design-build Subcontractor request for punch list
2.	Recommendation of final acceptance	2 weeks after design-build Subcontractor has declared all punch list items complete
3.	Monthly Design Status Report	Last working day of the month

SECTION 9 – COMMISSIONING ASSISTANCE

9.1 REQUIREMENTS

9.1.1 Commissioning Overview

NREL is committed to commissioning this facility to ensure that all systems are complete and functioning properly upon occupancy and that facility staff has adequate system documentation and training. Commissioning consists of systematically documenting that specified components, systems, and interfaces are designed, installed and started up properly, and then functionally tested to verify and document proper operation through all modes and conditions. In addition, Owner-personnel training shall be verified and final project operations and maintenance (O&M) documents shall be reviewed for completeness and inclusion to a recommissioning manual.

9.1.2 Commissioning Process Summary

A. Commissioning Process During Design

The commissioning authority (CA), provided by the Subcontractor, works with the design-build team to develop a Design Phase Commissioning Plan. The design-build team performs the commissioning related tasks of documenting the design intent in addition to their normal functions. The CA shall review and enhance the Owner's preliminary project requirements developed during the programming phase.

The CA performs a focused review of design documents to meet design intent, User's requirements, and commissionability at 60% and 95% of Preliminary Design and 60% and 100% of Final Design. The design-build team develops commissioning specifications for the construction documents, with review and approval by the CA. The design-build team completes a Preliminary Design Commissioning Report, Final Design Commissioning Report, and a Construction Phase Commissioning Plan, all with review and approval by the CA.

The CA, along with the design-build team, shall perform all requirements and provide documentation necessary to satisfy the LEED™ Fundamental Commissioning prerequisite and Additional Commissioning credit tasks for the design phase.

B. Commissioning Process During Construction and Warranty

A scoping meeting is conducted by the CA where the commissioning process and Construction Phase Commissioning Plan is reviewed with the subcontractors, and the Plan is revised accordingly. The CA reviews submittals pertaining to equipment designated for commissioning to ensure all equipment meets Owner's project requirements. The design/team coordinates and the CA reviews and approves the development and verification of prefunctional

checklists, startup plans, and functional performance test procedures for specific equipment and systems.

In general, the checkout and performance verification proceeds from simple to complex; from component level to equipment to systems and intersystem levels; and with prefunctional checklists being completed before functional testing. The design-builder executes and documents the prefunctional checklists and performs startup and initial checkout. The design-build team documents that the checklists, startup procedures, and functional performance tests are completed according to the approved plans. The CA monitors and assures implementation according to the approved plans. This may include the CA witnessing startup and testing of selected equipment, sufficient to be confident that proper procedures are followed. Items of non-compliance related to installation, lack of proper start-up, or failure to pass a functional performance test, are corrected and retested at the design-builder's expense.

The CA reviews and coordinates the training provided by the design-builder and verifies that it is complete. The design-build team completes a Final Commissioning Report and recommissioning manual, reviewed and approved by the CA, upon building acceptance by the Owner. The CA monitors and assures implementation of seasonal testing and performance evaluation conducted by the design-build team during the Warranty Phase. The CA reviews and approves a Post-Warranty Commissioning Report completed by the design-build team at the close of the one-year Warranty Phase.

The CA, along with the design-build team, shall perform all requirements and provide documentation necessary to satisfy the LEED™ Fundamental Commissioning prerequisite and Additional Commissioning credit tasks for the construction phase. The CA shall also review, approve, monitor, and assure implementation of a measurement and verification (M&V) Plan by the design-build team to satisfy the LEED™ Measurement & Verification credit.

9.1.3 Scope of Work

A. Commissioning Authority Responsibilities

- The primary role of the CA is to review, comment, and approve the execution of a design review and testing plan, and to monitor and assure systems are functioning in accordance with the documented design intent and the subcontract documents.
- The CA is not responsible for design concept, design criteria, compliance with codes, design, or general construction scheduling, cost estimating, or management.
- The CA may assist with problem-solving or resolving non-conformance or deficiencies, but ultimately that responsibility resides with the design-build team.

