

Expression of Interest
BRAC Armed Forces Reserve Center
Commissioning Services
Requisition # DEFK11023

Statement of Qualifications

January 10, 2011

Sustainable Engineering Solutions, LLC
5 Forest Park Drive
Farmington, CT 06032
(860) 270-0413
www.Sustainable-Eng.com

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NAVY DIVISION
STATE OF WV



State of West Virginia
Department of Administration
Purchasing Division
2019 Washington Street East
Post Office Box 50130
Charleston, WV 25305-0130

Request for Quotation

RFQ NUMBER
DEFK11023

PAGE
2

ADDRESS CORRESPONDENCE TO ATTENTION OF
TARA LYLE 304-558-2544

RFQ COPY
TYPE NAME/ADDRESS HERE

DIV ENGINEERING & FACILITIES
ARMORY BOARD SECTION

1707 COONSKIN DRIVE
CHARLESTON, WV
25311-1099 304-341-6368

DATE PRINTED	TERMS OF SALE	SHIP VIA	F.O.B.	FREIGHT TERMS
12/03/2010				

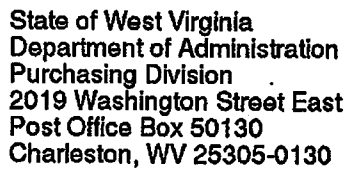
BID OPENING DATE: 01/12/2011 BID OPENING TIME 01:30PM

LINE	QUANTITY	UOP	CAT NO	ITEM NUMBER	UNIT PRICE	AMOUNT
<p>ADDENDUM(S) MAY BE CAUSE FOR REJECTION OF BIDS.</p> <p>VENDOR MUST CLEARLY UNDERSTAND THAT ANY VERBAL REPRESENTATION MADE OR ASSUMED TO BE MADE DURING ANY ORAL DISCUSSION HELD BETWEEN VENDOR'S REPRESENTATIVES AND ANY STATE PERSONNEL IS NOT BINDING. ONLY THE INFORMATION ISSUED IN WRITING AND ADDED TO THE SPECIFICATIONS BY AN OFFICIAL ADDENDUM IS BINDING.</p> <p><i>E. J. Lewis</i> SIGNATURE</p> <p>Sustianable Engineering Solutions, LLC. COMPANY</p> <p>1/10/11 DATE</p> <p>NOTE: THIS ADDENDUM ACKNOWLEDGEMENT SHOULD BE SUBMITTED WITH THE BID.</p> <p>REV. 09/21/2009 END OF ADDENDUM NO. 1</p>						
0001	1	JB		BOI		
3				RESERVE CTRS IN ELKINS, FAIRMONT AND SPENCER-RIPLEY		

SEE REVERSE SIDE FOR TERMS AND CONDITIONS

SIGNATURE	TELEPHONE	DATE
TITLE	FERN	ADDRESS CHANGES TO BE NOTED ABOVE

WHEN RESPONDING TO RFQ, INSERT NAME AND ADDRESS IN SPACE ABOVE LABELED 'VENDOR'



AFQ NUMBER
DEFK11023

PAGE
3

ADDRESS CORRESPONDENCE TO: ATTENTION OF
TARA LYLE
304-558-2544

TYPE NAME/ADDRESS HERE

**DIV ENGINEERING & FACILITIES
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LINE	QUANTITY	UOP	CAT NO	ITEM NUMBER	UNIT PRICE	AMOUNT
***** THIS IS THE END OF RFQ DEFK11023 ***** TOTAL: _____						

SEE REVERSE SIDE FOR TERMS AND CONDITIONS

SIGNATURE .		TELEPHONE	DATE
TITLE	FEIN	ADDRESS CHANGES TO BE NOTED ABOVE	

WHEN RESPONDING TO RFQ, INSERT NAME AND ADDRESS IN SPACE ABOVE LABELED 'VENDOR'



Sustainable Engineering Solutions, LLC

January 10, 2011

Ms. Tara Lyle, Senior Buyer
Purchasing Division
2019 Washington Street East
P.O. Box 50130
Charleston, WV 25305-0130

RE: Requisition # DEFK11023
Expression of Interest BRAC Armed Forces Reserve Centers Commissioning Services

Dear Ms. Lyle,

Attached is our Expression of Interest for the BRAC Armed Forces Reserve Centers Commissioning Services projects. Our proposal is based on the Request for Qualifications dated December 2, 2010 Requisition # DEFK11023.

With over 60 commissioning projects totaling over 7 million square feet; staff with extensive commissioning and sustainable design experience and Certified Commissioning Professionals through the Building Commissioning Association, we are well qualified to meet and exceed the expectations for this project.

We are very excited about the project and look forward to the opportunity to work with the State of West Virginia.

Should you have any questions or require any further information, please do not hesitate to contact our office.

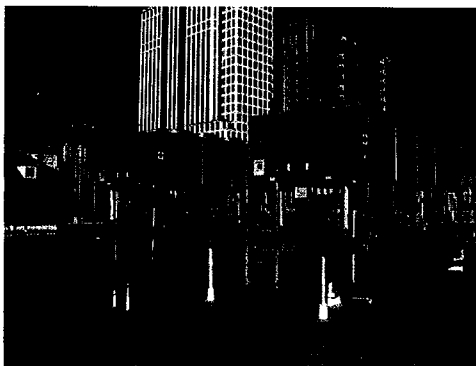
Sincerely,

Sustainable Engineering Solutions, LLC

Ernest F. Lawas, P.E., CCP, CEM, LEED AP
Principal

Firm Background

Sustainable Engineering Solutions, LLC (SES) was founded by professionals who understand the need for hands-on, practical engineering expertise. We have a foundation of diverse experience in commissioning, LEED® consulting, energy engineering and project management. Having commissioned over 60 projects, a total of over 7 million square feet of construction, we have extensive experience with HVAC systems and equipment including steam systems, hydronic systems, air handling systems, laboratory systems, electrical systems, plumbing systems and all major automatic temperature control systems. Our extensive experience also includes fire protection systems, fire alarm, security, lighting controls, fuel oil transfer, emergency generators and ATS gear, tel/data, and building envelope.



SES staff has provided commissioning services for clients in the academic, corporate, healthcare, research and destination sectors throughout the northeast and nationwide. Our staff has extensive experience in commissioning, energy engineering, design, and project management. This experience has been utilized on various projects including laboratories, correctional facilities, energy plants, hospital/healthcare, public and private educational facilities and office complexes. A list of all key personnel who will participate in the project, their roles, and experience has been included in the resume section of this proposal.

As a result of increased system complexities and accelerated construction schedules, standard design and construction delivery methods are no longer enough to assure that a completed building will operate optimally. Commissioning identifies and solves problems before they disrupt a successful project.

Company Contact

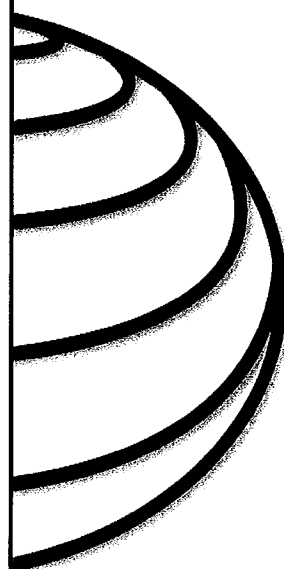
Ernest Lawas, PE, CCP, CEM, LEED AP - Principal
Sustainable Engineering Solutions, LLC.
5 Forest Park Drive
Farmington, CT 06032
Phone: (860) 270-0413 ext. 701
Fax: (860) 270-0413
Email: elawas@sustainable-eng.com



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Project Approach

ASHRAE Guideline 0, *The Commissioning Process*, defines commissioning as "a quality-oriented process for achieving, verifying, and documenting that the performance of facilities, systems, and assemblies meets defined objectives and criteria" and is the foundation of our services. In the case of building projects such as the Spencer-Ripley, Fairmont and Elkins AFRC projects, the objectives and criteria are set by the Owner. It is the responsibility of the Commissioning Authority (CxA) to ensure that the Owner's criteria and objectives are met by the design team and the installing contractors. Essentially, the commissioning process formalizes the review and integration of all project expectations during planning, design, construction, and occupancy phases by inspection, functional performance testing, oversight of operator training and record documentation.

As the CxA, Sustainable Engineering Solutions (SES) will supervise and oversee the commissioning process. This process is a systematic verification to determine that various systems operate as intended. In addition, we will develop and utilize functional test procedures to verify and document the performance of those systems being commissioned.

SES intends to conduct a scoping meeting with all parties. All commissioning team members will be present to review scope, schedule, and all future activities.

The first deliverable includes the development of the preliminary commissioning plan. The commissioning plan is an informational document that clarifies how the commissioning process shall proceed as well as defining the commissioning team's expectations for process performance and participation. This plan outlines the responsibilities of the CxA and the Owner, as well as what services will be required of the Design Team, General Contractor or Construction Manager, and their subcontractors to support the day-to-day operations. This document also describes the processes that will be used to carry out commissioning and includes project specific information such as schedules, contacts and checklists.

SES will review the Owner's Project Requirements (OPR) and the Basis of Design (BOD) documentation (if formally documented) for clarity and completeness and to ensure the BOD meets the design goals set forth by the Owner. This step leads to the design documents review (predicated on the current phase of the project) that will be performed to evaluate if the design is meeting the OPR and BOD. A back check of this review will be performed at the next subsequent design submission to verify that review comments have been appropriately addressed.

As the project enters the Construction Documents phase, the development of commissioning specifications and integration of the commissioning requirements into the project documents will occur. The specification outlines how the commissioning process shall proceed, the responsibilities of the CxA and the Owner, as well as what services will be required overall of the Design Team, Construction Manager, and their subcontractors to support the commissioning effort. Details on the reporting process, documentation



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requirements, alerts to coordination issues, deficiency resolution, startup requirements, including acceptance criteria, will be included in the specification. During the construction process, SES will also review select equipment submittals concurrently with the Design Team to confirm that commissioning requirements have been addressed.

Throughout the construction process and prior to the commencement of functional testing of the equipment, SES will be making regular site visits to observe the general construction process; specific equipment installation, e.g. piping pressure tests and duct leakage testing; and general progress of construction. These visits will occur at least monthly if not more frequently and will increase in frequency as systems near readiness for functional testing. Once the equipment and systems are deemed ready for functional testing and testing commences, SES staff will be on site on a regular basis as long as the equipment/systems and the contractors are available for testing.

Pre-functional checklists will be developed by the CxA prior to the construction phase and are to be completed as part of startup & initial checkout, preparatory to functional testing.

Our functional testing of equipment for these types of construction projects will start at the owner's discretion and will commence with the central systems and move outward to subordinate systems. As an example, in the case of HVAC systems, our functional testing approach starts with the hydronic systems, then the main air handlers, and then out to the terminal equipment. As we begin the testing of the main air handlers, we typically pick one air handler and completely finish the functional testing. We use this commissioned air handler as a model for the remaining air handlers. We then allow the Contractors to proceed to check all other air handlers in the same manner prior to resuming our commissioning. This gives the Contractors and Design Team a comfort level for our testing procedures and helps to streamline the remaining air handler testing. Concurrent with the HVAC functional testing, we anticipate system testing for the electrical, plumbing, fire/life safety, and other special systems and equipment. This can be accomplished through coordination with both the contractors and the commissioning team.

Our approach to any system deficiency is to correct it while on site and proceed to re-verify its operation. Our experience has proven that this proactive approach is well received by the designers and contractors. They understand that our goal is to have the building operate as intended. Our process has proven to not only reduce building turnover and future operational problems, but also reduce contractor "call-backs". This benefits the entire project team and helps eliminate any adversarial relationships and minimize time delays. If, during the testing process, system deficiencies cannot be readily rectified, SES will facilitate discussions with the Owner, Design Team and Construction Manager/General Contractor. Based on these discussions, the Owner will finalize how the Contractors will proceed in improving the systems to an acceptable standard.

During the functional testing of equipment, a deficiency notice is issued through the Owner every week for the systems tested to date.



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Predicated on the season in which the systems and equipment are ready for testing, deferred or seasonal testing would be performed. The intent is to verify the operation of the equipment in the in season for which it was designed to operate, e.g., heating systems in winter and vice versa. Any deficiencies identified at this time will be documented, corrective action performed by the responsible parties and verified by the CxA.

At the conclusion of functional testing, O&M manuals and documentation is reviewed by the CxA for thoroughness and completeness. Accuracy of this documentation is crucial for the O&M Staff to perform their duties.

Prior to any formal training, SES will develop a Systems Manual for the commissioned systems and equipment. This manual is meant to provide key knowledge of the design intent, performance parameters, system setpoints and a description of the final sequence of operations. This manual is reviewed with the O&M Staff in a formal classroom training session provided by the CxA and is meant to supplement the training provided by the installing contractors.

Our primary goal with all of our commissioning projects is to provide the Owner / Operators with a facility that operates as intended. Along with a functioning building, a necessity to any successful project is a trained operating staff that is knowledgeable in the operation of those building systems. We will verify proper classroom training with the facility staff. Their participation in the functional testing of equipment is also a key ingredient towards a successful transition from building construction to building operations.

As an additional service, SES suggests to include a Near End of Warranty Review (10 months into a 12 month warranty) to be performed. This review will capture and identify any issues that developed since occupancy of the building and are attributable to the design or construction process. Any issues will be documented and tracked by the CxA, for corrective action by responsible party.

At the conclusion of the project a Final Commissioning Report will be produced by the CxA and include acknowledgements, executive summary, building description, commissioning plan, lessons learned, and appendices containing the various record and other relevant documents for the commissioning process. A safe and healthy facility, improved energy performance and improved system documentation are all key goals and part of every quality commissioning effort with any new construction or renovation project.



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Additional Proposed Services

Additional services that SES can provide for these projects may include:

- Design documents review: If the project is in the design phase, SES can perform a quality based design review(s) on the design package of drawings and specifications for consistency with the OPR, BOD and general quality of the design.
- Warranty review: A review of the specified contractor provided warranties to confirm they are consistent with the owner's requirements.
- As-built documentation review: A review of the as-built or record drawings to confirm accuracy clarity.
- Recommissioning management plan: This document shall outline the steps required to recommissioning the project, the recommended frequency for recommissioning, instructions for recalibration of devices and frequency and blank functional performance test sheets direct and document the recommissioning test procedures.
- Construction Engineering and Inspection Services (CEI) for the review and acceptance of site civil work or other work as required.
- Provision of full-time or as needed experienced inspectors, construction engineers and project managers for the identified projects. The full-time project personnel advise the Owner and Design Team through all building phases. The full-time site personnel basic responsibilities may include overall construction administration; coordination of the efforts of design professionals or sub-consultants; liaison with affected utilities; monitoring construction schedules and contractor payments; providing testing and inspection services; reviewing claims and changes; and providing required administration of the construction contracts.



