



Massachusetts School Building Authority

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COMMISSIONING REQUIREMENTS FOR GREEN REPAIR PROJECTS May 2, 2011

Please be advised that the MSBA intends to engage Commissioning Consultants for all Green Repair projects unless otherwise notified. We will make every effort to engage the Commissioning Consultant during the design process so that any Contractor tasks and associated costs in connection with the commissioning process can be included in the bidding documents. However, due to the high volume of project activity and the fast-track nature of the Green Repair project schedules, the Commissioning Consultant may not be engaged until later in the project schedule.

Commissioning and functional performance testing are not intended to replace the Designers' responsibilities to specify manufacturers' testing requirements or performance specifications normally included in the contract documents and/or required to maintain warranties. Under normal circumstances, the assigned Commissioning Consultant will provide the Design Team with the commissioning requirements, including appropriate provisions to be included in the bidding documents. If, however, a project proceeds to bidding prior to the assignment of a Commissioning Consultant, Designers must be certain that the bidding documents contain language that puts the Contractor on notice that systems will be commissioned and that they are required to participate in commissioning activities and, in some cases (particularly on window replacement projects), include the actual testing in their scope of work. In general, testing will include the following:

- **Roofing Replacement:** Infrared (thermal) scans shall be performed of the completed roofing systems. The infrared scans will be performed by the Commissioning Consultant.
- **Window and Door Replacement:** Water penetration testing of representative areas as determined by the Commissioning Consultant in accordance with ASTM E1105 or equivalent procedure. Project specifications should indicate that the installing contractor is responsible for performing the tests, including all required set-up and removal. Testing shall be witnessed by the Commissioning Consultant.
- **Boiler Replacement:** Boiler functional performance tests in accordance with PECEI Functional Test Procedure #96 (Heating Water System Functional Test) or equivalent procedure. This procedure requires the installing contractor to operate the installed equipment under various sequences and conditions. Testing shall be witnessed by the Commissioning Consultant.

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In addition, Designers need to be certain that bidding documents also include language requiring the bidders to:

1. Include any costs for commissioning process activities in the contract price.
2. Include commissioning process requirements and activities in all subcontracts or equipment purchases.
3. Ensure the cooperation and participation of all subcontractors and manufacturers of equipment or systems to be commissioned.
4. Attend commissioning team meetings.

For your information, attached please find the MSBA “Standard Scope of Commissioning Services for Green Repair Projects” issued to the Commissioning Consultant with each commissioning work order.

MASSACHUSETTS SCHOOL BUILDING AUTHORITY

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ATTACHMENT A-2

**STANDARD SCOPE OF COMMISSIONING SERVICES FOR
GREEN REPAIR PROJECTS**

December 16, 2010

A. General

The intent of this Standard Scope of Commissioning Services for Green Repair Projects document is to identify the services that generally will be required for each project. The MSBA will issue an individual Work Order for each project, and each Work Order will set forth the project-specific scope of commissioning services. A Work Order may not include some of the project phases and commissioning services described in this document, and/or it may include additional services that are not included as part of this document.

- 1) In performing the scope of work and work tasks required by a Work Order, Contractor shall consider the following:
 - a. Acceptable industry standards, including, but not limited to, those developed by the American Society of Testing and Materials (ASTM), Factory Mutual (FM), Underwriters Laboratories Inc. (UL), American National Standards Institute (ANSI), American Society of Heating, Air Conditioning and Refrigeration Engineers (ASHRAE), National Roofing Contractors Association (NRCA), Building Commissioning Association (BCA), The Green Building Council (LEED), and the Collaboration for High Performance Schools (CHPS).
 - b. Contractor's knowledge and expertise. Contractor may propose means and methods that are applied to commissioning and have been previously developed and successfully used by Contractor.
 - c. This Standard Scope of Commissioning Services for Green Repair Projects.
- 2) Contractor shall communicate and coordinate all activities with the Owner's Project Manager (OPM), Designer, and/or other authorized representative of the Owner for the Project.

B. Commissioning Activities: Commissioning activities for individual projects shall be as listed in the Work Order and may include one or more of the following integrated building systems:

- 1) Windows and doors and all materials and components forming a part of these systems including, but not limited to, windows, doors, louvers, vents, grilles and their connections to new or existing construction.
- 2) Roofing systems and all materials and components forming a part of these systems including parapets and roof openings (e.g., skylights, pipe chases, ducts, penetrations), and interfaces with accessory systems as may occur, including, but not limited to, drains, lightning protection, electrical equipment, signage, and antennas.
- 3) Boiler systems and all materials and components forming a part of these systems including, but not limited to, boilers burners, pumps, drives, fans, feed units, tanks, fuel storage and handling systems, piping, controls, and energy management systems.

