

MASSACHUSETTS SCHOOL BUILDING AUTHORITY

**40 BROAD STREET
BOSTON, MASSACHUSETTS 02109**

ATTACHMENT A-2

STANDARD SCOPE OF COMMISSIONING SERVICES FOR FULL BUILDING COMMISSIONING

July 2020

A. General

- 1) The intent of this Standard Scope of Commissioning Services document is to establish the standard scope of services that generally will be required for each commissioning 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.
- 2) 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 Heating, Air Conditioning and Refrigeration Engineers (ASHRAE), Building Commissioning Association, The United States Green Building Council (USGBC), and the Collaboration for High Performance Schools (CHPS). Unless otherwise stated in the Work Order, Full Building Commissioning shall meet the Enhanced Commissioning requirements of LEED and 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
- 3) Contractor shall communicate and coordinate all activities with the Owner's Project Manager (OPM) for the Project. The MSBA Commissioning Program Manager and the MSBA Project Manager assigned to the project shall be kept abreast of all commissioning issues as they arise and be included in the distribution of all commissioning documentation when distributed to any member of the project team. All commissioning project correspondence and reporting should be transmitted to the MSBA commissioning email inbox, commissioning@massschoolbuildings.org.

B. Categories of Service: The category of commissioning services shall be as indicated in the Work Order and may be for any of the following categories of service. The intent of the following descriptions of the categories of services is to provide a foundation whereby the MSBA can obtain needed services that are related to commissioning for projects whether new construction, renovations, upgrades, assessments to improve performance, meeting LEED or NE-CHPS requirements, or other. The descriptions 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) **Full Building Commissioning:** Commissioning activities for new construction or major addition and renovation projects may follow the project phases from the Design Development Phase through construction, acceptance and building occupancy and may include most or all of the building systems outlined in Paragraph C.
- 2) **Partial Building or Individual System(s) Commissioning:** Commissioning activities for repair and renovation projects may follow the project phases from the Design Development Phase through construction, acceptance and building occupancy and may include one or more of the building systems outlined in Paragraph C.

- 3) Other related assignments.

C. 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) Building thermal envelope and all materials and components forming a part of these systems including, but not limited to, walls, windows, doors, louvers, vents, grilles and sun-screens.
- 2) Roofing systems and all materials and components forming a part of these systems including parapets and roof openings (e.g., skylights, monitors, pipe chases, ducts, penetrations).
- 3) HVAC Systems: Heating, ventilation and air conditioning systems, and all mechanical equipment forming a part of these systems including, but not limited to, all boilers, chillers, direct expansion refrigeration equipment, fuel storage and handling systems, pumps, piping, air handler systems, terminal equipment, fans, exhaust systems, ventilation systems, variable frequency drives, heat recovery systems, thermal solar systems, and automated temperature controls and energy management systems.
- 4) Plumbing Systems and all equipment forming a part of these systems including, but not limited to, potable and non-potable water systems, water pressure booster systems, service water heating systems, sanitary waste and vent systems, grey water systems, laboratory waste and acid neutralization systems, storm water systems including rain water reclamation systems, natural gas systems, and compressed air systems.
- 5) Electrical Power Systems and all equipment forming a part of these systems including, but not limited to, electrical supply and distribution systems, emergency and standby power systems including automatic transfer switching systems, lighting and lighting control systems, low voltage systems, grounding and bonding systems, audio visual systems, photovoltaic systems, wind power systems and interfaces to automated temperature/building automation control systems.
- 6) Voice, Data, Video systems and all equipment forming a part of these systems including, but not limited to, cabling, switches, servers, routers and interfaces.
- 7) Life Safety Systems and all equipment forming a part of these systems including, but not limited to, security and surveillance systems, fire alarm systems, fire protection and suppression systems, fire pump systems, egress lighting, and egress pressurization.
- 8) Building Automation and Controls and all equipment forming a part of these systems including, but not limited to, the interface of these systems with HVAC systems, lighting, fire alarm and security systems.
- 9) Other building systems including, but not limited to, acoustic, Americans with Disabilities Act and Massachusetts Architectural Access Board compliance, NE-CHPS and LEED compliance.