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Project Staffing

The Commissioning Agent for this project will be Mr. Walker Greeno, CxTS, LEED AP. He will be supported by Mr. Ernest Lawas, PE, CCP, CEM, LEED AP, Mr. Keith David, CCP, LEED AP, and Mr. Sean Hayes, LEED AP. Mr. Greeno has over 9 years of commissioning and engineering experience including, laboratory design, whole building commissioning and construction project management. Mr. Greeno is a Certified Commissioning Technical Process Support Provider through the University of Wisconsin and LEED® Accredited Professional with the United States Green Building Council. Mr. Greeno has been involved in numerous projects achieving LEED® Certification or higher levels of LEED®. The specific experience of Mr. Greeno, Mr. Lawas, Mr. David and Mr. Hayes is listed in their respective resumes included in the section *Project Team Key Personnel Resumes* in this proposal.

Each project staff member is fully knowledgeable in traditional test and balance procedures and has performed troubleshooting and diagnostic tasks using our own test and balance equipment. As commissioning providers with extensive field engineering experience each project staff member is highly experienced in the O&M practices for systems and equipment. This is developed through years of hands on experience. Additionally, each project staff member has provided LEED® Fundamental and Enhanced Commissioning Services for numerous projects.

In addition to years of commissioning experience, both Mr. Lawas, who is a Certified Energy Manager and Energy Auditor with the Association of Energy Engineers, and Mr. David, are highly knowledgeable in energy efficient equipment design, control methodology and optimization. This is from their extensive experience performing energy audits and studies for energy efficiency improvement projects and will be brought to bear where ever possible on this project. In addition to their energy engineering experience, Mr. Lawas and Mr. David are also very knowledgeable of life cycle costing, necessary to properly evaluate energy improvement opportunities in the energy studies they have performed or evaluated.



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Project Organization and Staffing

BRAC Armed Forces Reserve Center Projects State of West Virginia

Ernest Lawas, PE, CCP, CEM, LEED® AP

Principal-In-Charge

- Commissioning plan review
- OPR & BOD Review
- Commissioning Schedule
- Review commissioning record

Walker Greeno, CxTS, LEED® AP

Lead Commissioning Authority, Project Manager

- Commissioning plan and submittal review
- Functional test writing
- Controls Software Review
- Pre-functional Checklists
- TAB Review
- Functional Test Execution
- O&M Review and Owner Training
- Compilation of Commissioning Record
- Seasonal Testing
- Warranty Review
- Post Occupancy Review
- Final report development

Keith David, CCP, LEED® AP

Commissioning Specialist

- Installation Observations
- Functional Test Execution
- O&M Review
- Systems Manual Development
- Final report development

Sean Hayes, LEED® AP

Commissioning Specialist

- Installation Observations
- Functional Test Execution
- Systems Manual Development
- Seasonal Testing
- Post Occupancy Review



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Project Team Key Personnel Resumes

Ernest Lawas, PE, CCP, CEM, LEED® AP

Project role: Principal-in-Charge

Registered Engineer in the State of Connecticut
and Massachusetts

Certified Commissioning Provider

Certified Energy Manager

Certified Energy Auditor

LEED® Accredited Professional



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As Principal-in-Charge for the project, Mr. Lawas will oversee the OPR & BOD review, review formal submissions of the commissioning plan, design reviews, testing oversight and assist in coordinating the commissioning schedule and review the commissioning record.

Mr. Lawas has over 15 years of mechanical engineering, energy engineering and commissioning experience. With experience as a commissioning provider and construction project manager, he possesses firsthand knowledge of reducing energy consumption and cost via practical means. Mr. Lawas has many years of experience with electrical systems, steam systems, DDC control systems, HVAC systems, plumbing systems, diagnostics and troubleshooting, and operations and maintenance. As a Certified Commissioning Provider, Mr. Lawas has significant experience as Commissioning Authority on a wide range of projects including educational institutions, hospital and healthcare facilities and science buildings and laboratories. Mr. Lawas is a LEED® Accredited Professional and has been involved in numerous projects achieving LEED® Certification or higher levels of LEED®.



Selected Personal Commissioning Project Experience

Trumbull High School – Trumbull, CT

- Fundamental and enhanced LEED® commissioning services.
- Multi-story high school of approximately 360,000 square feet.
- All HVAC equipment including central heating and cooling plant, exhaust systems, emergency generator, emergency lighting, site lighting, fire protection system and fire alarm system

Deerfield Academy Fitness Center & Greer Store – Deerfield, MA

- Fundamental and enhanced commissioning services for this private academy's 26,000 square foot Fitness Center, store and café.
- Scope of work included all HVAC systems, remote chilled water plant, steam to hot water heating systems, air handling systems, terminal devices, general exhaust, emergency lighting, domestic hot water, fire alarm system, sight lighting controls, and automatic temperature controls system.

Education

Bachelor of Science, Mechanical Engineering – State University of NY at Binghamton

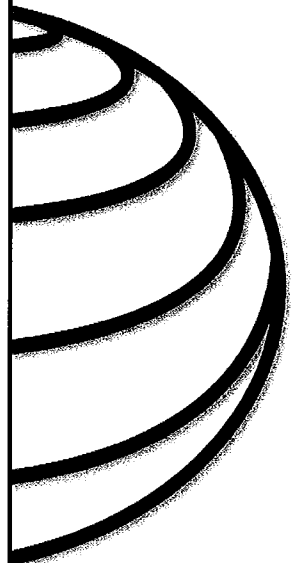
Professional Affiliations

Building Commissioning Association

ASHRAE

Association of Energy Engineers

United States Green Building Council



Walker Greeno, CxTS, LEED® AP

Project role: Project Manager, Lead Commissioning Authority

Commissioning Technical Process Support Provider
LEED® Accredited Professional



As the Lead Commissioning Authority and Project Manager, Mr. Greeno will be the single-point client contact who understands this project, responsible for development of the commissioning plan, commissioning specifications and functional test procedures; execution of the functional testing; publishing of field reports, writing the final commissioning report; reviewing the TAB final report, facilitating the owner training and O&M submission and performing the 10 month post occupancy review.

Mr. Greeno has over 9 years of commissioning and engineering experience including, laboratory design, whole building commissioning and construction project management. He has experience in the industry with a variety of clients ranging from schools, higher educational institutions, hospital and health care facilities, and laboratories. Mr. Greeno is a Certified Commissioning Technical Process Support Provider through the University of Wisconsin and LEED® Accredited Professional with the United States Green Building Council. Additional skills include extensive field experience, specification writing, energy management controls and optimization and air and water balancing practices. Mr. Greeno has been involved in numerous projects achieving LEED® Certification or higher levels of LEED®.

Selected Personal Commissioning Project Experience**Kelly Middle School – Norwich, CT**

- Enhanced Commissioning Services for LEED® Silver Certification 125,000 square foot public middle school.
- Scope of work included design review, OPR development, oversight of the functional testing of the HVAC, electrical and plumbing systems. Post occupancy services included near end of warranty review and owner staff training oversight.

25 Yale Science Park – New Haven, CT

- Six story building tenant office fit out of approximately 175,000 square feet.
- All HVAC equipment, general exhaust systems, emergency lighting, and fire alarm control interface to HVAC system.

The Hollander Foundation 410 Asylum Street – Hartford, CT

- Commissioning Services for LEED® Silver Certification
- Six story mixed use building of approximately 140,000 square feet
- All HVAC equipment, central heating plant, domestic hot water system, lighting controls, exhaust systems, fire alarm interface to HVAC system.

Education

University of Maryland, Undergraduate Studies
Phoenix Controls Certified in Start-up and Design
United States Air Force Management School
OSHA-10 Hour Construction Safety
OSHA Confined Space Training

Professional Affiliations

Building Commissioning Association
ASHRAE
United States Green Building Council
Connecticut Green Building Council
Construction Institute



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Keith A. David, Jr., CCP, LEED® AP
Project role: Commissioning Provider

Certified Commissioning Provider
LEED® Accredited Professional



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Mr. David will be responsible for the development and execution of the functional testing; publishing field reports during construction; O&M materials review and the development of the system manual and final report.

Mr. David has over 8 years of mechanical engineering and commissioning experience. With experience as an HVAC design engineer and commissioning provider, he possesses firsthand knowledge of fundamental system operation and system design concepts. As a Certified Commissioning Provider, Mr. David has significant experience as Commissioning Authority on a wide range of projects including hospital and healthcare facilities, science buildings and laboratories and manufacturing facilities. Mr. David is a LEED® Accredited Professional and has been involved with numerous projects achieving LEED® standard Certification or higher.

Selected Personal Commissioning Project Experience

Smith College Ford Hall – Northampton, MA

- Fundamental and enhanced LEED® commissioning services to achieve LEED® certification.
- Four story science and engineering building of approximately 142,000 square feet including biological, engineering and teaching laboratories.
- All HVAC equipment including radiant floor heating, laboratory fume hood & exhaust system; emergency lighting; fire alarm control interface to HVAC system and the smoke evacuation system were commissioned.

Trumbull High School – Trumbull, CT

- Fundamental and enhanced LEED® commissioning services.
- Multi-story high school of approximately 360,000 square feet.
- All HVAC equipment including central heating and cooling plant, exhaust systems, emergency generator, emergency lighting, site lighting, fire protection system and fire alarm system

Smith College Clark Science Center, Northampton, MA

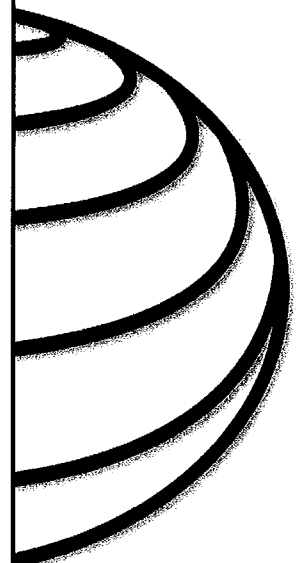
- Provided Fundamental Commissioning Services
- Four story building of classrooms, laboratories and offices covering approximately 80,000 square feet
- Scope of work included HVAC systems, air handling systems, terminal devices, general exhaust, domestic hot water, fire alarm system, and automatic temperature controls system.

Education

Bachelor of Science, Mechanical Engineering – Norwich University, Northfield, VT
OSHA-10 Hour Construction Safety
OSHA Confined Space Training

Professional Affiliations

Building Commissioning Association
ASHRAE
United States Green Building Council



Sean Hayes, LEED® AP

Project role: Commissioning Specialist

LEED Accredited Professional



Mr. Hayes will be responsible for understanding the design intent, performing the functional performance tests, assisting in the systems manual development, seasonal testing, and post occupancy review.

As a commissioning technician, Mr. Hayes has worked on "whole building" and "system" commissioning projects with a focus on LEED® buildings. Commissioning projects include primary and secondary educational facilities, office buildings, multi-use facilities and media facilities. Mr. Hayes has experience with various types of mechanical, electrical and plumbing/fire protection systems.

Selected Personal Project Experience**Catherine M. McGee Middle School - Berlin, CT**

- Commissioning for the new building HVAC systems serving this 154,000 square foot public middle school as part of an overall indoor air quality ventilation system renovation.
- Scope of work includes HVAC equipment, new central cooling plant, air handling units, rooftop units, make up air systems, lighting and lighting control systems, power quality testing, transformer testing, building automation system and balancing verification.

Marine Science Magnet High School – Groton, CT

- Commissioning services for the 65,000 square foot, new aquaculture high school.
- Scope of work included HVAC equipment, ground source heat pumps, water to water heat pumps, air handling systems, terminal devices, lab exhaust systems, general exhaust, emergency generator, automatic transfer switches, emergency lighting, domestic hot water, fire alarm system, sight lighting controls, electrical breaker testing, fire alarm system, fire protection system, aquaculture systems, and automatic temperature controls system.

Annie Fisher Montessori School – Hartford, CT

- Commissioning services for the 120,000 square foot, renovate as new public middle school.
- Scope of work included HVAC equipment, central chilled water and hot water heating plant, cogeneration system, air handling systems, terminal devices, lab exhaust systems, general exhaust, emergency generator, automatic transfer switches, emergency lighting, domestic hot water, fire alarm system, sight lighting controls, electrical breaker testing, fuel oil system, and automatic temperature controls system.

Education

Undergraduate Studies – Eastern Connecticut State University
OSHA 10 hour Construction Safety

Professional Affiliations

Building Commissioning Association



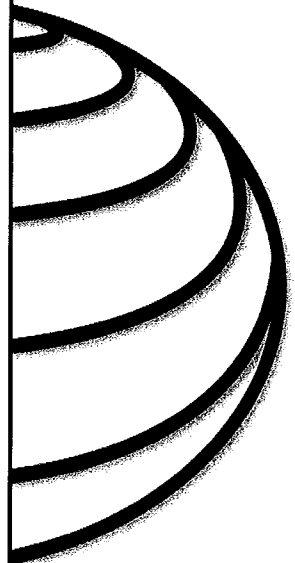
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Relevant Project Experience & References

25 Yale Science Park – New Haven, CT

New 175,000 square foot office tenant fit out on 6 floors for 700 staff members for Yale University. Scope of work included HVAC systems, air handling systems, terminal devices, general exhaust, emergency lighting, domestic hot water, fire alarm system, and automatic temperature controls system.

Year Completed: 2008
Project Size: 175,000 square feet
SES Contact: Walker Greeno, Project Manager
Project Cost: \$11 Million
Owner Contact: Thomas DeAngelis, Program Manager (203) 624-5317
Winstanley Enterprises
300 George St. Suite 525
New Haven, CT 06511

Smith College Clark Science Center, Northampton, MA

This renovation project consisted of 80,000 square feet of classrooms, laboratories and offices on 4 floors. SES is providing Fundamental Commissioning Services. Scope of work included HVAC systems, air handling systems, terminal devices, general exhaust, domestic hot water, fire alarm system, and automatic temperature controls system.

Year Completed: In Progress
Project Size: 80,000 square feet
Owner Contact: James Lucy, Director of Facilities
(413) 585-2406
Smith College
126 West Street
Northampton, MA 01063

United States Postal Service Process and Distribution Centers – Multiple National Locations

Provided commissioning services for various USPS P&DC facilities totaling 5.6 million square feet at numerous locations across the country. Scope of work included HVAC systems, central heating and cooling plants, air handling systems, terminal devices, general exhaust, and automatic temperature controls system. Locations include:

Manisota, FL USPS P&DC
Billings, MT USPS P&DC
Long Beach, CA USPS P&DC
Santa Clarita, CA USPS P&DC
Redding, CA USPS P&DC
San Jose, CA USPS P&DC

Santa Barbara, CA USPS P&DC
Anaheim, CA USPS P&DC
West Sacramento, CA USPS P&DC
Fox Valley, IL USPS P&DC
Lansing, MI USPS P&DC

Year Completed: 2009 to Present
Project Size: 5.6 million square feet
Project Contact: Sunil Shah, (813) 375-3369
ConEd Solutions
3101 West Martin Luther King Jr. Blvd Suite 110
Tampa, FL 33607



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(860) 270-0413

www.Sustainable-Eng.com



The Hollander Foundation at 410 Asylum St. – Hartford, CT

This renovated 140,000 square foot, six story mixed use building included affordable and market rate housing and first floor retail spaces. SES provided LEED® Fundamental Commissioning Services for **LEED® Silver Certification** on the project. Scope of work included HVAC equipment, central heating plant, air handling systems, terminal devices, exhaust systems, emergency lighting, domestic hot water, interior lighting controls, fire alarm system and automatic temperature controls system.