- The design-build subcontractor will provide all tools or the use of tools to start, checkout and functionally test equipment and systems, except for specified testing with portable dataloggers, which shall be supplied and installed by the design-build team.
 - The CA shall be responsible for assuring the LEED™ requirements for the Fundamental Commissioning prerequisite and the Additional Commissioning credit are met.
 - The CA is not responsible for overseeing or managing the overall LEED™ application and documentation process.
1. Preliminary Design Phase (Schematic Design and Design Development or Title I)
 - a. Review, comment, approve, monitor, and assure the commissioning work during the Preliminary Design Phase.
 - b. Review and approve the Design Phase Commissioning Plan developed by the design-build team including the LEED™ commissioning requirements during design.
 - c. Review and enhance the Owner's preliminary project requirements that have already been developed during the Programming Phase. Assist design-build team members in developing their portions of the design intent and review their submissions.
 - d. Perform a focused design review at the end of Preliminary Design as described in Attachment 1 and include LEED commissioning requirements.
 - e. Review and approve the draft project-specific Construction Phase Commissioning Plan developed by the design-build team.
 - f. Complete a Preliminary Design Commissioning Report at the end of the Preliminary Design Phase.
 2. Final Design Phase (Construction Documents or Title II)
 - a. Review, comment, approve, monitor, and assure the commissioning work during the Final Design Phase.
 - b. Perform a focused review of the drawings and specifications when 60% and 95% complete, as described in Attachments 2 and 3.
 - c. Conduct coordination meeting with the Owner and design-build team to resolve issues identified during design review.
 - d. Assist and review the development of documentation for design intent, operating parameters, and full sequences of operation for inclusion in the construction documents.
 - e. Review and approve the draft Construction Phase Commissioning Plan updated and expanded by the design-build team. The Plan will include a section referencing the specifications as they apply to subcontractor responsibilities during commissioning.

- f. Review and approve the full commissioning specifications developed by the design-build team for all commissioned equipment and systems. The commissioning specification shall include:
 - Detailed description of the responsibilities of all parties included in the commissioning process;
 - Details of the commissioning process;
 - Reporting and documentation requirements, including formats;
 - Deficiency resolution;
 - Prefunctional checklist and startup requirements;
 - Functional performance testing process;
 - Specific functional performance test requirements, including test conditions; and
 - Acceptance criteria for each piece of equipment being commissioned.
 - g. Assure the approved commissioning specifications are included in the design-build construction specifications.
 - h. Along with the design-build team, perform all tasks and provide documentation necessary to satisfy the LEED™ Fundamental Commissioning prerequisite and Additional Commissioning credit.
 - i. Complete a Final Design Commissioning Report at the end of the Final Design Phase.
- 3 Construction and Acceptance Phase
- a. Monitor and assure the implementation of the commissioning activities in a logical, sequential and efficient manner using consistent protocols and forms, centralized documentation, clear and regular communications and consultations with all necessary parties, frequently updated timelines and schedules, and technical expertise.
 - b. Monitor the commissioning work of the design-build team and subcontractors and ensure that commissioning activities are identified in the master schedule.
 - c. Review and approve the Construction Phase Commissioning Plan revised by the design-build team that was previously developed during Final Design.
 - d. Plan and conduct a commissioning scoping meeting where the commissioning process and the Construction Phase Commissioning Plan are reviewed with the design/build team (at minimum including electrical, mechanical, controls, and plumbing).
 - e. Coordinate additional meetings as necessary during construction to plan, schedule, and review commissioning activities and to resolve issues.
 - f. Review and approve subcontractor submittals applicable to systems being commissioned for compliance with commissioning needs and the Owner's requirements, concurrent with the design-build reviews.