D. Project Phases: Commissioning services for individual projects are anticipated to be provided starting from the Design Development Phase and continue through preparation of construction documents, 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 scope of work within Work Orders that meet the need for commissioning services for each project.

1) Design Development and Construction Documents Phases

- a. Contractor shall review and comment on the clarity and completeness of the Owner's Project Requirements (OPR) document developed by the Owner, OPM, and design team. Provide assistance as necessary to ensure a thoroughly developed document.
- b. Within thirty days of execution of a Work Order, Contractor shall prepare and submit to the OPM and the MSBA a Design Phase Commissioning Plan which shall include:

- i. General Building Information. A very 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. A detailed scope of work highlighting the systems that will be commissioned as indicated in the Work Order, and what commissioning tasks will need to occur over the design process. This section shall also cover the level of detail needed for the project's design documentation and the content of the commissioning specifications.
 - v. Commissioning Schedule. A preliminary commissioning schedule which is cross-referenced with the Project's schedule highlighting dates when key commissioning activities need to be completed.
 - vi. Commissioning Forms. A description of the forms to be completed for various phases of the commissioning process and where they are located or can be obtained.
 - vii. Systems Manual. Define the roles, responsibilities, and requirements of the OPM, Design Team, CM/GC and subcontractors in the compilation and preparation of the Systems Manual.
- C.** Contractor shall review and comment on the clarity and completeness of the Basis of Design (BOD) document developed by the design team.
- d.** Contractor shall perform a thorough review of all completed drawings and specifications in compliance with the following milestones:: 100% Design Development, 60% Construction Documents and 90% Construction Documents, and shall review and comment on the completeness, coordination among design disciplines, and adherence to the OPR. Such review shall include each of the following issues:
- i. Review and provide input as to how to facilitate effective commissioning (including sufficient accessibility, test ports, monitoring points and related features).
 - ii. Review for adequacy of the energy efficiency and adequacy of the effectiveness of building layout and efficiency of system types and components for building shell, HVAC systems and lighting systems.
 - iii. Review envelope design and assemblies for thermal and water integrity, moisture vapor control and assembly life.
 - iv. Review HVAC, lighting, fire control, emergency power, security control system, strategies and sequences of operation for adequacy and efficiency.
 - v. Review commissioned systems layout and their impact on other systems and the facility as a whole toward facilitating operations and maintenance (including equipment accessibility and system control).
 - vi. Review systems relating to thermal, visual, acoustical, air quality comfort, and air distribution and report on their compliance with the design intent.
 - vii. Review and report on building materials, landscaping, use of water resources, and waste management and their respective possible impact on the environment and their compliance with the design intent.
 - viii. Review and comment on the adequacy of the specified building operations and

- maintenance plan.
- ix.** Review and comment on the adequacy of specified operator training requirements.
 - x.** Review the bid documents and comment on the adequacy of building commissioning specifications including testing requirements by equipment type.
 - xi.** Review the mechanical concepts/design and recommend enhancements for operational or efficiency improvements.
 - xii.** Review the electrical concepts/systems and recommend enhancements for operational or efficiency improvements.
 - xiii.** 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, testing requirements, and training requirements.
 - xiv.** Review life cycle cost analysis of the mechanical systems relative to energy efficiency (as defined in M.G.L c.149, §44M), operations and maintenance, indoor air quality, functionality, and sustainability.
- e.** For each review milestone and within two weeks of receipt of documents, Contractor shall prepare a Design Review Report which shall include a list of documents reviewed by title and issue number or date as well as a record of issues and findings that require further attention (Issues Log). The Design Review Report and Issues Log shall be submitted to the MSBA, OPM, Design Team and Construction Manager/General Contractor (CM/GC) for discussion and resolution. Once acted upon by the appropriate party, each issue shall be back-checked by the Contractor who shall revise the Design Review Report and Issues Log to include the issue resolution and back-check results and re-issue the report to the MSBA, OPM, Design Team and Construction Manager/General Contractor (CM/GC). Prior to the Bidding Phase the Contractor shall provide a summary of all findings in the Issues Log which are not addressed by the OPM, Design Team, and Construction Manager/General Contractor. The summary shall be provided to the OPM, Design Team, Construction Manager/General Contractor and MSBA.
 - f.** Contractor shall participate in design review meetings on an as-needed basis, which meetings shall be coordinated by the OPM and be held no less frequently than monthly and more frequently as design reaches completion. Contractor shall notify MSBA, through the designated MSBA project manager, of the scheduling of all design review meetings. Contractor shall maintain minutes of meetings and provide to MSBA.
 - g.** Contractor shall, through the OPM, organize, coordinate, and conduct a controls integration meeting with the mechanical, electrical and systems control engineers who are part of the Design Team to discuss integration issues between equipment, systems and disciplines so that integration issues and responsibilities are clearly described in the construction specifications. Contractor shall keep MSBA informed, through the designated MSBA Project Manager, regarding the scheduling of the controls integration meeting and the results of the meeting as well as any required follow up or action items as well as the responsible party for each follow up item.
 - h.** 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.
 - i.** 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, training plan