Year Completed: 2009
Project Size: 105,000 square feet
Project Cost: \$14 Million
Owner Contact: Sharon Gowen, Common Ground Community
(860) 218-0502
410 Asylum Street
Hartford, CT 06103

Democracy Now! – Manhattan, NY

This renovated 11,000 square foot radio studio included media spaces such as broadcast studios, computer rooms, offices and administrative areas. SES provided LEED® Fundamental and Enhanced Commissioning Services for **LEED® Commercial Interiors Certification** on the project. Scope of work included HVAC equipment, central chilled water plant, air handling systems, terminal devices, exhaust systems, emergency lighting, domestic hot water, interior lighting controls and automatic temperature controls system.

Year Completed: 2009
Project Size: 11,000 square feet
SES Contact: Walker Greeno, Project Manager
Project Cost: \$1.5 Million
Owner Contact: Karen Ranucci (646) 265-8483
100 Lafayette Street, Suite 604
New York, NY 10013

Trumbull High School – Trumbull, CT

This renovate as new 360,000 square foot public high school includes traditional academic spaces such as classrooms, gymnasiums, media center, laboratory classrooms, vocational wing, administrative wing, natatorium, and cafeteria. SES is providing LEED® Fundamental and Enhanced Commissioning Services for **LEED® Silver Certification**. Scope of work includes HVAC equipment, central chilled water and hot water heating plant, air handling systems, terminal devices, lab exhaust systems, general exhaust, emergency generator, automatic transfer switches, emergency lighting, domestic hot water, fire alarm system, sight lighting controls, electrical breaker infrared scan, fuel oil system, and automatic temperature controls system.

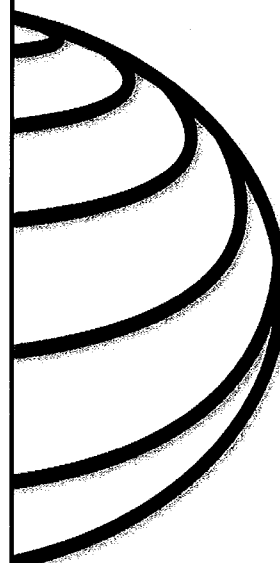
Year Completed: On-going
Project Size: 360,000 square feet
Project Cost: \$73 Million
Owner Contact: John Barbarotta, AFB Construction – Owner's Rep.
(203) 275-8370
622 Clinton Avenue
Bridgeport, CT 06605



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Capital Prep Magnet School – Hartford, CT

This renovate as new public high school includes spaces for classrooms, gymnasium, media center, laboratory classrooms, administrative areas and cafeteria. Scope of work includes HVAC equipment, central chilled water and hot water heating plant, cogeneration system, air handling systems, terminal devices, lab exhaust systems, general exhaust, emergency generator, automatic transfer switches, emergency lighting, domestic hot water, fire alarm system, sight lighting controls, electrical breaker testing, fuel oil system, and automatic temperature controls system.

Year Completed: 2010
Project Size: 108,000 square feet
Project Cost: \$30 Million
Owner Contact: John Mena, Diggs Construction, LLC (860) 296-1664
1010 Wethersfield Ave.
Hartford, CT 06114

Deerfield Academy Fitness Center & Greer Store – Deerfield, MA

Commissioning Authority for this private academy's 26,000 square foot Fitness Center that includes a school store and Café area. Providing Fundamental and Enhanced Commissioning Services consistent with the **LEED® requirements** although the project is not seeking LEED® Certification. Scope of work includes HVAC systems, remote chilled water plant, steam to hot water heating systems, air handling systems, terminal devices, general exhaust, emergency lighting, domestic hot water, fire alarm system, sight lighting controls, and automatic temperature controls system.

Year Completed: On-going
Project Size: 26,000 square feet
Project Cost: \$7 Million
Owner Contact: Chuck Williams, Director of Facilities (413) 774-1570
Deerfield Academy
7 Boyden Lane
Deerfield, MA 01342



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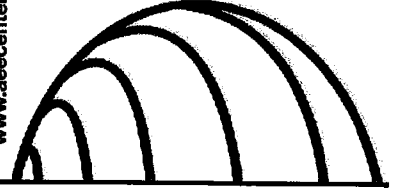
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www.aeecenter.org



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BRAC Armed Forces Reserve Center Commissioning Services

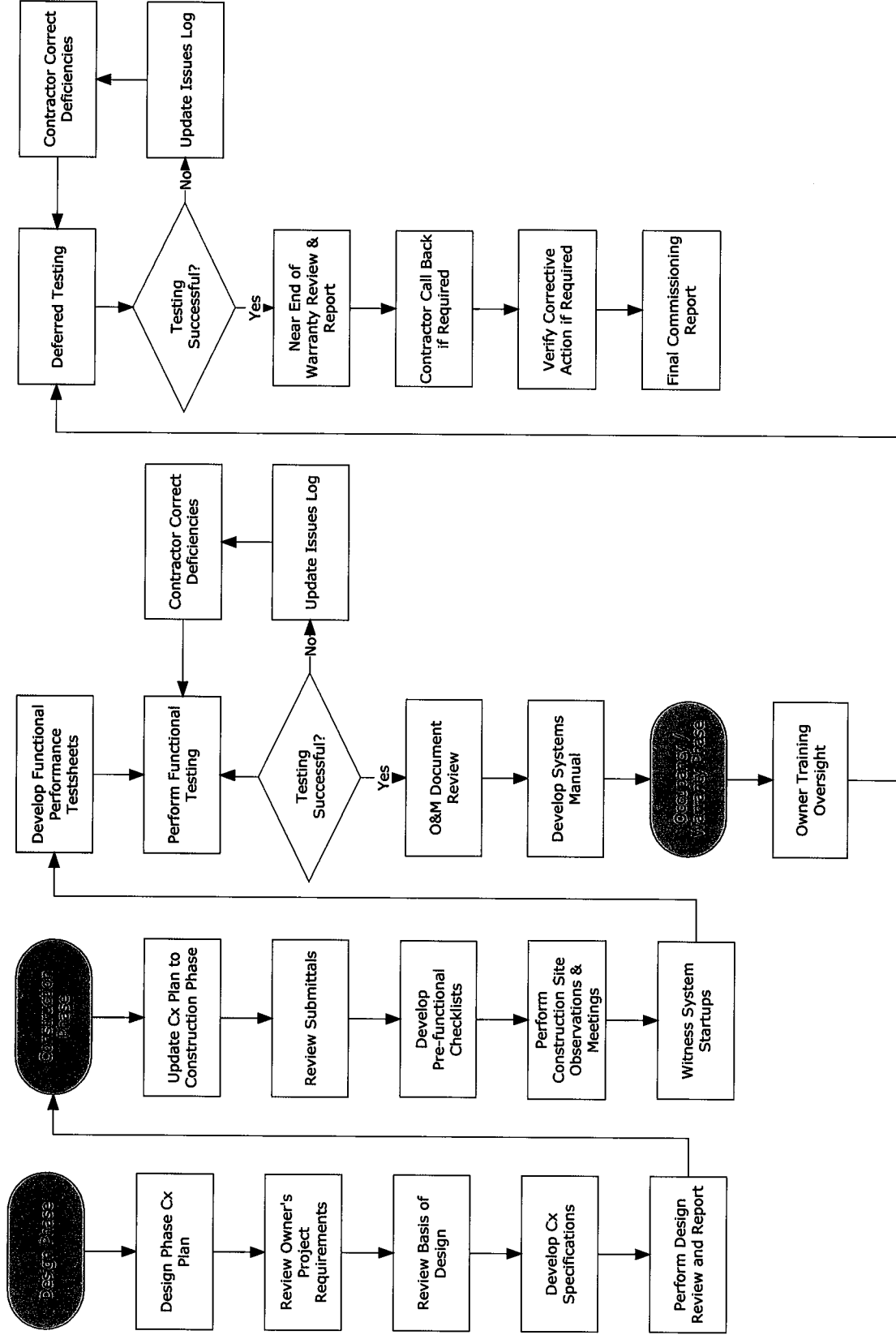


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Commissioning Plan—Design Phase

1. General Project Information

Project:

Location:

Building Type:

Square Footage:

Number of stories:

Const. Period:

Sustainable Project Target

2. Cx Team

Owner Representative Contact: Email: Phone: Fax: Mobile:	Commissioning Authority (CxA) Sustainable Engineering Solutions, LLC 5 Forest Park Drive Farmington, CT 06032 Contact: Keith David, CCP, LEED AP Email: kdavid@sustainable-eng.com Phone: (860) 270-0413 Fax: (860) 270-0413 Mobile: (413) 244-8857
Architect Contact: Email: Phone: Fax: Mobile:	Design Engineer Contact: Email: Phone: Fax: Mobile:

3. Overview

3.1. Abbreviations and Definitions

The following are common abbreviations used in this document.

A/E	Architect and design engineers (Design Team)	FPT	Functional performance test
CxA	Commissioning authority	GC	General contractor
CC	Controls contractor	MC	Mechanical contractor
CM	Construction Manager	PFC	Prefunctional checklist
Cx	Commissioning	OPR	Owner's Project Requirements
Cx Plan	Commissioning Plan document	PM	Project manager
BOD	Basis of Design Document	Subs	Subcontractors to General
EC	Electrical contractor	TAB	Test and balance contractor

3.2. Commissioning Intent

Commissioning is a systematic process of ensuring that all building systems perform interactively according to the design intent and the owner's project requirements. As the CxA, Sustainable Engineering Solutions, LLC will supervise and oversee the commissioning process. This process is best described as a systematic verification to determine that each individual system functions as intended. In addition to this work, the CxA will develop and utilize functional test procedures that will be used to verify and document the performance of those systems being commissioned. If there are deficiencies identified within a particular system during the commissioning process, then the CxA will facilitate discussions with the Owner, General Contractor, and the Design Team. Dependent on the outcome of these discussions, the Owner will finalize their decisions on how they will proceed in bringing the systems to an acceptable standard.

This commissioning plan has been developed by SES to act as an informational document to clarify how the commissioning process shall proceed. This plan will outline the responsibilities of the CxA, Owner, Design Team, and Contractors.

3.3. High Performance Building Requirements

This project is a High Performance Building Project in accordance with the State of Connecticut Department of Public Works. The CT HPB Standards requires building commissioning as part of the design and construction process. The minimum commissioning-related requirements include verification and ensuring that fundamental building elements and systems are designed, installed and calibrated to operate as intended for the following energy related systems:

- Central building automation systems
- All heating , ventilating and air conditioning
- Scheduled or occupancy sensor lighting controls
- Daylight dimming Controls
- Emergency Power Generator and automatic transfer switching
- Life Safety systems (fire alarm, fire protection)
- Security systems installation and operation
- Electrical systems including all switch gear and circuit breaker testing

- Domestic water pumping and mixing systems (if present)
- Plumbing systems
- Renewable energy systems
- Communications systems
- Building envelope systems

The CT HPB Commissioning Requirements for this project include:

- Engage a third party commissioning authority that does not include individuals directly responsible for project design or construction management.
- Develop and utilize a commissioning plan.
- Conduct a focused design review prior to the construction documents phase.
- Conduct a focused design review of the construction documents.
- Incorporate commissioning requirements into the construction documents.
- Conduct a selected review of contractor submittals of the equipment to be commissioned.
- Integrated design meetings
- Verify installation, functional performance, training and operation and maintenance documentation.
- Develop a Systems Manual.
- Complete a commissioning report.
- Conduct a near-warranty end or post-occupancy review.

3.4. Communication

The following describes the possible communication options for the CxA and the Cx Team. The communications options represent how information will be requested by and from the CxA, general correspondence and other communications shall be handled for the project. The selected option shall be implemented for all communications on the project unless the owner indicates otherwise.

- ☐ All formal, informal, and general correspondence and communication both to and from the CxA shall be communicated through the owner's representative.
- ☐ All formal correspondence to and from the CxA shall be communicated through the owner's representative. Informal, general correspondence and other communication may be directed to the Cx Team members as needed with the owner's representative being copied on all correspondence.
- ☐ All formal, informal, and general correspondence and other communication may be directed to the Cx Team members as needed with the owner's representative being copied on all correspondence.
- ☐ Informal phone calls, conversations, etc. regarding the commissioning process and the general project issues may be held directly between the Cx Team members at any time.

3.5. Key Process Tasks

This Design-Phase Commissioning Plan outlines the responsibilities and procedures that will be used throughout the duration of the commissioning process. The plan identifies systems that are to be commissioned and provides an overview of the methods of verification and documentation that will be utilized by the CxA. Preliminary schedules for the functional testing of the systems will be outlined. This preliminary Commissioning Plan will be reviewed by the Owner. After the approval of the Commissioning Plan, the CxA will be responsible for presenting and reviewing it with the Commissioning Team. This Commissioning Plan will be updated to more accurately reflect the specific requirements of this project as the job progresses. The members of the Commissioning Team will participate in the commissioning process as outlined below.

3.5.1. Owner's Project Requirements Development

The CxA will assist the Owner in the development of the Owner's Project Requirements (OPR). The OPR is a document that outlines and identifies the design, construction, acceptance and operational criteria for the project. It includes information to help the project team properly plan, design, construct, operate and maintain the systems and assemblies.

3.5.2. Design Reviews

The CxA will review the design development documents as well as documents prior to the 100% CD submissions with a back check. The established OPR and BOD documents provide the basis for the CxA's design review. In addition to reviewing the design for compliance with the OPR and BOD, the CxA will assess the design for energy efficiency, proper function, ability to be commissioned and completeness.

The CxA will provide the design review comments in a keyed note matrix format corresponding to specific drawing references where applicable. The design team will respond in the same format. A meeting will be scheduled with the owner, design team and CxA to discuss the final disposition of the review comments. A timeframe for inclusion of all comments agreed to shall be established to ensure revisions are incorporated in following submissions. This process can be minimized with the completion of the OPR and BOD prior to the design review so all parties may have a clear understanding of the owner's requirements and design criteria during the review. The owner has the final design making authority over inclusion any review comments into the design.

3.5.3. Specifications

The CxA will develop the commissioning specifications for the project to accomplish two key objectives:

- Provide general commissioning specifications that detail project requirements.
- Provide specific requirements for special systems and equipment, early submissions of necessary O&M manuals and training plans and other key tasks.

The CxA will develop and provide the general commissioning specifications sections and will work with the design team to develop language regarding equipment or system specific commissioning requirements to be included in other sections. Specification Section 0180 – Commissioning Requirements will be provided by the CxA for DD and for the Bid Documents submissions.

3.5.4. Controls Review

The CxA will perform a review of the designed control systems strategy. The intent of the review is to verify that the strategy will meet the owner's project requirements and the needs of commissioning process, i.e., functional performance testing. The CxA will also review the controls specifications to assure that all necessary requirements for coordination with the Testing, Adjusting and Balancing subcontractor are included.