- g. Request, review, and approve additional information required to perform commissioning tasks, including O&M materials and subcontractor installation, start-up and checkout procedures.
- h. Review and approve the prefunctional tests and checklists refined and distributed by the design-build team.
- i. Before startup, review and approve the control sequences and interlocks and the detailed testing procedures.
- j. Review and approve an enhanced start-up and initial systems checkout plan developed by the design-build team with Subs.
- k. Perform site visits, as necessary, to observe component and system installations. Attend selected planning and job-site meetings to obtain information on construction progress. Review construction meeting minutes for revisions/substitutions relating to the commissioning process. Assist in resolving any discrepancies.
- l. Verify prefunctional tests and checklist completion by reviewing prefunctional checklist reports or by direct site observation.
- m. Verify systems startup by reviewing start-up reports and by selected site observation.
- n. Review and approve the functional performance test procedures for equipment and systems refined and distributed by the design-build team. Test procedures may include energy management control system trending, stand-alone datalogger monitoring or manual functional testing.
- o. Review and witness all or part of the functional performance test procedures, sufficient to be confident that proper procedures are followed. Review and approve the documentation of this testing and assure documentation is included in the recommissioning manual. Notify Owner's project manager of any deficiencies in results or procedures. Review retesting as necessary until satisfactory performance is achieved.
- p. Analyze any functional performance trend logs and monitoring data to verify performance.
- q. Continually maintain a master deficiency and resolution log and develop a separate testing record. Provide to the Owner and design-build CM written progress reports and test results with recommended actions.
- r. Review equipment warranties to ensure that the Owner's responsibilities are clearly defined.
- s. Verify the training of the Owner's operating personnel.
- t. Review and approve a recommissioning manual developed by the design-build team per LEED™ requirement for the Additional Commissioning credit.
- u. Review and approve the preparation of the O&M sections of the recommissioning manual.

- v. Along with the design-build team, perform all tasks and provide documentation necessary to satisfy the LEED™ Fundamental Commissioning prerequisite and Additional Commissioning credit for the Construction Phase.
 - w. Along with the design-build team, perform all tasks and provide documentation necessary to satisfy the LEED™ Measurement & Verification credit.
 - x. Complete a Final Commissioning Report at the end of the Construction Phase.
4. Warranty Period Phase
- a. Monitor and assure implementation of required seasonal or deferred testing and deficiency corrections; and review and approve the final testing documentation for the commissioning record in the recommissioning manual.
 - b. Return to the site at 10 months into the 12-month warranty period and review with facility staff the current building operation and the condition of outstanding issues related to the original and seasonal commissioning. Also, interview facility staff and identify problems or concerns they have with operating the building as originally intended. Make suggestions for improvements and for recording these changes in the recommissioning manual. Identify areas that may come under warranty or under the original construction subcontract. Assist facility staff in developing documents and requests for services to remedy outstanding problems.
 - c. Update a master deficiency and resolution log.
 - d. Along with the design-build team, perform all tasks and provide documentation necessary to satisfy the LEED™ Measurement & Verification credit.
 - e. Provide a Post-Warranty Commissioning Report.

B. Systems To Be Commissioned

The following systems, including all components and controls, shall be commissioned:

- Central building automation systems, including linkages to remote monitoring and control sites (this excludes any security-related control systems or interlocks).
- Energy and water submetering systems. Submetering shall include electricity consumption, demand and production; chilled and hot water energy; HVAC, lighting and plug loads; natural gas; and total, make-up, and service hot water consumption.

- Life safety systems. Verify that HVAC and lighting systems are interlocked and operate per code under emergency situations. HVAC and lighting includes any system that provides indoor air quality, comfort, and lighting. These may include air relief dampers, operable windows, and daylighting components.
- All equipment of the HVAC systems, including Test and Balance (TAB) procedures, ductwork testing and cleaning, and comfort performance. These systems may include three-way valves, pumps, sequences of operation and other interface with the central plant systems.
- Back-up power systems.
- Lighting control systems. These systems are likely to include daylighting and dimming features.
- Service Hot Water Systems. These systems may include solar hot water.
- Renewable Energy Systems. These systems may include photovoltaics.
- Electrical distribution including the efficiency and sizing of electrical transformers.
- Fire Suppression Systems, to meet Ordinary Hazard Group 2 Classification.
- Landscape irrigation and stormwater management.