development and execution, operations and maintenance manuals, as-built drawings and coordination among subtrades. The training plan shall identify required training for multipleshift schedules as well as seasonal training for facilities operations staff.

- ii. The Cx Specification shall specifically include specifications for the start-up protocols, including an identification of any and all equipment or instrumentation needed for measurements during pre-functional testing and functional performance testing, so that these requirements and any specialized equipment or instrumentation will be clearly delineated and provided for in the Construction Documents. These procedures shall also be included in the Design Team's pertinent bid specifications for relevant subcontractors.
- i. Building upon the responsibilities defined in the Design Phase Commissioning Plan and the Cx Specifications, and prior to bid, Contractor shall develop the Construction Phase 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 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.
 - vii. Checkout, Startup & Pre-functional Testing: Define the processes and procedures to be used for the installation review, startup 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. Training & Turnover: Identify training requirements, and responsibilities for development of the training plan and participation by the Commissioning Team members in the training process. The training program shall assure that the Owner's building operation personnel receive adequate training for the proper operation of the new facility systems. Define required O&M, as-built and commissioning deliverables and the deliverables turnover procedures, with references to the construction specifications as appropriate, to ensure that the school district receives all necessary documentation from the GC/CM. Define a procedure for the turn-over of all required tools, lubricants, spare parts and miscellaneous start-up consumables required to be provided by the CM/GC including requirements for documentation and acceptance. The project specific training plan to be developed by the Contractor for each assigned project shall include, but not be limited to the following:
 - (1) List of each item of equipment and individual system that requires training of District staff
 - (2) Minimum hours of training for each District shift, for each item identified in (1) above. Multiple District shifts will require multiple trainings to ensure District staff coverage.
 - (3) For equipment/systems which require training for different seasons, i.e. heating/cooling seasons, identify the minimum training hours per season
 - (4) Draft specification requirements for GC/CM submittal of the following:
 - i. Training plan and schedule
 - ii. Proposed trainer resumes and training syllabus for each equipment
- iii. (5) Draft specification requirements for professional filming of each training session. Training budget would be assigned to the GC/CM, with the intent that all filming would be conducted by a single entity.
- xi. Other commissioning-related correspondence, checklists, test forms, and documentation.
- xii. Upon OPM's receipt of 100% complete Construction Documents, Contractor shall provide to the OPM six (6) hard copies and one (1) electronic copy (DOC and PDF formats) on compact disk or flash drive 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. Contractor shall attend and participate in the pre-bid meeting(s) defining, to those in attendance, what is involved in the commissioning process, reviewing the sequence and schedule of the commissioning phase, and explaining its importance to the Project.
- b. Contractor shall assist the Design Team and the OPM in responding to requests from prospective bidders for information or clarification relating to commissioning.
- c. Upon request of the OPM, Contractor shall evaluate and provide input to the OPM and Design Team with respect to proposals received from Construction Managers, equipment suppliers, subcontractors or advisers providing equipment, materials or services in connection with the

Project.