3.5.5. Controls Checkout Plan

The controls subcontractor will develop and submit a control checkout plan detailing the process they intend to use to verify the installation and functionality of the controls system including a step-by-step description of the process and forms they will use to document the controls checkout. The controls subcontractor will coordinate with the Testing, Adjusting and Balancing (TAB) subcontractor to ensure that appropriate control equipment is available for use and training has been provided to the TAB subcontractor for completion of the TAB work.

3.5.6. Testing, Adjusting and Balancing

The TAB contractor submits the outline of the TAB plan and approach to the CxA and the controls contractor eight weeks prior to starting the TAB. Included in the approach, is an explanation of the intended use of the building control system. The CxA reviews the plan and approach for understanding and coordination issues and may comment, but does not "approve." The controls contractor reviews the feasibility of using the building control system for assistance in the TAB work. The TAB submits weekly written reports of discrepancies, contract interpretation requests and lists of completed tests to the CxA and CM. This facilitates quicker resolution of problems and will result in a more complete TAB before functional testing begins.

TAB work must be performed after the controls system has been completed and all checkout and startup documentation has been completed by the controls subcontractor to assure accurate testing, adjusting and balancing. The CxA will verify the air and water balancing by spot checking systems, reviewing completed balancing reports and through selected site observation.

3.5.7. Prefunctional Checklists

Prefunctional checklists (PFC) are important to ensure that the equipment and systems are hooked up and operational and that functional performance testing may proceed without unnecessary delays. Each piece of equipment receives full prefunctional checkout by the Contractor. No sampling strategies are used. In general, the prefunctional checkout for a given system must be successfully completed prior to formal functional performance testing of equipment or subsystems of the given system.

PFCs are primarily static inspections and procedures to prepare the equipment or system for initial operation (e.g., oil levels checked, fan belt tension, labels affixed, gages in place, sensor calibration, etc.). However, some PFC items entail simple testing of the function of a component, a piece of equipment or system (such as measuring the voltage imbalance on a three phase pump motor of a chiller system). The word prefunctional refers to before functional testing. PFCs augment and are combined with the manufacturer's start-up checklist.

Contractors typically already perform some, if not many, of the PFC items the commissioning authority will recommend. However, few contractors document in writing the execution of these checklist items. The CxA does not witness prefunctional check-out, except for testing of larger or more critical pieces of equipment and some spot-checking.

The CxA will produce prefunctional checklists that can be used by the installing contractors. Any deficiencies that are found can then be corrected early in the process when the contractors are fully mobilized on site. The PFCs will be created for all equipment included in the scope of the commissioning process, as defined later in this document.

The CxA still performs a full verification of the installation as part of the functional testing, but the PFCs allow the installing contractors to properly review their own installation prior to the functional testing.

3.5.8. Functional Testing

The Commissioning Authority will coordinate, supervise and participate in, the functional performance testing (FPT) of the building systems and equipment. This testing will be done in accordance with the approved functional test procedures and the results will be recorded on the functional test sheets provided by the CxA. The Contractors will provide trained technicians that have participated in the installation of the systems and equipment being tested to assist in the functional testing process. The Owner will also provide operational staff to participate in the functional testing.

The CxA provides a master list of FPTs in the appendix of the plan (to be completed in the construction phase commissioning plan) and develops FPT procedures in a sequential written form, coordinates, oversees and documents the actual testing. Conditional variations such as emergency modes and opposite seasonal testing are identified in the FPTs. Some FPTs may include DDC trend logging to confirm system operation.

When a piece of equipment or system has been verified by the Contractors as ready for testing and prefunctional checkout and startup have been completed, they will notify the CxA and that piece of equipment and/or system will be examined for commissioning readiness. Once deemed complete the functional testing will commence.

If the system appears not ready for testing or fails during the testing process, the CxA will update the Commissioning Deficiency List and notify the contractors and owner that the Commissioning Deficiency List has been updated. This update will describe any and all deficiencies and what the recommended action is to correct any problems. If assistance is needed from the Design Team, a request will be incorporated into the Commissioning Deficiency List asking for such recommendations and/or comments from the Design Team. Any review comments should be provided via the Commissioning Deficiency List. After review and approval, this notice shall be given to the respective Contractors. Once the Contractors have made any necessary corrections, they will update the Commissioning Deficiency List stating that the corrective action was taken. Once a corrective item has been completed the Commissioning Authority shall resume testing this outstanding item.

The Commissioning Authority will keep the Owner, Design team and Contractors informed of the process of this testing by providing a bi-weekly update on the Commissioning Deficiency List. If the test results do not comply with the test standards, the CxA will facilitate a meeting between the Owner, Design Team and Contractors to resolve the issue. The CxA will provide recommendations of what actions should be taken and moderate discussions concerning any outstanding issues. The Owner and the Design Team will provide the final decision of what approach will be taken and direct the responsible parties to take corrective action.

If the test fails more than one re-test due to the lack of appropriate action by the Contractors, the CxA will call a meeting to discuss appropriate resolutions and procedures. The final testing

results for each test will be included in the CxA's Commissioning Report which will be submitted to the Owner upon completion of the Commissioning Process.

3.5.9. Schedule

Incorporation of commissioning into the project schedule requires coordination among the commissioning team members. During the design phase, time must be allowed for development, review and revision of the OPR and BOD. In addition design review, response and revision should be incorporated into the schedule.

During construction it is essential that the flow of information and materials include the CxA and that time for CxA review and any required revisions be allowed. The CxA will work with the lead individuals on overall project scheduling, typically the architect and CM to ensure that the commissioning milestones are included.

Detailed testing and training schedules will be developed by the CxA and CM as construction progresses establishing sequential priorities to ensure work progresses in a logical manner that supports the commissioning process. Examples of the sequential priorities that will be required for the project include:

- Equipment is not "temporarily" started (for heating or cooling), until pre-start checklist items and all manufacturers' pre-start procedures are completed and moisture, dust and other environmental and building integrity issues have been addressed.
- Functional testing does not begin until prefunctional and startup check-out and TAB have been completed for any given system (this does not preclude a phased approach).
- The controls system and equipment it controls are not functionally tested until all points have been calibrated and pre-functional testing completed.
- TAB is not performed until the controls system has been sufficiently functionally tested and approved by the CxA for TAB work.
- TAB is not performed until the envelope is completely enclosed and ceiling complete, unless the return system is ducted.

3.6. Responsibilities

3.6.1. Commissioning Authority Responsibilities

The CxA will prepare a preliminary Commissioning Plan and submit this plan to the Owner for review. The Commissioning Authority will adjust the document based on the Owner's assessment and related comments and submit it for final approval. The CxA and the Owner will review the final Commissioning Plan with the Contractors involved. Specific responsibilities vary with the management scenario and the CxA's specific scope of services. Ideally, the same party or firm acts as CxA through all project phases, as detailed below:

Pre-design Phase

During Pre-design, the CxA develops the Pre-design and design phase commissioning plan and ensures the OPR is developed.

Design Phase

During design, the CxA directs commissioning activities, possibly performing many of them, depending on the management scenario in place. The core commissioning responsibilities are:

- Reviewing the designer's BOD, plans, and specifications, ensuring they meet the OPR
- Developing the initial construction-phase commissioning plan
- Ensuring that commissioning, training, and documentation requirements are reflected in construction contract documents.

Construction Phase

During construction, the CxA is in charge of the commissioning process and makes the final recommendations to the owner about functional performance of commissioned building systems and assemblies. The CxA is an advocate for the owner, acting as independently and objectively as possible. The core commissioning activities during construction are to:

- Review construction submittals as they relate to systems to be commissioned
- Develops pre-functional checklists (construction checklists) for installing contractors use
- Observe installations and start-up
- Organize, plan, develop, and execute functional testing
- Documents the correction and re-testing of noncompliance items
- Review traditional O&M manuals
- Verify operator training.
- Develop the Systems Manual

Post Occupancy Phase

During occupancy and operations, the CxA helps resolve commissioning issues and directs opposites season testing.

The CxA will participate in a near-warranty-end review of system and assembly performance.

3.6.2. Owner Responsibilities

The Owner will review the preliminary Commissioning Plan and provide comments to the CxA. As required, they will meet with the CxA to clarify any changes to the document. The Owner will approve the final document. With the CxA, they will review the final Commissioning Plan with the Contractors involved.

3.6.3. Owner's Project Management Staff Responsibilities

The owner's project management staff's ultimate responsibility is to see that the commissioning plan is executed. The owner should:

- Include commissioning responsibilities in all commissioning team members' scopes of services.
- Make sure there is sufficient time for commissioning in the project schedule.
- Ensure the CxA is receiving cooperation from other team members.
- Ensure that other owner responsibilities (developing the OPR, having O&M staff participate during construction) are fulfilled.
- Ensures that all design review and construction-phase issues identified through commissioning are resolved in a timely manner.

3.6.4. Owner's Operations Staff Responsibilities

Pre-design Phase

The owner's O&M staff and Cx team should establish the OPR during pre-design.

Design Phase

During design, this staff contributes to reviews of the designer's BOD, plans, and specifications.

Construction Phase

During construction, this staff may:

- Assist in reviewing selected submittals
- Assist in construction observation, verifying completion of construction checklists and observing start-up
- Participate in or witness testing
- Review O&M and systems manual
- Participate in training.

Post Occupancy Phase

The owner's O&M staff's role and responsibilities are:

- Participate in a post occupancy/near end of warranty review with the CM, designer, CxA.
- Share any warranty or construction related items and cooperating with CxA in executing the post occupancy commissioning activities
- Assist in resolving issues identified during the review sessions

3.6.5. Design Team Responsibilities

The Design Team will understand the commissioning process as outlined in the Commissioning Plan and provide participation as detailed in the plan or as requested by the Owner.

Design Phase

The design team's responsibilities are to:

- Review the OPR and develop the basis-of-design (BOD) documentation, including design narratives, rationale, and criteria, according to their scopes of services, and update this document with each new design submission
- Provide input to the commissioning plan
- Respond to questions and concerns by the CxA and others
- Respond to design review comments
- Incorporate commissioning requirements in construction contract documents.

Construction Phase

During construction, designers:

- Review the commissioning plan
- Attend selected commissioning meetings
- Answer questions about system design and intended operation
- Respond to or incorporate CxA comments on construction submittals
- Help resolve design-related issues raised during commissioning

Post Occupancy Phase

The design team's role and responsibilities are:

- Participate in a post occupancy/near end of warranty review with the CM, Owner, CxA.

- Assist in providing any corrective solutions to warranty or construction related issues identified cooperating with CxA in executing the post occupancy commissioning activities

Additional tasks sometimes required are to present system description overviews for primary systems during O&M staff training, review and approve testing plans and procedures, review completed test forms, or witness selected tests.

3.6.6. Construction Managers Responsibilities

Throughout the commissioning process, the CxA will generate documents containing deficient or outstanding items and share them with the commissioning team. It is important that the CM obtain all necessary information back from the subcontractors for communication back to the CxA via the commissioning deficiency list. This is necessary to assure proper issue tracking and proper close-out of any outstanding items identified throughout the commissioning process.

Design Phase

The construction manager (if yet selected) reviews commissioning requirements and performance criteria for coordination, schedule, and cost implications.

Construction Phase

The CM role and responsibilities are:

- Ensuring subcontractors' commissioning work is completed and cooperating with CxA in executing the commissioning plan.
- Providing input into the commissioning plan.
- Integrating the commissioning schedule into the overall project schedule.
- Participating in commissioning meetings.
- Responding to questions and issues raised by the CxA.
- Resolving issues identified during commissioning and coordinating correction of identified deficiencies.
- Providing equipment, system and assembly data and information needed by the CxA.
- Performing specified training.
- Submitting required portions of the systems manual.

Post Occupancy Phase

The CM role and responsibilities are:

- Post occupancy/near end of warranty review with the owner, designer, CxA.
- Ensuring subcontractors' are responding to warranty items and cooperating with CxA in executing the post occupancy commissioning activities.
- Resolving issues identified during commissioning and coordinating correction of identified deficiencies.

3.6.7. Trade Contractors Responsibilities

Design Phase

Trade contractors of specialty or complex systems or designs should review commissioning requirements and performance criteria of their systems for coordination, schedule, and cost implications.

Construction Phase

The responsibilities of the installing trade contractors (and vendors, as appropriate) include:

- Cooperating with the CxA (and the contractor's commissioning manager, when applicable) in executing the commissioning plan.
- Providing input into the commissioning plan.
- Coordinating with other trades as necessary to facilitate a smooth and complete commissioning process.
- Participating in commissioning meetings.
- Responding to questions and issues raised by the CxA.
- Executing and documenting tasks in the construction checklist and start-up process.
- Performing and documenting tests when in their scope.
- Participating in resolving issues identified during commissioning.
- Correcting identified deficiencies and responding to deficiency notices via the commissioning deficiency list.

Post Occupancy Phase

The responsibilities of the installing trade contractors (and vendors, as appropriate) include

- Post occupancy/near end of warranty review with the owner, designer, CxA.
- Ensuring proper response to warranty items and cooperating with CxA in executing the post occupancy commissioning activities
- Resolving issues identified during commissioning and correction of identified deficiencies

Commissioning-related activities of trade contractors are to prepare O&M manuals and submissions to the systems manual and provide training on commissioned systems and assemblies.

3.7. Commissioning Documents

In order to gain a complete understanding of the design intent and desired functionality of the systems and equipment to be commissioned the Commissioning Authority (CxA) requires several documents from the Owner, Design Team and the Contractors. It should be noted that the CxA will view the contract documents (plan drawings, specifications, etc.) as taking precedence over any other forms of project documentation.

The documents utilized by the CxA include but are not limited to:

Owner's Project Requirements (OPR)

- Also referred to as the design intent, the OPR is documentation of a project's functional requirements and expectations of how it will be used and operated. This includes project and design goals, measurable performance criteria, budgets, schedules, success criteria, and supporting information.

Basis of Design (BOD)

- The basis of design is the documented primary decision-making process and assumptions behind design decisions made to meet the OPR. It describes the systems, assemblies, conditions and methods chosen to meet these requirements.

Contract Documents

- Contract Documents include all addenda, trade plan drawings, specifications, sequences of operations, etc. as produced by the Architect and / or Engineer of Record and their consultants to obtain construction bids

Construction Checklists

- Construction checklists are detailed sheets used by the CxA to ensure all equipment is installed per the contract documents. These sheets are customized by the CxA for the specific piece of equipment or specific system being commissioned.

Submittals

- Equipment Submittals and shop drawings are detailed specification sheets and assembly details of the exact equipment to be installed as part of the project. Submittals and shop drawings are produced by the manufacturer, supplier or fabricator of the equipment for review and approval by the Architect or Engineer of Record. The CxA also reviews applicable submittals to ensure conformance with the commissioning plan.

Change Orders

- Change Orders are changes to the contract documents that occur after a project price has been bid or negotiated. Regardless of the cause, Change Orders can change the scope of the project or affect the commissioning requirements of the project or specific systems.

Manufacturer Approved Equipment Start-Up Reports

- Equipment manufacturers possess the most detailed knowledge regarding the equipment they provide. All applicable information provided by manufacturers will be incorporated in the commissioning process.

O & M Manuals and Associated Equipment Manufacturer's Documentation

- Operation and Maintenance (O&M) manuals and Associated Equipment Manufacturers Documentation will be used to generate the construction checklists and is a key component of the training of operations and maintenance personnel.