C. Functional Performance Test Requirements

- The functional performance testing shall include operating the system and components through each of the written sequences of operation and other significant modes including startup, shutdown, unoccupied mode, manual mode, staging, miscellaneous alarms, power failure, security alarm when impacted, and interlocks with other systems or equipment. Sensors and actuators shall be calibrated during prefunctional checklist testing by the installing subcontractors and spot-checked by the commissioning authority during functional testing, sufficient to be confident that proper procedures are followed.
- Tests on respective HVAC equipment shall be executed during the heating, cooling, and swing seasons. However, some overriding of control values to simulate conditions may be allowed, if used judiciously. The central plant shall have its efficiency benchmarked for later use by operations staff. Functional testing shall be done using conventional manual methods, control system trend logs and read-outs, or stand-alone dataloggers, to provide a high level of confidence in proper system function, as deemed appropriate by the CA and the User.

- The functional performance testing process and any needed equipment shall be coordinated with the building's energy management control system and long-term monitoring objectives. Long-term continuous measurement and verification of performance shall be based on the *International Performance Measurement and Verification Protocol - Option B Methods by Technology* for the following:
 - Lighting systems and controls
 - Constant and variable motor loads
 - Variable frequency drive (VFD) operation
 - Chiller efficiency at variable loads (kW/ton)
 - Cooling load
 - Air and water economizer and heat recovery cycles
 - Air distribution static pressures and ventilation air volumes
 - Process energy systems and equipment specific to this project.

9.2 Deliverables

A. Design/Construction Phase

Provide the following deliverables.

No.	Description	Due Date
1.	95% Preliminary Design Commissioning Report	4 months after subcontract execution

The report shall include an executive summary, list of participants and roles, building description, overview of commissioning scope, and a general description of design verification methods. For each commissioned feature, the report should contain the evaluation of the CA regarding the adequacy of the design in meeting the design intent, User's requirements and subcontract documents based on reviewing the 95% Preliminary Design submittal. All outstanding non-compliance items shall be specifically listed. Recommendations for improvement, future actions, and commissioning process changes shall also be listed. Appendices shall contain meeting minutes, progress reports, deficiency lists, findings, unresolved issues, and communication records.

No.	Description	Due Date
2.	Final Design Commissioning Report	8 months after subcontract execution

The report shall include an executive summary, list of participants and roles, building description, overview of commissioning scope, and a general description of design verification methods. For each commissioned feature, the report should contain the evaluation of the CA regarding the adequacy of the design in meeting the design intent, Owner’s requirements and subcontract documents based on the 100% Final Design submittal. Recommendations for improvement, future actions, and commissioning process changes shall also be listed. Appendices shall contain meeting minutes, progress reports, issues log, deficiency lists, design review findings, and communication records.

No.	Description	Due Date
3.	Final Commissioning Report	At final acceptance of the building

The report shall include an executive summary, list of participants and roles, building description, overview of commissioning and testing scope and a general description of testing and verification methods. For each piece of commissioned equipment, the report should contain the evaluation of the CA regarding the adequacy of the equipment, documentation and training meeting the subcontract documents in the following areas:

- 1) Equipment meeting the specifications,
- 2) Equipment installation,
- 3) Functional performance and efficiency,
- 4) Equipment documentation and design intent, and
- 5) Operator training.

All outstanding non-compliance items shall be specifically listed. Recommendations for improvement to equipment or operations, future actions, and commissioning process changes shall also be listed. Each non-compliance issue shall be referenced to the specific functional test, inspection, or trend log where the deficiency is documented. The functional performance and efficiency section for each piece of equipment shall include a brief description of the verification method used (manual testing, BAS trend logs, data loggers, etc.) and include observations and conclusions from the testing.