3) Construction Phase

- a. Contractor shall coordinate the commissioning work with the CM/GC, OPM and the Design Team and assess whether the commissioning activities are properly accounted for in the master Project schedule.
- b. Contractor shall attend construction meetings at least once per month to advise the project team on critical path milestone dates, including equipment delivery and installation, and other matters that impact commissioning and commissioning status.
- c. When equipment to be commissioned is ready to be installed, and during the installation of such equipment, 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 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 on any issues related to these matters verbally before leaving the site and in writing within seven calendar days of the site visit. Contractor, however, shall not be required to make exhaustive or continuous on-site inspection to check the quality or quantity of the work.
- d. In addition to attending construction meetings, Contractor shall, through the OPM, plan and conduct periodic commissioning team meetings, which shall include, at a minimum, the OPM, CM/GC, sub-contractors responsible for the installation of systems to be commissioned, the Design Team, and the facility's operations personnel. These meetings should occur at least monthly during most of the Construction Phase and more frequently during the three months prior to the commencement of the Acceptance Phase. Contractor shall prepare commissioning meeting minutes and distribute them to the MSBA, the OPM and all attendees within seven calendar days of the meeting.
- e. Contractor shall prepare Pre-Functional Checklists and Functional Test Procedures for commissioned equipment and systems, and in the process shall:
 - i. Review CM/GC and subcontractor submittals applicable to equipment and systems being commissioned concurrently with review by the OPM and Design Team to obtain equipment and system information and verify compliance with commissioning needs and requirements; Prepare a list of any substituted products, manufacturers, and/or equipment that vary from the bid documents and advise the OPM, 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. Before startup, gather and review the approved control sequences of operation and interlocks, and work with the OPM, CM/GC, appropriate subcontractors and appropriate members of the design team until sufficient clarity has been obtained, in writing, to be able to write detailed functional performance test procedures.
 - iv. The functional performance test procedures shall be developed from industry performance testing standards and supplemented by information contained in approved shop drawings and submittals and shall include requirements for operating each system and its components through each of the written sequences of operation and

other significant modes and sequences, including startup, shutdown, unoccupied mode, manual mode, staging, miscellaneous alarms, power failure, security alarm when impacted and interlocks with other systems or equipment.

- v. Submit completed pre-functional checklists and functional performance test procedures and distribute to the OPM, 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 start-up plans and checkout plans, equipment and component test procedures, and shall coordinate these plans and procedures with the OPM and Design Team and through the OPM, shall facilitate CM/GC compliance with the requirements of the Cx Plan and Construction Documents.
- g. Contractor shall review the testing, adjusting and balancing (TAB) execution plan before TAB is executed, and shall monitor functional testing of the control system, and, through the OPM and Design Team, recommend and coordinate such retesting of the control system as may be necessary until, in the opinion of the Contractor, it's ready for use for TAB. In connection with the TAB, Contractor shall review air and water systems balancing by spot testing, by reviewing completed reports, and by selected site observation.
- h. Contractor shall review and comment on the Training Plan developed by the CM/GC. Review the plan for compliance with training requirements of the facility's operations staff and obtain documentation from the Owner attesting to the adequacy and acceptance of the Training Plan.

4) Acceptance Phase

- a. 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 and the CM/GC, and shall lead all commissioning team meetings.
- b. Contractor shall update and revise the Cx Plan and related documentation as necessary during the commissioning process.
- c. 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, balancing reports, approved shop drawings, open RFI's and manufacturers' start-up sheets and comment on the readiness for functional performance testing.
- d. 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.
- e. 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. Execution of tests on HVAC equipment during both the heating and cooling season. Tests shall be conducted with the systems utilizing permanent electrical power and, to the extent possible, under full load conditions, though, some overriding of control values to simulate conditions may be allowed, if used judiciously.
 - iii. Execution of tests using conventional methods, control system trend logs or stand-alone data loggers, to provide a high level of confidence in proper system function.