Commissioning Plan

- This is an overall plan, developed before bidding (Design Phase Commissioning Plan) or after bidding (Construction Phase Commissioning Plan), that provides the structure, schedule, and coordination planning for commissioning. The Commissioning Plan is updated as the project progresses from pre-design, through design and construction.

Prefunctional Checklists

- Prefunctional checklists are detailed sheets created by the CxA and used by the installing contractors to ensure all important equipment details are included in the installation. These sheets are customized by the CxA for the specific piece of equipment or specific system being commissioned.

Functional Performance Test Sheets

- Functional Performance Test Sheets are detailed sheets used by the CxA to ensure all important equipment parameters are verified during the initial operation of the equipment

for the commissioning process. These sheets are customized by the CxA for the specific piece of equipment or specific system being commissioned.

Indoor Air Quality (IAQ) Assessments (where applicable)

- The acceptance tests and the functional performance tests, together with the documentation requirements of the commissioning process, will allow factors that affect IAQ such as outdoor air ventilation rate, ventilation effectiveness, and contaminant removal and control to be documented and verified.

System Training Manual

- The Systems Training Manual will provide the information needed to understand, operate, and maintain the systems and/or to inform others about the systems. It is to be the repository of all updates and corrections as they occur.

Commissioning Database

- The Commissioning Database is a tracking database. The database is used by the CxA to track issues and assign responsibility for corrective action. All members of the design / construction / commissioning team will be given access to the Commissioning Database as required to respond to issues or deficiencies.

Commissioning Notices

- The Commissioning Notice is a typically a bi-weekly report generated by the CxA that identifies the project progress as it relates to building commissioning. The Commissioning Notice is a summary of current issues from the tracking database. The Commissioning Notice is distributed to the Owner, design team, and responsible contractors, when applicable, at commissioning progress meetings. The Commissioning Notice identifies and tracks the corrective action of deficiencies identified by the CxA.

Commissioning Reports

- The CxA will write and submit a final commissioning report detailing, for each piece of commissioned equipment or assembly, the adequacy of equipment or assemblies meeting contract documents. The following components are typically included:
 - Description of the OPR
 - Description of the project specifications
 - Verification of installation (commissioning notices)
 - Functional performance tests sheets
 - O&M documentation evaluation
 - Value of the commissioning process
 - Outstanding issues
 - Systems manual
 - Design review comments
 - Training program evaluation
 - Post occupancy review

Noncompliance items will be specifically listed. A brief description of the verification method used (manual testing, trend logs, data loggers, etc.) and observations and conclusions from the testing will be included. The final commissioning report is updated after occupancy / operations-phase commissioning.

4. Systems to be Commissioned

The following equipment/ systems will be commissioned in this project. All general references to equipment in this document refer only to equipment that is to be commissioned. The system description is meant to include all support equipment, components and controls. The final list will be generated based on the OPR and Basis of Design documentation. The commissioning process includes but is not limited to the following systems:

HVAC Systems

- Boilers and Associated Pumping Equipment
- Air Cooled Chiller and Associated Pumping Equipment
- Rooftop Air Handling Units
- Energy Recovery Units
- Exhaust Fans
- AC Split Systems
- Spot checking of air and water balancing
- Associated Automatic Temperature Control System for the above referenced equipment

Plumbing System

- Domestic hot water heater(s)
- Domestic hot water recirculation pumps
- Domestic hot water piping installation and sanitizing

Electrical Systems

- Interior Lighting controls system
- Exterior Lighting controls system
- Paging system
- Phone Systems
- Elevator shunt trip / recall

Life Safety & Security Systems

- Fire Alarm / Fire Protections System
- Call for aid station
- Security system

Building Envelope

5. Commissioning Phases and Process Overview

5.1. Commissioning Process During Pre-Design

Objectives

The primary activities and objectives of commissioning during pre-design are the following:

- Develop the OPR
- Identify a scope and budget for the commissioning process
- Develop the initial commissioning plan
- Accept the pre-design phase commissioning process activities

5.2. Commissioning Process During Design

Objectives

Design-phase commissioning objectives include the following:

- Update the design-phase commissioning plan developed during pre-design.
- Update the OPR.
- Verify the BOD document against the OPR.
- Verify plans and specifications against the BOD and OPR.
- Develop the commissioning plan for the construction and occupancy / operations phases.
- Develop and incorporate commissioning requirements into project specifications.
- Begin developing the systems manual.
- Define training requirements for O&M personnel.
- Perform commissioning-focused design reviews.
- Accept the design-phase commissioning.

Additional Commissioning Team Tasks

Additional design phase responsibilities of the commissioning team (led by the CxA, who is frequently responsible for these requirements) include the following:

- Build and maintain cohesiveness and cooperation among the project team.
- Assist owner in preparing requests for project services that outline commissioning roles and responsibilities developed in the commissioning plan.
- Ensure that commissioning activities are clearly stated in all project scopes of work.
- Develop scope and budget for project-specific commissioning process activities.
- Identify specialists who will be responsible for commissioning specific systems and assemblies.
- Conduct and document commissioning team meetings.
- Inform all commissioning team members of decisions that result in modifications to the OPR.
- Integrate commissioning into the project schedule.
- Track and document issues and deviations relating to the OPR and document resolutions.
- Write and review commissioning reports.

5.3. Commissioning Process During Construction

Objectives

Commissioning during construction (also known as the **acceptance phase**) should document and verify that

- All systems and assemblies are provided and installed as specified.
- All systems and assemblies are started and function properly.
- The systems manual is updated and provided to facility staff.
- Facility staff and occupants receive specified training and orientation.

Additional Commissioning Team Tasks

Pre-Functional Verification

A detailed schedule for all commissioning activities, with specific dates consistent with overall project construction schedule will be developed, with the assistance of the owner's operations and maintenance personnel, to assist the Construction Manager in scheduling the responsible subcontractor to assist where necessary.

Functional testing of all applicable systems and subsystems cannot begin until:

- HVAC systems and associated subsystems have been completed, calibrated, prefunctional and startup check-out and TAB have been completed and the systems are and believed to be operating in accordance with contract documents.
- Automatic control systems have been completed and calibrated and prefunctional and startup check-out completed and believed to be operating in accordance with contract documents.
- Testing, adjusting, and balancing procedures have been completed, and all TAB reports have been submitted and reviewed and discrepancies corrected and accepted.
- A statement shall be issued certifying that all work has been completed and equipment and systems are operational in accordance with contract documents.

Before the functional testing can start, a list of all equipment and systems involved in the commissioning process shall be developed. This list will be compiled based on construction document reviews, shop drawing submittals, and input from the design team and owner.

Based on this list of equipment to be commissioned, pre-start / start-up documentation for all equipment and systems involved in the commissioning process must be provided by the contractors prior to any functional testing. This documentation must include detailed, step-by-step procedures used in the start-up of the equipment and must clearly indicate all manufactures required checkout procedures and evidence that such procedures have been thoroughly completed. This documentation shall also clearly state that such equipment has been put through the appropriate season startup process, conducting the functional performance tests on each piece of equipment and system. Provisions for verifying all relevant data, recording the results obtained, and listing the parties involved in each start-up and checkout must be included in the documentation.

Functional Testing

The CxA will direct the performance of all functional test procedures. The CxA will provide a bi-weekly report or Commissioning Notice of the progress of the functional testing via the Commissioning Database. The CxA will provide recommendations and moderate meetings with all parties to discuss solutions to any problems identified during the testing. The final testing

results for all tests will be included in the CxA's Commissioning Report which will be submitted to the Owner upon completion of the Commissioning Process.

The Owner will provide time for their operations staff to participate in the functional testing under the supervision of the Commissioning Authority. The Owner will review all reports and Commissioning Notices. When required they will review the functional test reports with the Design Team and direct the Contractors to take corrective action where deemed necessary. As required, the Owner will review with all parties any problems identified during the functional testing process. With the Design Team, the Owner will direct appropriate parties to take corrective action to solve problems identified during the testing process.

If so desired by the Owner, the Design Team will assist the Owner in reviewing the CxA's reports. As required, they will review with all parties any issues identified during the functional testing process. With the Owner, the CM will direct appropriate parties to take corrective action to solve problems identified during the testing process.

The Contractors will perform the functional testing as directed by the CxA by providing the correct personnel when requested by the CxA. The Contractors will act in a timely manner to correct any problems described in any of the commissioning reports. The Contractors will document all corrective actions taken as noted on the commissioning reports. The Contractors will participate in discussions with all parties to determine possible solutions to any problems encountered during the functional testing. As directed by the Owner and Design Team, the Contractors will take required actions to correct problems identified during the functional testing process

5.4. Post Occupancy Commissioning

The commissioning team shall perform a post occupancy or near-end-of-warranty review of the project. The CxA shall return to the site in 10 months into the 12 month warranty period. The CxA will review with the current building operation with the facility staff and address the condition of outstanding issues related to the owner's project. The CxA will also interview the facility staff to identify problems or concerns they have in operating the building as originally intended. The CxA will provide suggestions for improvements and record these changes in the systems manual. The CxA will identify any problems covered under the warranty or under the original construction contract. The documented warranty or construction related problems will be shared with the commissioning team. The construction manager or general contractor shall be responsible for organizing the respective subcontractors to perform any corrective actions required to resolve these problems identified.

SECTION 01810 – GENERAL COMMISSIONING REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings, specifications and other general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Sections, apply to this Section.
- B. Owner's Project Requirements (OPR) and the Basis of Design (BOD) documentation prepared by the Owner and Architect / Engineer, respectively, contain requirements that apply to this section.
- C. Related Sections
 - 1. Division 3 (ALL SECTIONS)
 - 2. Division 4 (ALL SECTIONS)
 - 3. Division 5 (ALL SECTIONS)
 - 4. Division 6 (ALL SECTIONS)
 - 5. Division 7 (ALL SECTIONS)
 - 6. Division 8 (ALL SECTIONS)
 - 7. Division 9 (ALL SECTIONS)
 - 8. Division 15, Section 15010 General Conditions for Mechanical Systems
 - 9. Division 15, Section 15950 Testing, Adjusting and Balancing
 - 10. Division 16, Section 16000 General Conditions for Electrical Systems
 - 11. Division 17, Section 17000 Temperature Controls

1.2 SUMMARY

- A. This section includes requirements for Commissioning during the pre-design phase, design phase, construction phase and the building turnover phase. This section includes general Commissioning requirements for all specified and associated systems, sub systems and equipment. The intent of this section is to specify the Commissioning responsibilities of the General Contractor referred to herein as the Contractor, Heating, Ventilation and Air conditioning (HVAC) Subcontractor, Testing, Adjusting and Balancing (TAB) Subcontractor, Automated Temperature Controls (ATC) Subcontractor, Plumbing Subcontractor, Fire Protection Subcontractor, Fire Alarm Subcontractor and, Data and Communication Subcontractor, Security Subcontractor and the Electrical Subcontractor. The Contractor will assure participation and cooperation of their Subcontractors as required throughout the duration of the Commissioning process.
- B. This project has been designed and will be Commissioned in accordance with the requirements of the High Performance Building Construction Standards (HPBS) for State Funded Buildings as outlined in RCSA Section 16a-38k-1 through 16a-38k-9 and further defined by the Connecticut Building Standard Guidelines Compliance Manual for High Performance Buildings August 2009 Prepared For The Connecticut Office of Policy and Management by Northeast Energy Efficiency Partnerships. The Commissioning Authority will coordinate with the

architect, owner and general contractor throughout the integrated design and construction process.

1.3 DEFINITIONS

- A. Architect: Includes Architect identified in the Contract for Construction between Owner and Contractor.
- B. Automated Temperature Controls (ATC): This term is inclusive of any and all automated controls, building management systems, energy management systems and their various networks, software and components.
- C. Basis of Design (BOD): A document that records concepts, calculations, decisions, and product selections used to meet the OPR and to satisfy applicable regulatory requirements, standards, and guidelines. The document includes both narrative descriptions and lists of individual items that support the design process.
- D. Commissioning Authority (CxA): The individual or group engaged under separate contract to the Owner responsible for executing the Commissioning requirements.
- E. Commissioning Plan: An informational document that outlines the organization, schedule, allocation of resources, and documentation requirements of the Commissioning process.
- F. Contractor: The prime contractor (General Contractor) identified in the Contract for Construction between Owner and Contractor.
- G. Engineer of Record: Includes the design Engineer(s) identified in the Contract for Construction between Owner and Contractor, responsible for design of HVAC, electrical, communications, controls for HVAC systems and other related building systems.
- H. Owner's Project Requirements (OPR): A document that details the program requirements of a project and the expectations of how it will be used and operated. These include project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information.
- I. Pre-Functional Checklists: The CxA will produce pre-functional checklists that can be used by the Contractor and Subcontractors prior to the start of functional testing. These checklists are tools to help the Subcontractors verify that the installation complies with the Contract Documents and is complete and ready for functional performance testing. The pre-functional checklists will be created for all applicable equipment included in the Scope of Work identified in section 1.10 of this Section.
- J. Subcontractor: Installing contractors responsible to the Contractor for installation of systems and equipment. This term is inclusive of all trades (HVAC, electrical, plumbing, etc.).
- K. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.
- L. Testing, Adjusting, and Balancing (TAB): Includes any and all testing, adjusting and balancing as performed by the TAB Subcontractor.

1.4 COMMISSIONING TEAM

- A. Members Appointed by Contractor and Subcontractor(s): Individuals, each having the authority to act on behalf of the entity he or she represents, explicitly organized to implement the commissioning process through coordinated actions. The Commissioning Team shall consist of, but not be limited to, representatives of the Contractor and of each Subcontractor, including project superintendents, installers, suppliers, and specialists deemed appropriate by the CxA.
- B. Members Appointed by Owner:
 - 1. The CxA: Owner has engaged the CxA under a separate contract.
 - 2. Representatives of the Owner including facility users and operation and maintenance personnel.
 - 3. Architect and Engineer of Record.

1.5 OWNER'S RESPONSIBILITIES

- A. Provide the OPR and review the BOD documentation for use in developing the commissioning plan, checklists and testing plans, operation and maintenance training plan, and a systems manual.
- B. Assign operation and maintenance personnel and schedule them to participate in commissioning team activities, including but not limited to, the following:
 - 1. Coordination and testing meetings.
 - 2. Training in operation and maintenance of systems, subsystems, and equipment.
 - 3. Demonstration of operation of systems, subsystems and equipment.
- C. Participate, as needed, in performing deferred or opposite seasonal testing of systems and equipment.
- D. Participate, as needed, in the post-occupancy system performance review 10 months into the 12 month warranty period.
- E. Provide, where applicable, the following information for reference in the post-occupancy Commissioning report (to be provided within 180 days after one year of completion):
 - 1. A description of any post-occupancy adjustments made to equipment or building operation and the reasons for which the changes were made.
 - 2. One year worth of all energy use by source and water use.

1.6 CONTRACTOR'S AND SUBCONTRACTOR'S RESPONSIBILITIES

- A. Contractor shall assign representatives with expertise and authority to act on its behalf and shall schedule them to participate in and perform commissioning process activities including, but not limited to, the following:
 - 1. Evaluate performance deficiencies identified in test reports and, in collaboration with entity responsible for system and equipment installation, recommend corrective action.