Appendices shall contain acquired sequence documentation, logs, meeting minutes, progress reports, deficiency lists, site visit reports, findings, unresolved issues, and communication records. Prefunctional checklists and functional tests (along with blank forms for future use by the operators) and monitoring data and analysis will be provided in a separate labeled binder as part of the recommissioning manual.

B. Warranty Phase

Provide the following deliverables.

No.	Description	Due Date
1.	Post-Warranty Commissioning Report	1 year after execution of this subcontract phase

The report shall include an executive summary, list of participants and roles, building description, overview of commissioning and testing scope and a general description of testing and verification methods applied during the warranty period. For each piece of commissioned equipment, the report should contain the evaluation of the CA regarding the adequacy of the equipment, documentation and training meeting the subcontract documents in the following areas:

- 1) Equipment meeting the specifications,
- 2) Equipment installation,
- 3) Functional performance and efficiency,
- 4) Equipment documentation and design intent, and
- 5) Operator training.

All outstanding non-compliance items shall be specifically listed.

Recommendations for improvement to equipment or operations, future actions, and recommissioning shall also be listed. Each non-compliance issue shall be referenced to the specific functional test, inspection, or trend log where the deficiency is documented. The functional performance and efficiency section for each system shall include a brief description of the verification method used (manual testing, BAS trend logs, data loggers, etc.) and include observations and conclusions from the testing.

Appendices shall contain acquired sequence documentation, logs, meeting minutes, progress reports, deficiency lists, site visit reports, findings, unresolved issues, and communication records. Functional tests and monitoring data and analysis will be provided in a separate labeled binder.

Attachment 1

FOCUSED PRELIMINARY DESIGN REVIEW ELEMENTS

The following areas shall be reviewed by the commissioning authority in the Preliminary Design submittal.

Design Area	Review Description
____ <i>Commissioning facilitation</i>	Input regarding making the building easier to commission (see Attachment 3).
____ <i>Energy Efficiency</i>	General efficiency of building shell, building layout, HVAC system types, lighting system type, etc..
____ <i>Operations and Maintenance (O&M)</i>	How building O&M and recommissioning can be made easier (accessibility and system control, etc.).
____ <i>Indoor Environmental Quality (IEQ)</i>	How thermal, visual, acoustical comfort and air quality can be enhanced (see Attachment 4 for IAQ).
____ <i>Functionality for Tenants</i>	How the design can be changed to improve functionality for the occupants.

Attachment 2

FOCUSED 60% AND 95% DESIGN REVIEW ELEMENTS

The commissioning authority shall perform a review at the 60% and 95% of Final Design completion stages comprised of the following areas:

Design Area	Review Description
___ <i>Commissioning facilitation</i>	Input regarding making the building easier to commission (see Attachment 3).
___ <i>Component energy efficiency</i>	Review for adequacy of the efficiency of bldg. shell components, HVAC systems and lighting systems.
___ <i>Control system & control strategies</i>	Review HVAC, lighting, fire control, emergency power, security control system, strategies and sequences of operation for adequacy and efficiency.
___ <i>Indoor environmental quality</i>	Review to ensure that systems relating to thermal, acoustical, air quality comfort, and air distribution are in accordance with the design intent (see Attachment 4 for IAQ).
___ <i>Functionality for occupants</i>	Review to ensure that the design meets the functionality needs of the occupants.
___ <i>Operations and maintenance</i>	Review for effects of specified systems and layout toward facilitating O&M and recommissioning (equipment accessibility, system control, etc.).
___ <i>O&M documentation</i>	Verify that the building O&M plan and documentation requirements specified are adequate and can be included in the recommissioning manual.
___ <i>Training</i>	Verify that operator training requirements specified are adequate.
___ <i>Commissioning specifications</i>	Verify that bid documents adequately specify building commissioning and that there are adequate monitoring and control points specified to facilitate commissioning, O&M, and recommissioning (trending capabilities, test ports, control points, gages and thermometers).
___ <i>User's design guide or standard</i>	Verify that the design complies with the User's own design standard or guideline.