C. Project Phases: Commissioning activities for individual projects are anticipated to be provided starting from the Construction Documents Phase and continue through bidding, construction, close-out and building occupancy or as otherwise indicated in the Work Order. The project phases described below are not intended to limit services but to allow the MSBA to develop scopes of work within Work Orders that meet the needs for commissioning services for each project.

1) Construction Documents Phase

- a. During the Construction Documents phase of the Project, commissioning services may include, but not be limited to those listed below and all other services required for projects of the type and scope of this project and customarily performed by commissioning consultants during design phases.
- b. Contractor shall participate in design review meetings on an as-needed basis, which meetings shall be coordinated by the OPM or Owner's Representative.
- c. Contractor shall review and provide input on the development of the design documentation including design intent and basis of design.
- d. Contractor shall perform a thorough review of all drawings and specifications at the 60% complete Construction Documents phase, and shall review and comment on their completeness, coordination among design disciplines, and adherence to the original design intent, performance standards and any applicable regulatory requirements. Such review shall include each of the following issues:
 - i. Assess the design intent and basis of design prepared by the Owner and the Design Team and comment on their clarity, completeness and whether the documents meet the design intent.
 - ii. Review and provide input as to how to facilitate effective commissioning.
 - iii. Review for adequacy of the energy efficiency of system types and components.
 - iv. Review envelope design and assemblies for thermal and water integrity, moisture vapor control and assembly life.
 - v. Review commissioned systems layout and their impact on other systems and the facility as a whole toward facilitating operations and maintenance.
 - vi. Review and report on building materials and waste management and their respective possible impact on the environment and their compliance with the design intent.
 - vii. Review the bid documents and comment on the adequacy of building commissioning specifications including testing requirements.
 - viii. Review the Construction Documents, including the drawings and specifications prepared for each subcontractor, to assess their completeness and coordination among the various disciplines, to assess provisions for construction sequencing, materials and equipment delivery and storage, site and building access.
 - ix. Contractor shall develop a record of issues and findings that require further attention (Issues Log). The Issues Log shall be updated regularly, including at the conclusion of each review, and regularly shared with the MSBA, OPM or Owner's Representative, Design Team and Construction Manager/General Contractor (CM/GC) for discussion and resolution.
- e. Contractor shall develop commissioning specifications (the "Cx Specifications") for inclusion in the Construction Documents. Schedule for completion of the Cx Specifications shall be commensurate with the overall Project schedule. The Cx Specifications shall, at a minimum, define the commissioning requirements for each specification section, for a special commissioning specification division, and for each of the systems and equipment to be commissioned as identified in the Work Order, and shall be coordinated for format and content with the project manual developed by the Design Team. The Cx Specifications shall include, but shall not be limited to, requirements for commissioning submittals, startup and checkout test plans, functional test development support, pre-functional checklists and functional test execution, as-built drawings and coordination among subtrades.
- f. Prior to the Project being put out to bid, Contractor shall develop the Commissioning Plan (the "Cx Plan"), including all documentation identifying and describing all required functional performance tests and defining clear procedures for the commissioning process. The Cx Plan shall be provided to the Design Team and the OPM or Owner's Representative for review, approval and incorporation into the Construction Documents. At a minimum, the Cx Plan shall include the following:
 - i. General Building Information. A brief description of the building's location, size and type

of use;