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2. Provide the CxA with a detailed and accurate construction schedule updated on a monthly basis. Coordinate scheduling of commissioning activities with the CxA and include them in the construction schedule.
 3. Provide a schedule for equipment submittals, installation manual submittals, operation and maintenance data submittals, equipment start-up, and testing to CxA for incorporation into the commissioning plan. Update schedule on a monthly basis throughout the construction period.
 4. Provide CxA with copies of all approved change orders or other modifications impacting construction when approved.
 5. Participate in construction phase coordination meetings.
 6. Participate in commissioning field observations.
 7. Ensure accurate completion of construction checkout documents for all systems to be commissioned prior to verification site visits by the CxA.
 8. Certify readiness of systems to be commissioned prior to functional performance testing.
 9. Participate in functional performance testing of systems to be commissioned.
 10. Resolving issues identified during commissioning and coordinating correction of deficiencies. Ensure responses to open issues within two weeks of being posted via online web-based tracking database (SES Commissioning Portal).
 11. Participate in operation and maintenance planning and verification.
 12. Participate in operation and maintenance training sessions.
 13. Participate in final review at acceptance meeting.
 14. Certify the work is complete and systems are operational according to the contract documents, including calibration of controls and any instrumentation.
 15. Coordinate Subcontractor participation in commissioning activities.
 16. Assist in coordinating the Subcontractors, as needed, to provide project close-out documentation such as system manual, record documentation and training documentation.
 17. Assist in coordinating the Subcontractors, as needed, to perform testing of systems and equipment as it relates to project phasing.
 18. Assist in coordinating the Subcontractors, as needed, to perform deferred or opposite seasonal testing of systems and equipment. Assist in coordinating the Subcontractors to resolve issues discovered as a result.
 19. Assist in coordinating the Subcontractors to resolve issues discovered during the system performance review 10 months into the 12 month warranty period.
- B. Subcontractor(s) shall assign representatives with the expertise and the authority to act on behalf of the entity responsible for installation of systems to be commissioned who shall participate in and perform commissioning team activities including, but not limited to, the following:
1. Provide a schedule for equipment submittals, installation manual submittals, operation and maintenance data submittals, equipment start-up, and testing to CxA for incorporation into the commissioning plan. Update schedule on a monthly basis throughout the construction period.
 2. Participate in construction phase coordination meetings.
 3. Provide information to the CxA for developing construction phase commissioning plan including, but not limited to:
 - a. Schedule as mentioned above
 - b. Equipment submittals
 - c. Installation manual submittals

- d. Operation and maintenance information submittals
4. Complete construction checkout documents for all systems to be commissioned.
5. Maintain updated Project Record Documents for periodic review by the CxA and submit final record documents at project completion.
6. Certify readiness of systems to be commissioned prior to functional performance testing. Provide any available support documentation (start-up reports, pressure test reports, etc.).
7. Participate in functional performance testing of systems to be commissioned.
8. Participate in test procedures meeting.
9. Provide technicians who are familiar with the construction and operation of the installed systems, are trained in the use of required testing instruments and procedures to participate in testing of installed systems, subsystems and equipment.
10. Participate in operation and maintenance planning, documentation and verification.
11. Resolving issues identified during commissioning and coordinating correction of deficiencies. Ensure responses to open issues within two weeks of being posted via online web-based tracking database (SES Commissioning Portal).
12. Provide project close-out documentation including but not limited to system manual, operations and maintenance manuals, training documentation, etc.
13. Participate in training sessions for Owner's operation and maintenance personnel.
14. Participate in final review at acceptance meeting.
15. Participate, as needed, in performing deferred or opposite seasonal testing of systems and equipment.
16. Participate, as needed, in resolving warranty related issues discovered during the system performance review 10 months into the 12 month warranty period

1.7 COMMISSIONING DOCUMENTATION

- A. Commissioning plan: An informational document, prepared by the CxA, that outlines the schedule, allocation of resources and documentation requirements of the commissioning process, including:
 1. Plan for delivery and review of submittals, systems manuals and other documents and reports. Identification of the relationship of these documents to other functions and a description of submittals that are required to support the commissioning processes. Submittal dates include the latest date approved submittals must be received without adversely affecting commissioning.
 2. Overview of the organization, layout and content of commissioning documentation and a description of documents to be provided along with identification of responsible parties.
 3. Identification of systems and equipment to be commissioned.
 4. Description of schedules for testing procedures along with identification of parties involved in performing and verifying tests.
 5. Identification of items that must be completed before the next operation can proceed.
 6. Description of responsibilities of commissioning team members.
 7. Description of requirements for operation and maintenance training, including required training materials.
 8. Description of expected performance for systems, subsystems, equipment and controls.
 9. Requirements for documenting changes on a continuous basis to appear in the project record documents.
 10. Process and schedule for completing construction checklists for systems to be commissioned.

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11. Step by step procedures for testing systems, subsystems and equipment with descriptions for methods of verifying relevant data, recording the results obtained and listing parties involved in performing and verifying tests.
- B. Pre-functional Checklists: CxA shall develop pre-functional checklists for each system to be commissioned including all interfaces and interlocks. Separate entries will be provided for each item to be checked. Pre-functional checklists will be completed by the installing Subcontractor and verified by the Contractor and CxA. Space will be provided for sign off of installing Subcontractor, Contractor and CxA. Each checklist will include, but not limited to, the following:
1. Name and identification code of each item being checked.
 2. Verification of each item including verification of all required data and construction practices listed in the construction checklists. This list outlines all work necessary to be completed prior to the start of functional testing for the particular system, subsystem and equipment.
 3. Notation of any equipment or installation that deviates from approved submittals or the construction documents.
 4. Name(s) of personnel involved with verification and dates on which verification activities and construction checklists were completed.
- C. Field Observation Reports: The CxA will issues periodic field observation reports resulting from site visits made throughout construction. The reports will be submitted to the Owner and the Contractor for distribution to the Subcontractor and include, but are not limited to, the following:
1. Witnessing systems, assemblies, equipment, and component startup.
 2. Cleanliness and proper storage of construction materials like duct work, refrigerant piping, etc.
 3. Observed installation deficiencies and/or deviations from the Contract Documents.
- D. Certificate of Readiness: Certificate of Readiness shall be signed by the Contractor, Subcontractor(s), Installer(s) and CxA certifying that systems, subsystems, equipment, and associated controls are ready for functional performance testing and that all relevant information including submittals, installation data and operation and maintenance documentation has been submitted. Completed pre-functional checklists signed by the responsible parties shall accompany this certificate.
- E. Functional Performance Test Procedures: The CxA shall develop functional performance test sheets for each system to be commissioned including interfaces and interlocks. Separate entries will be provided for each item to be tested. CxA shall prepare separate tests for each mode of operation and provide space to indicate whether the mode under test responded as required. All information gathered will be documented by the CxA. Each test will include, but not limited to, the following:
1. Name and identification of each item being checked.
 2. Date of test.
 3. Indication of whether the record is for a first test or retest following correction of a problem or issue.
 4. List of deficiencies.
 5. Calibration of sensors and sensor function.

6. Testing conditions under which test was conducted, including (where applicable) ambient conditions, setpoints, override conditions, and status and operating conditions that impact the results of the test.
 7. Control sequences for mechanical and electrical systems.
 8. Verification of control signals for each setpoint at specified conditions.
 9. Responses to control signal at specified conditions (where applicable).
 10. Sequence of responses to control signals at specified conditions.
 11. Electrical demand or power input at specified conditions (where applicable).
 12. Expected performance of systems, subsystems and equipment at each step of the tests. Narrative description of observed performance of systems, subsystems and equipment. Notation to indicate whether the observed performance at each step meets the expected results.
 13. Interaction with ancillary equipment.
- F. Training Plans: To be prepared by the Contractor and Subcontractors and submitted to the CxA and the Owner for review and comment prior to finalizing training plans.
- G. Commissioning Issues Log: The CxA will document any and all deficiencies and corrective actions taken for systems and equipment that fail initial functional performance tests including required modifications to systems and equipment and revisions to functional performance test procedures. Re-tests and final results will also be documented.
1. Commissioning Notice: CxA prepares and maintains an issue log that describes design, installation and performance issues that are at variance with the OPR, BOD and Contract Documents. Identification and tracking of issues as they are encountered, documenting the status of unresolved and resolved issues. The issues log is shared with members of the Commissioning team via an interactive web-based portal which is maintained by the CxA.
 - a. SES Commissioning Portal: The interactive web-based portal is an on-line database maintained by Sustainable Engineering Solutions, LLC. The portal is used by the CxA to track issues and assign responsibility for corrective action.
 - b. All members of the Commissioning Team will be given access to the portal as required to respond to issues or deficiencies. Issues can be sorted based on responsibility, status, date posted and issue tag.
 - c. Issues status will begin as "Open" until the responsible Contractor or Subcontractor addresses the issue stating that corrective action has been performed.
 - d. Once the Contractor / Subcontractor have addressed the issue stating that corrective action has been performed the issue status will be changed to "Pending Verification" as the issue awaits re-verification by the CxA.
 - e. After the CxA has confirmed that the corrective action has taken place, as stated by the responsible Contractor or Subcontractor, the issue status will be indexed to "Closed" but remain visible for record purposes.

1.8 SUBMITTALS BY CONTRACTOR

- A. Information listed below shall be submitted with the product and system product literature and shop drawing submittals for review and approval by the Owner, Architect, Engineer of Record and the CxA. This information will be used to confirm the product compliance with the OPR, BOD and Contract Documents and to establish detailed commissioning requirements and

procedures. The information shall be specific to each system to be commissioned and shall be inclusive of all related systems, equipment and components.

1. The Contractor shall provide the submittals in accordance with the requirements identified in Divisions 1, 3, 4, 5, 6, 7, 8, 9, 15, 16 and 17.
 - a. Manufacturer's detailed installation and start-up requirements including equipment checklists for each piece of equipment/assembly.
 - b. Operation instructions.
 - c. Manufacturer's recommended maintenance and troubleshooting procedures.
 - d. Warranty and owners obligations to maintain warranty.
 - e. Detailed product data for each piece of equipment including part load capacities, electrical components and requirements, etc. (As appropriate)
 - f. Manufacture's certified test reports on each piece of equipment.
 - g. Performance curves for each piece of equipment being submitted. (As appropriate)
 - h. Coordination and Record Drawings.
 - i. Logic flow diagrams for control systems sequences of operation. Include detailed sections of the Sequence of Operations for related function groups.
 - j. Indicate initial setpoints, reset schedules, sensor locations, etc.
 - k. Detailed test reports resulting from testing of any exterior enclosure (window, door, curtain wall, etc.) mock-ups performed by the installing contractor or third-party entity prior to construction.

B. Operation and Maintenance Manuals

1. The Contractor shall develop the Operation and Maintenance manuals in accordance with the requirements identified in Divisions 1, 3, 4, 5, 6, 7, 8, 9, 15, 16 and 17.
 - a. All submittal information indicated in section 1.8 sub section A of this Section shall be included in the operations and maintenance manual in addition to the information required below.
 - b. Manufacturer's break-in instructions.
 - c. Manufacturer suggested service requirements.
 - d. Spare parts list edited for specific equipment used on the project. Provide names/numbers of local distributors for spare parts.
 - e. Copy of all equipment specifications.
 - f. Preventative maintenance instructions.
 - g. Troubleshooting guide.
 - h. Plumbing and HVAC piping sanitation certificates.
 - i. Air and Water Balancing Reports.
 - j. Warranties and Warranty start dates.
 - k. Equipment Start-up Reports

1.9 COORDINATION

- A. Coordination Meetings: The CxA shall conduct periodic coordination meetings with the Commissioning Team to review progress on the commissioning plan, to discuss scheduling conflicts and to discuss upcoming commissioning process activities.
- B. Pretesting Meetings: The CxA shall conduct pretest meetings with the Commissioning Team prior to the start of the functional performance testing to review start-up reports, pretest verification results, testing procedures, testing personnel and instrumentation requirements and

manufacturer's authorized service representative services for each system, subsystem, equipment and component to be tested.

- C. Field Observations: The CxA shall conduct periodic field observations of the exterior enclosure during construction. The Contractor must notify the CxA at least one week prior to completion of key milestones, assemblies and sub-system components installation and functional testing (e.g. infrared scanning, mass water infiltration, etc.) so that site visits can be coordinated while access is available to witness. If the CxA is not notified prior to final assembly then finished sections may have to be disassembled for review at no cost to the owner. Any costs associated with dissembling and re-assembling components shall be borne solely by the contractor.
- D. Coordination During Functional Performance Testing: The CxA shall coordinate sequence of testing activities to accommodate required quality assurance and control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and verification.
- E. Manufacturer's Field Services: The Subcontractor(s) shall be responsible for coordinating services from the manufacturer's representative, technicians or vendors as needed. The CxA will coordinate when these services are required and notify the Subcontractor(s) at least one week prior to scheduled functional performance testing. .

1.10 SYSTEMS TO BE COMMISSIONED

- A. The following systems, subsystems, equipment and components will be commissioned and will be referred to collectively herein as the Systems to be Commissioned:
 - 1. Geothermal energy systems
 - 2. Hydronic pumping systems
 - 3. Radiant floor heating systems
 - 4. Energy recover units (ERUs)
 - 5. Supply air systems
 - 6. Exhaust fans
 - 7. Chilled beams
 - 8. Spot verification of air and water balancing of the above systems
 - 9. Lighting control systems
 - 10. Fire alarm system and interface to the existing building
 - 11. Domestic hot water heating systems
 - 12. Fire protection system and interface to the existing building
 - 13. Building automation control system as it relates to the above equipment
 - 14. Building envelope

PART 2 – PRODUCTS

2.1 TEST EQUIPMENT

- A. All standard and non-standard testing equipment required to perform start-up, initial checkout and functional performance testing shall be provided by the Division contractor for the equipment being tested. This includes any equipment, such as ladders or man lifts, necessary to gain access to systems or equipment to be commissioned.

- B. The ATC sub contractor will be responsible for providing any available software to interface with the automated temperature control system for functional performance testing purposes. If necessary due to licensing restrictions the ATC contractor will be responsible for providing a computer as well to operate the software.
- C. The ATC sub contractor will be responsible for securing access to any available networks (wireless or local) for use with web-based control systems. The ATC contractor will be responsible for providing user access to the web-based control system for the CxA to facilitate functional performance testing.
- D. All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance within the tolerances specified in applicable Divisions. The Subcontractor's instrumentation shall meet the following standards:
 - 1. Be of sufficient quality and accuracy to test and/or measure system performance within the tolerances required to determine adequate performance.
 - 2. Be calibrated on the manufacturer's recommended intervals with calibration tags permanently affixed to the instrument being used.
 - 3. Be maintained in good repair and operating condition throughout the duration of use on this project.
 - 4. Be recalibrated / repaired if dropped and/or damaged in any way since last calibrated.