Attachment 3

COMMISSIONING FACILITATION REVIEW

One of the primary tasks for the commissioning authority is reviewing the design documents to facilitate commissioning during construction. The Construction Phase commissioning process can be made easier and more effective if certain features are included in the design. Below is a list of some of these features. The review is not expected to be limited to only those issues listed below.

- Clear and rigorous design documentation, including detailed and complete sequences of operation.
- An HVAC fire and emergency power response matrix listing all equipment and components (air handlers, dampers, valves, etc.) with their status and action during a fire alarm and under emergency power.
- Access for reading gages, entering doors and panels, observing and replacing filters, coils, etc.
- Pressure gages, thermometers and flow meters in strategic areas to facilitate verifying system performance, O&M and recommissioning.
- Required isolation valves, dampers, interlocks, piping, etc. to allow for manual overrides, simulating failures, seasons and other testing conditions.
- Pressure and temperature (P/T) plugs close to controlling sensors for verifying their calibration.
- Pressure and temperature (P/T) plugs at less critical areas or on smaller equipment where gages and thermometers would be over-kill.
- Specification of the location and criteria for the VAV duct static pressure sensor and chilled water differential pressure sensor.
- Uniform inlet connection requirements to VAV terminal boxes.
- Specification of the entire VAV supply and exhaust system for the laboratory area.
- Adequate balancing valves, flow metering and control stations and control system functions to facilitate and verify reliable test and balance.
- Specification of the lighting control system including fixture type and layout, circuit grouping, and occupancy-based controls.
- Sufficient monitoring points in the building automation system (BAS), even beyond that necessary to control the systems, to facilitate performance verification and recommissioning.
- Adequate trending and reporting features in the BAS.
- Clear and complete commissioning specifications for the Construction Phase.
- Complete O&M and recommissioning documentation requirements in the specifications.
- Complete training requirements in the specifications.
- Review entire document and building information management plan from design through construction and turnover to ensure adequacy and compliance with the User's program.

Attachment 4

COMMISSIONING FOR INDOOR AIR QUALITY REVIEW CHECKLIST DESIGN PHASE

Preliminary and Final Design Phase

Document the results from each of the following tasks:

1. Review indoor air quality requirements in accordance with the initial design intent of the User's needs, codes, and standards: *ASHRAE Standard 62-1999, Ventilation for Acceptable Air Quality* and *Standard 55-1992 Thermal Environmental Conditions for Human Occupancy*.
2. Review that the indoor air quality objectives established in the Programming Phase are included in the design and are well documented in the design intent.
3. Establish the outdoor air intake requirements and location for each area of the building.
4. Establish procedures for verifying and documenting ventilation rates in each area.
5. Review how adequate ventilation rates will be maintained during all occupied modes of operations, particularly during VAV terminal box turn-down.
6. Review air intakes and exhausts for short-circuiting.
7. Review exterior pollution sources such as garages, loading docks, and cooling towers.
8. Review the impact of the office partitions configurations with respect to ventilation effectiveness.
9. Review choice of filtration type and design, materials, and location.
10. Review HVAC material specifications and application regarding potential for airflow erosion, corrosion and microbial contamination (HVAC insulation materials, etc.).
11. Review air supply system components to ensure control and minimization of the presence of free water and to minimize microbial contamination (condensate trays, humidifiers, water baffles, mist eliminators and cooling towers).
12. Verify the suitability of access doors and inspection ports to all chambers and components of air handling system plenums. Verify that proper cleaning of both sides of coils, condensate pans and/or humidifier reservoirs can be accomplished through the doors.
13. Verify that the specifications specify proper methods and conditions for operating the HVAC system prior to full control and occupancy, to minimize dirt and unwanted moisture entering the ductwork, coils, building cavities and any occupied portions of the building.

END OF STATEMENT OF WORK