- ii. Commissioning Team Information. A list of the Contractor's commissioning team members, and their contact information along with contact information of those members of the commissioning team that represent the OPM, Design Team, CM/GC and the Owner;
- iii. Commissioning Task Matrix. A matrix or narrative describing major commissioning activities and the commissioning team member(s) designated to lead and assist with fulfilling those objectives;
- iv. Commissioning Scope of Work. Detailed description of all systems scheduled for commissioning, including the nature of the testing to be performed for each piece of equipment, for each sub-system and for each system.
- v. Deliverables: Clearly define the deliverables to be produced from the commissioning process and the deadlines for such deliverables, and identify parties responsible for producing them. Deliverables shall include, but not be limited to, schedules, test plans, test reports, training plans and final report. Identify required format for deliverables and include sample documents as appropriate.
- vi. Schedule: Prepare a schedule of commissioning activities. The commissioning schedule shall be coordinated with the overall Project schedule as established by the OPM or the Owner.
- vii. Checkout, Startup & Pre-functional Testing: Define the processes and procedures to be used for the installation review and prefunctional testing process and required integration between these activities for each piece of equipment, sub-system and system.
- viii. Functional Performance Testing: Describe the functional performance testing process, including prerequisites and any special equipment or instrumentation needed to obtain necessary measurements during performance testing. Include requirements for deferred seasonal functional performance testing as appropriate.
- ix. Test Guidelines: Include requirements for review, approval and documentation practices and test acceptance criteria.
- x. Other commissioning-related correspondence, checklists, test forms, and documentation.
- xi. Prior to the Project being put out to bid, Contractor shall provide to the OPM or the owner's representative six (6) hard copies (at least one of which shall be reproducible) and one (1) electronic copy (DOC and PDF formats) on compact disk of the Commissioning Plan, specifications and graphic materials. Contractor shall provide one (1) hard copy and one (1) electronic copy of the above to the MSBA.

2) Bidding Phase

- a. During the Bidding Phase, Contractor shall provide the following services and all other services required for projects of the type and scope of this project and customarily performed by commissioning consultants during the bidding and negotiations phases.
- b. Contractor shall assist the Design Team and the OPM or Owner's representative in responding to requests from prospective bidders for information or clarification relating to commissioning.

3) Construction Phase

- a. During the Construction Phase, Contractor shall provide the following services and all other services required for projects of the type and scope of this project and customarily performed by commissioning consultants during the construction phase.
- b. Contractor shall coordinate the commissioning work with the CM/GC, OPM or Owner's Representative and the Design Team and assess whether the commissioning activities are properly accounted for in the master Project schedule.
- c. Contractor shall attend construction meetings at least once per month, or as frequently as necessary in the judgment of the OPM or Owner's Representative, to advise the project team on critical path milestone dates, including equipment delivery and installation, and other matters that impact commissioning and commissioning status.
- d. When systems to be commissioned are about to be installed and during the installation of such systems, Contractor shall track the progress and quality of the work being performed. To that end, Contractor shall visit the site at such intervals as are appropriate to the stage of construction; and whenever a significant amount of work in a specific trade discipline is being installed or constructed, Contractor shall bring to the site visits the specific members of Contractor's core team with expertise in such disciplines. Contractor shall advise the OPM or Owner's Representative on any issues related to these matters, and provide guidance to field representatives responsible for daily inspection of the Work. Contractor, however, shall not be required to make exhaustive or continuous on-site inspection to check the quality or quantity of the Work.
- e. Contractor shall prepare Pre-Functional Checklists and Functional Test Procedures for commissioned components and systems, and in the process shall:
 - i. Review CM/GC and subcontractor submittals applicable to systems being commissioned, concurrently with review by the Owner, OPM and Design Team to obtain component and system information and ensure compliance with commissioning needs and requirements; advise the OPM or Owner's Representative, CM/GC and Design Team of any deficiencies noted that may impact the commissioning execution or intended system performance; review the Design Team's submittal documentation and comments, and assist in resolving any discrepancies.
 - ii. Request and review additional manufacturers' or CM/GC's information as required to develop the test procedures, including operations and maintenance materials, contractor start-up plans and component test procedures. Contractor shall request and review all Requests for Information (RFI), change directives and construction contract Change Orders (CO) for any changes that would affect the systems to be commissioned.
 - iii. The functional performance test procedures shall be developed from shop drawings and submittals submitted by the construction contractor and approved by the designer.
 - iv. Submit completed pre-functional checklists and functional performance test procedures and distribute to the OPM or Owner's Representative, CM/GC, Design Team, and equipment vendors for review as required and to assure understanding prior to execution.
- f. Contractor shall review and comment on the CM/GC's systems equipment and component test procedures and shall coordinate these plans and procedures with the OPM or Owner's Representative and Design Team and through the OPM or Owner's Representative, shall facilitate CM/GC compliance with the requirements of the Cx Plan and Construction Documents.
- g. Through review of startup reports and selected site observations, the Contractor shall report on each commissioned system's readiness for testing.