PART 3 - EXECUTION

3.1 FUNCTIONAL PERFORMANCE TESTING REQUIREMENTS

- A. The requirements identified in this section are applicable to the functional performance testing of all system and equipment to be commissioned.
- B. The objective of functional performance testing is to demonstrate that each system is operating in accordance with the performance identified in the OPR, BOD and Contract Documents through systematic testing and documentation. The intent is to bring the systems from a state of substantial completion to full dynamic operation and documenting the performance. Additionally, during the functional performance testing process, areas of deficient performance are identified and corrected, improving the operation and function of the systems.
- C. The CxA shall achieve this objective by developing individual systems testing procedures which, when executed systematically by the Subcontractor(s), will allow the CxA to observe operation, evaluate performance, identify deficiencies, recommend modifications, adjust, and document the systems and systems equipment performance over a range of load and functional levels.
- D. In general, each system to be commissioned shall be made to operate through all modes of operation where there is a specified system response. Verifying each sequence identified in the OPR, BOD and Contract Documents is required. Proper responses to such modes and conditions as power failure, freeze condition, low oil pressure, no air or water flow, equipment general failure, etc. shall be tested.

3.2 COORDINATION AND SCHEDULING OF FUNCTIONAL PERFORMANCE TESTING

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- A. Scheduling of the Subcontractor(s) and personnel required to execute the functional performance testing is the responsibility of the Contractor.
 - 1. Commissioning activities shall be scheduled by the CxA and forwarded to the Contractor for distribution to the Subcontractors.
 - 2. The Contractor shall be responsible for integrating functional performance testing and commissioning requirements into the master activity schedule.
- B. The Subcontractor(s) shall provide sufficient notice to the CxA regarding their completion schedule for the pre-functional checklists and system start-up of all equipment and systems to be commissioned.
 - 1. Subcontractors are responsible for execution of all tests.
- C. Functional performance testing is conducted after pre-functional checklists and start-up procedures have been satisfactorily completed and documentation has been submitted and approved.
- D. The Contractor shall verify completeness of the exterior enclosure to facilitate the functional performance testing of the various systems and sub system assemblies.
- E. The Contractor shall verify completeness of the building envelope, perimeter and interior items which affect proper operation and control of HVAC, Plumbing and Electrical equipment and systems.
- F. The testing, adjusting and balancing of both air and hydronic systems shall be completed and any noted issues addressed before functional performance testing of air and water related equipment or systems. A preliminary report of the TAB Subcontractor's findings shall be submitted prior to the start of functional performance testing.

3.3 PREREQUISITE START-UP VERIFICATION

- A. Before any system start-ups begin, the Subcontractor(s) shall conduct a final installation verification audit for their work. The Contractor shall be responsible for completion of all work including change orders and punch list items to the Owner's satisfaction.
- B. Detailed test reports resulting from testing of any exterior enclosure (window, door, curtain wall, etc.) mock-ups performed by the installing contractor or third-party entity prior to or during construction.
- C. Each system, sub system, piece of equipment and component shall receive a full checkout. No sampling strategies are to be used. This checkout of the various systems to be commissioned shall verify that all components are properly installed. The checkout shall include, but not be limited to, the following items:
 - 1. Air Distribution Systems:
 - a. Mounting and support of equipment.
 - b. Noise, vibration, air and water leaks.

- c. Air filtration, presence and operation of dampers, diffusers, grilles, fire dampers and access doors.
 - d. Presence of thermostats and other adjustable temperature control devices.
 - e. Presence of smoke sensors and other safety devices.
 - f. Instrumentation, gauges, thermometers and flow measuring devices.
 - g. Access to equipment and filters.
 - h. Insulation of ductwork is complete.
 - i. Ductwork is sealed.
 - j. Power available to equipment.
 - k. Temperature controls are complete.
 - l. Air and water balancing is complete and a preliminary report available.
2. Heating and Cooling Systems Equipment and Piping:
- a. Service access is acceptable.
 - b. Proper cycling.
 - c. Excessive noise, vibration or leaks.
 - d. Presence of safety devices and controls.
 - e. Proper identification of all piping, valves, starters and equipment.
 - f. Pressure testing and flushing of systems has been completed.
 - g. Power available to equipment.
 - h. Temperature controls are complete.
 - i. Equipment start-up and checkout by the manufacturer's representatives are complete.
 - j. Air and water balancing is complete and a preliminary report available.
3. Plumbing Systems and Equipment:
- a. Service access is acceptable.
 - b. Proper cycling.
 - c. Excessive noise, vibration or leaks.
 - d. Presence of safety devices and controls.
 - e. Proper identification of all piping, valves, starters and equipment.
 - f. Pressure testing and flushing of systems.
 - g. Power available to equipment.
 - h. Equipment start-up and checkout by the manufacturer's representatives are complete.
4. Fire Protection System and Equipment:
- a. Service access is acceptable.
 - b. Proper identification of all piping, valves, and equipment.
 - c. Pressure testing and flushing of systems.
 - d. Power available to equipment.
 - e. All documentation required by NFPA has been completed
 - f. All switches and alarm devices have been wired and communicating with the fire alarm system.
5. Building Electrical System and Equipment:

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- a. Service access is acceptable to generator and transfer switches.
- b. Proper cycling.
- c. Excessive noise or vibration.
- d. Presence of safety devices and controls.
- e. Proper identification of all starters, switches and equipment.
- f. Power available to equipment.
- g. Equipment start-up and checkout by the manufacturer's representatives are complete.
- h. Fire alarm system is complete and all devices are communicating with the fire alarm master panel.
- i. All emergency lighting is in place and power is complete.
- j. Calibration of all sensors, switches, transducers and related control components shall be included as part of the installation verification performed by the Subcontractor(s).

6. Building Envelope Systems:

- a. Underground water proofing/membranes are in-place with water proofing integrity.
- b. Grouting and caulking of masonry walls complete and sufficient to prevent excessive air infiltration between joints.
- c. Airshafts are airtight with vapor barriers in place.
- d. Exterior walls: sufficient integrity to prevent excessive infiltration with the specified insulation in place:
 - 1) Window gasketing/window assemblies complete.
 - 2) Window to wall joints caulking complete.
 - 3) Panel joints caulking complete.
 - 4) Doorframes caulking complete.
 - 5) Wall insulation complete.
 - 6) Vapor barrier integrity complete.
- e. Interior Walls:
 - 1) Fire separations are in correct locations with fire and/or smoke damper installed properly.
 - 2) Sealing of walls to floors and slabs for required interior pressure relationships between spaces and for adequate fire separation.
- f. Roof:
 - 1) Roof to parapet joints complete.
 - 2) Flashing integrity complete.
 - 3) Roof insulation complete.
 - 4) Site lighting properly sealed.
- g. Exposed concrete decks: expansion joints in place, sealing/caulking completed.

- D. If any work is found incomplete, incorrect, or non-functional, the Subcontractor(s) shall correct the deficiencies before system start-up work proceeds.

3.4 SYSTEM START-UP

- A. The Contractor shall confirm that all start-up procedures take place and are documented in accordance with the requirements identified in Divisions 1, 3, 4, 5, 6, 7, 8, 9, 15, 16 and 17.
- B. A start-up schedule shall be developed and submitted by the Contractor to the CxA for approval. The Contractor shall be responsible for coordinating the Subcontractor(s), manufacturer's representatives and certified start-up technicians. The Contractor shall commence with system start-up after approval has been given to the start-up plan and after initial inspections by the Subcontractor(s) have been completed. The CxA shall witness system start-up on selected systems to be commissioned and document all system and equipment deficiencies noted during the start-up procedures.
 - 1. The Subcontractor(s) shall be responsible for submitting system start-up documentation in accordance with the requirements identified in 1, 3, 4, 5, 6, 7, 8, 9, 15, 16 and 17. Subcontractor shall provide the following:
 - a. Manufacturer's standard written start-up procedures copied from the installation manuals with check boxes by each procedure and a signature block added by hand at the end.
 - b. Manufacturer's standard issue field checkout sheets.
 - c. All documentation to include the date the start-up was performed and the name and credentials of the technician that performed it.
 - 2. The Contractor shall take corrective action on all system deficiencies noted and demonstrate to the CxA suitable system operation can be maintained. Approval from the manufacturer's representative or certified technician that originally discovered the deficiency is required.

3.5 PREREQUISITE FUNCTIONAL TESTING VERIFICATION

- A. The Contractor shall certify that systems to be commissioned have been completed, calibrated and start-up procedures have been completed. The Contractor shall verify that the systems to be commissioned are operating according to the OPR, BOD, and the Contract Documents and the Certificates of Readiness are signed and submitted.
- B. The Contractor shall certify that instrumentation and automated temperature controls associated with the systems to be commissioned have been completed and calibrated and are operating according to the OPR, BOD, and the Contract Documents and that preset set points have been recorded. A copy of the point-to-point checkout and sequence verification documents, resulting from the ATC sub contractor start-up, shall be provided to the CxA for review.
- C. The Contractor shall certify that the TAB procedures have been completed and that TAB preliminary reports have been submitted, discrepancies corrected and corrective work approved. The Contractor shall confirm that the equipment interface with monitoring and control system and TAB criteria including the following:
 - 1. Supply and return flow rated for variable flow and constant volume systems in each operational mode, including maximum and minimum flow capacity.
 - 2. Operation of terminal units in both heating and cooling cycles.
 - 3. Minimum outdoor air intake in each operational mode and at minimum and maximum airflows.

4. Building pressurization.
5. Total exhaust airflows and total outdoor air intake.
6. Operation of indoor air quality monitoring systems.

- D. The Contractor shall certify that all safety cutouts, alarms and interlocks with smoke control and life safety systems during each mode of operation have been tested, discrepancies corrected and corrective work approved.
- E. The Contractor shall confirm that all pre-functional check lists have been completed.

3.6 FUNCTIONAL PERFORMANCE TESTING

- A. The responsible Subcontractor will execute the functional performance testing under the direction of the CxA. The CxA shall observe the functional performance test procedures for all of the sub systems, equipment and components associated with the systems to be commissioned.
- B. Functional performance procedures may be executed by manual adjustment (i.e. manually manipulating the equipment and observe performance) or by monitoring the performance and analyzing the results using the control system's graphic trend log capabilities.
- C. Functional performance test procedures shall be performed using design conditions whenever possible to confirm design performance.
 1. If design conditions are not available then the functional performance test procedures shall be performed under conditions that simulate actual conditions to the closest practical approximation.
- D. The Subcontractor executing the functional performance test procedure shall provide all necessary materials, system modifications, etc. to produce the flows, pressures, temperatures, etc. necessary to execute the test under specified conditions.
- E. At completion of the functional performance testing, the Subcontractor executing the functional performance test procedure shall return all affected building equipment and systems to their pre-test condition.
- F. The functional test procedures are meant to allow the CxA to observe, evaluate, identify deficiencies, recommend modifications, adjust, and document the systems and systems equipment performance over a range of load and functional levels. In general, functional performance testing will be performed as listed on the following systems:
 1. Air Distribution Systems:
 - a. The TAB Subcontractor shall demonstrate total airflow at each air handling system to be commissioned at simulated full cooling, heating and/or max/min or fresh (outside) air.
 - b. Spot checks of approximately 50% of air outlets shall be made. The CxA shall select outlets and the TAB Subcontractor shall demonstrate a reading of that outlet. Where appropriate, the thermostat shall be adjusted to simulate full cooling, full heating, etc.

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- c. The TAB Subcontractor shall demonstrate proper room static pressure with respect to the adjacent space(s) where applicable.
- d. The TAB Subcontractor shall demonstrate motor speed, voltage and amperage draw at selected fan motors.
- e. The TAB Subcontractor shall verify the proper calibration of temperature, pressure and safety devices as installed on the various pieces of mechanical equipment. The Testing and Balancing Contractor (TAB) shall assist the CxA in the proper setting of all temperature, pressure and safety devices.
- f. Any noted drafts or noisy air distribution devices shall be evaluated and corrective action identified.
- g. Any discrepancies between the balancing report and the spot check results shall be dealt with to correct all deficiencies. In the event that significant deficiencies are detected, the entire balancing procedure shall be repeated.

2. Hydronic Distribution Systems:

- a. The TAB Subcontractor shall demonstrate total water flows at each pump, air handler, chiller, boiler and terminal heating equipment.
- b. Spot checks of approximately 50% of hydronic balancing valves shall be made. The CxA shall select outlets and the TAB Subcontractor shall demonstrate a reading of that outlet. Where appropriate, the thermostat shall be adjusted to simulate full cooling, full heating, etc.
- c. The TAB Subcontractor shall demonstrate motor speed, voltage and amperage draw at selected pump motors.
- d. The TAB Subcontractor shall assist in verifying the calibration and operation of any flow meters and differential pressure sensors.
- e. The TAB Subcontractor shall assist in verifying the calibration and operation of any temperature sensors.
- f. Any discrepancies between the balancing report and the spot check results shall be dealt with to correct all deficiencies. In the event that significant deficiencies are detected, the entire balancing procedure shall be repeated.

3. Exhaust Systems:

- a. The TAB Subcontractor shall demonstrate total airflow at each exhaust fan system to be commissioned.
- b. Spot checks of approximately 50% of air outlets shall be made. The CxA shall select outlets and the TAB Subcontractor shall demonstrate a reading of that outlet.
- c. The TAB Subcontractor shall demonstrate motor speed, voltage and amperage draw at selected fan motors.
- d. The TAB Subcontractor shall demonstrate proper room static pressure with respect to the adjacent space(s) where applicable.
- e. Any noted drafts or noisy air distribution devices shall be evaluated and corrective action identified.
- f. Any discrepancies between the balancing report and the spot check results shall be dealt with to correct all deficiencies. In the event that significant deficiencies are detected, the entire balancing procedure shall be repeated.