- iv. Analyze functional performance trend logs and monitoring data to assess performance.
 - v. 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 OPM, the Design Team and the MSBA 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.
 - vi. 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, review and comment on the accuracy of the test reports and the conformance of the test results with the Contract Documents, and document and include the test data and reports of such tests in the commissioning record and in the operations and maintenance manuals.
 - vii. Provide a written summary of each witnessed test. The written summary is to be provided to the OPM and MSBA within seven (7) days of the test date. The summary is to reflect the testing performed and results, attendees, and any required further actions and recommendations including retesting if necessary.
 - viii. Provide a monthly summary to MSBA during the Acceptance Phase of all tests witnessed during the reported month. The summary shall note tests completed successfully, as well as include any specific areas of concern regarding any equipment and/or systems performance. . Retest requirements should be specifically noted. Retest requirements should be specifically noted.
- f. Contractor shall coordinate and participate in the training of the facility's operations and maintenance staff in accordance with the requirements of the training plan, which shall include participation of appropriate systems and equipment vendors and contractors. Contractor shall provide documentation to the OPM and the MSBA that this has been satisfactorily completed. Contractor shall maintain a log of all completed training. The log shall include a summary of the training provided, date/time of the training, the name and company affiliation of the trainer, attendees, and any incomplete/unacceptable training based on Contractor observation and/or Owner feedback..
 - g. Contractor shall review completed as-built drawings and records, including operation and maintenance manuals prepared by equipment manufacturers, fabricators or installers. Contractor shall provide results of the records review and recommend approval or resubmittal of the records.
 - h. The Contractor, with the assistance of the OPM, Design Team and GC/CM shall develop a Systems Manual that provides the information needed to understand, operate, and maintain the building's systems and assemblies. Systems Manual shall be developed in accordance with the most up to date ASHRAE standard. The Systems Manual shall be developed as a system focused composite document that includes the operation manual, maintenance manual, and additional information of use to the Owner after they begin using the facility. The systems manual **shall be developed in addition to O&M manuals provided by the CM/GC** and focus on operation, rather than maintenance of the equipment, particularly interactions between equipment and systems.
 - i. 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.
 - j. Contractor shall assess and report to the OPM 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.

- k. Contractor shall review all equipment warranties and advise the MSBA, OPM, and Design Team of compliance with the Construction Documents.
- l. Contractor shall review all testing, adjusting and balancing with respect to each piece of equipment to be commissioned, for each system and combination of systems, and for the facility as a whole; shall assess the adequacy, accuracy and completeness of all final testing, adjusting, and balancing reports; and shall advise the OPM and MSBA of any necessary corrections.
- m. Contractor shall observe all environmental performance testing, and testing of environmental monitoring systems or tests by manufacturers' personnel over whom Contractor may not have direct control, shall review and comment on the accuracy of the test reports and the conformance of the test results with the Contract Documents, and all permits and other applicable requirements, and shall document and include the results of these tests in the Final Commissioning Report.
- n. Contractor shall monitor the continuing adjustment, optimization, and modification of all systems to assess whether they meet operating and performance requirements specified in the Contract Documents, and shall advise the OPM and the MSBA on a regular basis on the status of this process.
- o. Contractor shall coordinate with the OPM to review and recommend appropriate action with respect to the operator training program required by the CM/GC.
- p. Contractor shall comment on documentation provided by the CM/GC regarding the provision of all required tools, lubricants, spare parts and miscellaneous start-up consumables required to be provided by the CM/GC.
- q. 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.
- r. Contractor shall accompany the 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 on the installation completeness and functionality of all commissioned systems; and shall advise the OPM of any necessary corrections.
- s. Contractor shall provide the MSBA, 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. For each piece of commissioned equipment, 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:
 - Equipment/system specifications and design intent
 - Equipment/system installation
 - System functional performance and efficiency
 - Description of the verification method used (manual testing, trend logs, data

loggers, or other as appropriate) and observations and conclusions from the testing

- Non-compliance issues referenced to the specific functional test, inspection, trend log, and other records where the deficiency is documented
 - Equipment/system operations and maintenance
 - Record documentation
 - Operator and maintenance training
- 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 all acquired sequence documentation, 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.
 - v. Contractor shall provide an Addendum to the Final Commissioning Report confirming that any and all items having outstanding non-compliance are resolved.
- b. Prior to building turnover, train the Owner in the use of a cloud based computerized maintenance system (CMMS). The CMMS generates PM work orders for each piece of operating equipment based on elapsed time or running time for the equipment. The Contractor will not be responsible for data entry into the CMMS.