4) Acceptance Phase

- a. During the Acceptance Phase, Contractor shall provide those services listed below and all other services required for projects of the type and scope of this project and customarily performed by commissioning consultants during the Acceptance Phase.
- b. Contractor shall plan, organize, schedule and coordinate all commissioning and other work activities including pre-functional testing and functional performance testing during this phase of the Project, shall coordinate such activities with the OPM or Owner's Representative and the CM/GC, and shall lead all commissioning team meetings.
- c. Contractor shall update and revise the Cx Plan and related documentation as necessary during the commissioning process.
- d. Contractor shall review pre-functional checklist execution by site observation and spot checks, shall review all completed pre-functional checklists, shall review the deficiency and resolution log, approved shop drawings, open RFI's and manufacturers' start-up sheets and comment on the readiness for functional performance testing.
- e. Contractor shall review the calibration status of sensors and actuators reported during pre-functional check by the installing contractors and shall spot check the same during functional testing.
- f. Working with the CM/GC, equipment vendors and appropriate subcontractors, Contractor shall execute, coordinate, witness and assess the functional performance tests for each sub-system and system as established by the Cx Plan, and shall coordinate retesting as necessary until satisfactory performance is achieved. Services shall include:
 - i. Coordination, witnessing and assessing performance tests of building envelope components.
 - ii. Monitor the performance of functional performance tests.
 - iii. Maintain a master deficiency and resolution log, which shall become part of the Issues Log, and a separate testing record, provide periodic, written progress reports to the MSBA, Owner, OPM, and the Design Team which include test results with recommended actions, coordinate resolution of any deficiencies with the CM/GC and appropriate subcontractors, and witness and document repeat testing, as necessary to indicate whether all deficiencies are corrected.
 - iv. Witness all tests of commissioned equipment and systems which the Owner may contract for or which may be performed by manufacturer's personnel over whom the Contractor may not have direct control, and document and include the test data and reports of such tests in the commissioning record and in the operations and maintenance manuals.
- g. Contractor shall review completed as-built drawings and records, including operation and maintenance manuals prepared by equipment manufacturers, fabricators or installers.
- h. Contractor shall participate in meetings and other Project activities relating to system start-up and after substantial completion shall participate in the review of the building operations.
- i. Contractor shall assess and report to the OPM or Owner's Representative and the MSBA whether all equipment and systems are working in conformance with the requirements of the Construction Documents, and shall make recommendations for modification or adjustment as necessary.

- j. Contractor shall review all warranties and provide a written report to the OPM or Owner's Representative Design Team, and MSBA upon the extent of compliance with the Construction Documents, and any recommended action in response to discrepancies observed.
- k. Contractor may be requested by the MSBA to provide on-going support to the OPM, the MSBA and the Owner during the first full year of operation on an as-needed basis as a reimbursable service.
- l. Contractor shall accompany the Owner, OPM and Design Team on a walk-through site visit upon completion of punch list by the CM/GC, review the deficiency and resolution log and report to the OPM or Owner's Representative on the installation completeness and functionality of all commissioned systems; and shall advise the OPM or Owner's Representative of any necessary corrections.
- m. Contractor shall provide the Owner, OPM and Design Team with prompt written notice if Contractor becomes aware of any fault or defect or noncompliance with the Construction Documents as they may affect the systems to be commissioned.

5) Project Closeout

- a. Contractor shall provide a Final Commissioning Report. The report shall include an executive summary, list of participants and the role of each participant, brief building and systems descriptions, an overview of the scope of commissioning and testing, and a general description of testing and verification methods.
 - i. The report shall address the adequacy of the equipment, documentation and training, in satisfying the requirements of the Contract Documents in each of the following areas:
 - Material/system specifications and design intent
 - Material /system installation
 - System functional performance and efficiency
 - Description of the verification method used and observations and conclusions from the testing
 - Non-compliance issues referenced to the specific functional test, inspection, and other records where the deficiency is documented
 - Material /system operations and maintenance
 - Record documentation
 - ii. All outstanding non-compliance items shall be specifically listed in the report, and recommendations for improvement to equipment or operations, future actions, commissioning process changes, and other appropriate matters shall also be listed.
 - iii. Appendices shall contain Issues Log, meeting minutes, progress reports, deficiency lists, site visit reports, findings, unresolved issues, communications, and all other relevant information.
 - iv. Pre-functional checklists and functional performance tests and monitoring data and analyses shall be provided in a separate labeled binder.

6) Post Commissioning

- a. Contractor shall, through the OPM or Owner's Representative, plan, organize, schedule and coordinate required seasonal or deferred testing and deficiency corrections.
- b. Contractor shall provide the final testing documentation for the commissioning record and operations and maintenance manuals.

END OF ATTACHMENT A-2