6) Building Occupancy

- a. Contractor shall, through the OPM, 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.
- c. Ten months from the recorded date of Substantial Completion, and following one complete heating and cooling season, Contractor shall return to the Project site and review with the OPM, and building operations and maintenance staff including the status of outstanding issues related to the original and seasonal commissioning, shall interview facility staff and identify problems and any concerns they may have with the operation and maintenance of the facility as originally intended, shall make suggestions for improvements and for recording any proposed changes in the operations and maintenance manuals, shall identify to the OPM and MSBA those issues whose correction may be covered by equipment and system warranties or by the original construction contract, and shall assist the MSBA, OPM and the facility staff in developing reports and documents and requests for services to remedy outstanding problems. Once deficiencies have been corrected, Contractor may be requested by the MSBA to provide oversight on any final testing required, and document the results in the Commissioning Record as a reimbursable service.
- d. Contractor shall execute a Commissioning Certificate of Completion certifying that functional performance tests for each sub-system and system as established by the Commissioning Plan have been executed and satisfactory performance has been achieved; provide an Addendum to the Final Commissioning Report, confirming that any and all items having outstanding non-compliance are resolved, to the MSBA documenting that all items listed on the Issues Log in the Final Report have been appropriately resolved ; the ten-month Post Occupancy site visit and Project review have been completed; and a Final Commissioning Report has been submitted to the MSBA and the Owner. Contractor shall not execute the Commissioning

Certificate of Completion until submitting to the MSBA the Addendum to the Final Commissioning Report confirming that any and all items having outstanding non-compliance have been resolved.

- e. Commissioning Support During First Year of Operation: Commissioning activities for the selected commissioning consultant shall be to assist the building owner with the development and implementation of commissioning support during the first year of building operation and is intended to ensure that fundamental building systems are calibrated and operating as required to deliver functional and efficient performance and to further support the operation of a project that meets the owner's project requirements for energy, water, indoor environmental quality, and durability. Perform first-year optimization of the building systems and develop a systems manual. First year optimization scope shall satisfy the qualifications of and perform in accordance with LEED v4/4.1 Monitoring-Based Commissioning or NE-CHPS v3.2 EE3.3 and shall include at a minimum:
- Monthly collection of building energy use and benchmark against predicted energy model developed during the design phase and average comparable school building in the Northeast
 - Assist the district with developing ENERGY STAR Portfolio Manager accounts for the schools and conducting an energy benchmarking exercise utilizing ENERGY STAR Portfolio Manager Target Finder
 - Quarterly review and analysis of operations trend data for select commissioned systems to verify continued proper systems operation
 - Quarterly review and analysis of space temperature and carbon dioxide trend data for a sampling of building spaces to verify satisfactory indoor environments
 - Quarterly meetings with school operations and maintenance staff to review findings from review and analysis of building energy use, commissioned systems and space trend data. These quarterly meetings may also be used to discuss any specific questions or concerns the operations and maintenance staff may have regarding the commissioned systems to help direct the commissioning consultant's efforts for subsequent review and analysis
 - The systems manual shall organize equipment information by system and incorporate information above and beyond a regular operations and maintenance manual including; Basis of Design, Testing, Adjusting, and Balancing reports, project specific operating considerations, functional performance tests
 - Enhance documentation of the operational and maintenance (O&M) requirements for the equipment and systems included
 - Document current baseline operating conditions through trending of performance measurements and document changes to setpoints specified
 - Optimize control systems through calibration of critical sensors, review metered data and trend logs, and functional equipment testing
 - Assist the Owner to identify and schedule all Preventative Maintenance requirements to ensure satisfactory operation and preserve the manufacturer's warranty for all equipment and building components. Prioritize and schedule tasks in accordance with Owner's staffing and budget. Identify O&M staff
 - Training (new employees) or retraining needs. Personnel "training" sessions coordinated between the CxA and the facilities designated individual
 - Prepare a report summarizing all findings including any observed operational deficiencies, trend results, controls findings
 - Assist the Owner in administering and researching Warranty Issues
 - Verify receipt of all as-builts, manuals and drawings and review and coordinate documents with the Owner for usability and function

END OF ATTACHMENT A-2