4. Automated Temperature Controls (inclusive of all applicable systems):

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- b. The ATC Subcontractor shall demonstrate the proper operation of the temperature control sequences for each systems, sub systems, equipment and components serving the systems to be commissioned.
 - c. The sequences to be commissioned include, but are not limited to, the following:
 - 1) Occupied/unoccupied time sequences.
 - 2) Night setback/night set-up features.
 - 3) Morning warm-up sequences.
 - 4) Air-side economizers.
 - 5) Proper control of discharge air temperature from air handling equipment including reset temperature sequences.
 - 6) Heating hot water discharge temperature control to the building systems including hot water reset.
 - 7) Proper staging and control of the heat exchangers.
 - 8) Lead/lag operation of the various pumps.
 - 9) Control of hot water freeze pumps.
 - 10) Proper control and discharge temperatures from the reheat coils.
 - 11) Operation and control of the fan coils and unit heaters.
 - 12) Proper operation and control of the air-cooled chillers and condensers.
 - 13) Run standby operation of pumps.
 - 14) Proper operation and control of any energy recovery systems.
 - 15) Proper control of the refrigerant alarm exhaust fans
 - 16) Proper annunciation of building alarms including fail safe controls and proper shut down of equipment.
 - 17) Proper control of all air handling equipment with respect to air volume.
 - 18) Calibration of all temperature pressure and safety devices.
 - 19) Proper display of all ATC graphics.
 - 20) Control of all automatic control valves and dampers.
 - 21) Assist in calibration of all airflow stations.
 - 22) Demonstrate proper operation of any smoke control management systems.
 - 23) Demonstrate proper system operation when operating on emergency power.
 - 24) Demonstrate proper operation when electrical systems return back to "Normal" power.
 - d. The ATC Subcontractor shall demonstrate that a point-to-point checkout of all control points was completed.
 - 1) The control contractor and CxA will verify in the field and through the building automation system that the points both input and output actually exist and are terminated and identified correctly.
5. Plumbing Systems:
- a. Proper operation and control of the domestic water heating system.
 - b. Proper operation and calibration of the thermostatic mixing valves.
 - c. Verify proper operation and set-up of the emergency showers / eyewash units
6. Electrical Systems:

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- a. The electrical Subcontractor shall demonstrate the proper operation of the Emergency Power Systems including transfer of power from “Normal” to “Emergency” and back to “Normal” power.
 - b. The electrical Subcontractor shall demonstrate proper operation of emergency lighting during an emergency power scenario.
 - c. The electrical Subcontractor shall demonstrate proper operation of building and site lighting controls.
 - d. The electrical Subcontractor shall demonstrate site lighting time-clock operations.
 - e. Assist in the verification all fire alarm points including smoke detectors, pull stations, water flow switches, tamper switches, and any smoke damper control. Verify all addresses are complete and accurate.
 - f. Assist in the functional performance testing of the transformers.
 - g. Assist in the power monitoring.
7. Building Envelope Systems:
- a. Roofs including all penetrations, transitions, etc.
 - b. Skylights and other sloped glazing
 - c. Exterior walls, including the air barrier system, and water management systems
 - d. Windows
 - e. Doors, louvers
 - f. Sealants and expansion joints
 - g. Control joints
 - h. Flashings, including all transitions, end-dams, etc.
 - i. Shading devices
 - j. Curtain walls or window walls, storefront
 - k. Below-grade construction, including drainage and waterproofing/damp proofing
 - l. Floors, slab-on-grade
 - m. Interface conditions between each of the above listed elements
 - n. Other special building exterior enclosure systems, equipment and controls.
 - o. Building pressurization testing (Sub contractor provided).
 - p. Infrared imaging (Sub contractor provided as applicable).
 - q. Mass Water Infiltration (Sub contractor provided as applicable).
8. Problem Solving
- a. The CxA will recommend solutions to problems found, however the burden of responsibilities to solve, correct and retest problems rests with the Contractor, Subcontractor, Architect and Engineering of Record.
9. Trend Logs:
- a. Upon completion of successful functional performance testing the ATC contractor shall submit graphic trend logs to the Commissioning Team utilizing the trend functions of the building automation system.
 - b. Trend logs shall be color graphics with a legend and include the dates, timeline and point identification (i.e. hot water supply temperature, etc.) for the trend data.
 - c. Submit graphic trend logs for each piece of controlled equipment and include all necessary points and controlled parameter to clearly identify the equipment operation.

- d. Trend logs shall be submitted demonstrating successful performance for a seven (7) day period unless the controlled process requires a longer timeline.
- e. Trend log shall be submitted demonstrating successful seasonal performance.

3.7 OPPOSITE SEASON/DEFERRED FUNCTIONAL PERFORMANCE TESTING

- A. The purpose of opposite seasonal functional testing is to evaluate the performance of selected equipment during design weather conditions that may not have been available during the initial functional testing. Ideally cooling equipment needs to be functionally tested under hot, humid summer conditions to ensure proper operation in accordance with design specifications. The same is true for heating hot water, steam system and humidification systems which require colder, drier, winter climates.
- B. The purpose of deferred functional performance testing is to evaluate the performance of a selected system that may have been partially complete during the initial functional performance testing of the system's components. Ideally systems need to be functionally tested once completed but, due to project phasing, may be completed at the component level before being completed at the system level.
- C. The functional performance testing performed during seasonal/deferred testing will adhere to the guidelines listed above in section 3.6 in its entirety of this Section.
- D. The documentation and resolution of any noted deficiencies will be performed in accordance with section 1.7 sub section H and section 3.8 in its entirety of this Section.

3.8 DOCUMENTATION OF COMPLIANCE AND NON-COMPLIANCE

- A. Documentation:
 - 1. The CxA will witness and document the results of the functional performance tests using the specific procedural forms (i.e. functional performance test sheets) developed for that purpose.
 - 2. Recorded information will include measured performance data, visual observations and a comprehensive summary describing the operation of systems at the time of testing.
 - 3. Functional performance test sheets for each controller verifying proper operation of the control system, the system it serves, the service it provides and its location will be provided.
 - 4. All functional performance test sheets, procedural forms, etc. used to document compliant and non-compliant performance will remain the property of the CxA until the end of the project at which point they will become the property of the Owner.
- B. Compliance
 - 1. The CxA will record the results of the functional performance testing on each specific procedural form. Tests found to be compliant with the testing criteria stated in the procedural form will be identified as such and submitted to the Owner for approval.
 - 2. Where applicable, additional performance information may be recorded for future use or reference by the CxA when developing additional project documentation.
- C. Non- Compliance

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1. The CxA will record the results of the functional performance testing on each specific procedural form. Tests found to be non-compliant with the testing criteria stated in the procedural form will be identified as such.
2. Corrections of minor deficiencies identified may be made during the functional performance testing at the discretion of the CxA. In such cases the deficiency and resolution will be documented on the procedure form for record.
3. Every effort will be made to expedite the testing process and minimize unnecessary delays, while not compromising the integrity of the procedures. However, the CxA will not be pressured into overlooking deficient work or loosening acceptance criteria to satisfy scheduling or cost issues, unless there is an overriding reason to do so at the request of the Owner.
4. Should a deficiency be identified that cannot be readily corrected during the functional performance testing the CxA will notify the installing Contractor or Subcontractor. If there is no dispute regarding the nature of said deficiency then the installing Contractor or Subcontractor accepts the responsibility to correct it.
 - a. The CxA will document the deficiency, the Contractor or Subcontractor's response and their intentions and proceed to the next functional performance test.
5. If functional performance tests cannot be completed because of a deficiency outside the scope of the Contractor or Subcontractor responsible for installation of the system or equipment to be commissioned then the deficiency shall be documented and reported to the Owner.
 - a. The CxA will document the deficiency, the responsible Contractor or Subcontractor's response and their intentions and proceed to the next functional performance test.
6. After completion of the functional performance testing the CxA will publish all deficiencies through the web-based interactive commissioning database. At this point the deficiencies will be assigned a tag, responsibility and status and be known as "commissioning issues".
7. If there is any dispute regarding a specific commissioning issue or issues in general; whether the assigned responsibility or the nature of the issue are being disputed then the dispute will be documented and a copy given to the Contractor, Design Team and Owner for evaluation and resolution.
8. The intent is to make resolutions at the lowest management level possible. Other parties are brought into the discussions as needed. The Owner maintains the final interpretive authority.
9. Once the interpretation and resolution have been agreed upon by all parties, the appropriate party addresses the commissioning issue and updates the web-based interactive commissioning database indicating corrective action has taken place. The CxA will reschedule the functional performance test and the test will be repeated until satisfactory performance is achieved.
10. If it is determined that the system is constructed according to the Contract Documents the Owner will decide whether modifications required to bring the performance of the system to the OPR and BOD documents shall be implemented or if the noted performance will be accepted as submitted. If additional work is performed outside of the original project scope then the Owner will decide if functional performance testing shall be repeated and a revised functional performance test sheet submitted.

D. Cost(s) of Re-testing Non-Compliant System or Equipment

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1. The cost for the Contractor or Subcontractor to perform re-testing, if they are responsible for the deficiency preventing a successful initial functional performance test, shall be theirs. If they are not responsible, any cost recovery for retesting costs shall be negotiated with the Owner.
2. The cost associated with the time used by the CxA to direct any re-testing required because a specific pre-functional checklist, start-up or commissioning notice issue, reported to have been successfully completed, but determined during functional performance testing to be incomplete, will be back-charged to the Contractor, who may choose to recover costs from the party responsible.

E. Failure Due to Manufacturing Defect

1. If 10% or a total of three (3), whichever is greater, of identical pieces (size alone does not constitute a difference) of equipment fail to perform to the Contract Documents (mechanically or substantively) due to manufacturing defect, not allowing it to meet its submitted performance, all identical units may be considered unacceptable by the CxA. In such case, the responsible Contractor or Subcontractor shall provide the Owner with the following:
 - a. Within one week of original notification the Contractor or Subcontractor shall coordinate with the vendor and/or manufacturer's representative and shall examine all other identical units making a record of the findings.
 - b. Within two weeks of the original notification, the Contractor, Subcontractor vendor and manufacturer's representative shall provide a signed and dated, written explanation of the problem, cause of failures, etc. and all proposed solutions which shall include full equipment submittals, training, warranty, etc.
 - c. The proposed solution shall significantly exceed the specified requirements of the original installation and meet or exceed the performance identified in the Contract Documents.
 - d. The Owner will determine whether a replacement of all identical units or a repair is acceptable.
 - e. Two (2) examples of the proposed solution will be provided by the Contractor or Subcontractor and all parties will be allowed to test and review the performance for up to one week, upon which the Owner will decide whether to accept the proposed solution.
 - f. Upon acceptance of the proposed solution by the Owner, the responsible party shall replace or repair all identical units, at their expense and extend the warranty accordingly, if the original equipment warranty had already begun. The replacement/repair work shall proceed with reasonable speed beginning within one week from when replacement parts or units can be obtained.

F. Cost(s) of Re-testing System or Equipment due to Manufacturing Defect

1. The cost for the Contractor or Subcontractor to perform re-testing, if they are responsible for providing the defective equipment, shall be theirs. If they are not responsible, any cost recovery for retesting costs shall be negotiated with the Owner.
2. The cost associated with the time used by the CxA to direct any re-testing required because of defective equipment, will be back-charged to the Contractor, who may choose to recover costs from the party responsible.

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3.9 OPERATION AND MAINTENANCE TRAINING REQUIREMENTS

- A. The Contractor and Subcontractors shall be responsible for coordinating, scheduling and completing operations and maintenance training for the Owners designated personnel on all systems and equipment to be commissioned.
1. All training materials (agenda, hand-outs, etc.) shall be submitted to the CxA for review and approval at least two weeks in advance of scheduled training.
 2. Equipment training shall be provided by a factory authorized technical representatives, experienced in training, operation and maintenance procedures for installed systems, subsystems and equipment.
 3. All qualifications and certifications of the individual performing the training shall be submitted to the CxA for review and approval at least two weeks in advance of scheduled training.
 4. Each Subcontractor responsible for training will submit a written training plan to the CxA for review and approval at least two weeks in advance of scheduled training. The plan will include field orientation during installation, classroom instruction and field training after the completion of installation and cover the following elements:
 - a. Equipment (to be included in training).
 - b. Intended audience
 - c. Location of training
 - d. Objectives
 - e. Subjects to be covered (i.e. description, special methods, etc.)
 - f. Duration of training on each subject.
 - g. Instructor for each subject
 - h. Methods of instruction (i.e. classroom lecture, video, site walk-through, actual operational demonstrations, written handouts, etc.)
 - i. Instructor and qualifications
 5. For all major systems and equipment, the ATC subcontractor shall provide a short discussion of the control of the equipment during the mechanical or electrical training conducted by others in addition to formal ATC training on work station operation, graphics, etc.
 6. Subcontractors shall provide all qualified personnel, including manufacturer representatives, vendors, technicians, installing personnel, etc. for equipment and system training.
- B. The CxA will verify and approve the content and adequacy of the training of Owner personnel for systems to be commissioned.
1. Training rigor: to be established by Owner and CxA.
 2. In addition to these general requirements, the specific training requirements for Owner personnel are specified in Divisions 1, 3, 4, 5, 6, 7, 8, 9, 15, 16 and 17.
- C. Training Planning Meeting: Before operation and maintenance training, CxA shall convene a training planning meeting to include Owner's operation and maintenance personnel, the Contractor, and the Subcontractors. In addition to requirements specified in other Divisions, the following will be reviewed with all in attendance:
1. Review of the OPR and BOD.

2. Review installed systems, subsystems, and equipment.
3. Review instructor qualifications
4. Review instructional methods and procedures.
5. Review training module outlines and contents.
6. Review course materials (including operation and maintenance manuals.
7. Verify and discuss locations and other facilities required for instruction.
8. Review and finalize training schedule and verify availability of educational materials, instructors, audiovisual equipment, and facilities needed to avoid delays.
9. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

3.10 EXCLUSIONS

- A. The CxA is not responsible for the following: facilitating construction means or methods, regulating job site safety or providing any other unrelated management function.
- B. The CxA is not responsible for providing Design Engineering services.
- C. The CxA is not responsible for providing installation technician services requiring tools or the use of tools to functionally test, adjust or otherwise bring equipment into a fully operational state. The CxA shall observe technicians as they complete testing, and may make minor adjustments, but shall not perform installation or technician services. The Contractor and/or appropriate Subcontractor are responsible for providing all installation technician, vendor or manufacturer representative services as needed to meet the CxA's needs.

END OF SECTION 01810



DEERFIELD ACADEMY
FITNESS CENTER & GREER STORE
DEERFIELD, MA

DATE: 2010 SEP 15

OUTDOOR AIR TEMPERATURE: 66.0 Deg F
OUTDOOR AIR RELATIVE HUMIDITY: - % RH

System: Air Handling Unit

Tag: AHU-9
(Serves Dining Hall South Bubble)

FUNCTIONAL PERFORMANCE TEST PROCEDURE- RECORD SHEET

I. Documentation Requirements

Prior to executing the functional performance test procedures the Commissioning Authority requires the following completed documentation be submitted:

1. Manufacturer's Start-Up Report (if applicable)
2. Pre-Functional Checklist
3. Air and Water Balancing Report (preliminary or final)
4. Automated Temperature Controls Checklist
5. Verification that installing Contractor(s) are complete.

II. System Components

Prior to the functional performance and verification process, the Commissioning Authority shall verify all major system components, capacities, configurations and support functions are consistent with the design and supplemental documentation received. The following shall be verified per the Contract

1. Air Handling Unit Identification

McQuay
Model: CAH010GDAC

1. Fan Motor Performance (nameplate):

Supply Fan

Horsepower (HP)	Voltage (Volt)	Phase	FLA (Amp)
10	200	3	29.5

2. Verify factory start-up has been performed and any available reports submitted:
➤ Air handling unit start-up report.

Compliance: _____
Non-compliance: X

Remarks: ***Please provide a copy of any reports resulting from the start-up process for the air handling unit that confirms that the listed tasks were addressed. This form should also include the date that the start-up was performed and the name of the company and / or individual that performed it.***

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2. Verify duct insulation is installed: Compliance: X
 ➤ All supply air and make-up air ducts are to be Non-compliance:
 insulated with 1 ½" fiberglass

Remarks: ***The supply and return air ductwork has all been internally lined.***

3. Verify fan rotation, lubrication and belt alignment for Compliance: X
 the supply fan. Non-compliance:

Remarks:

4. Verify construction start-up filters were removed and Compliance:
 replaced with new filters: Non-compliance: X

Remarks: ***The cartridge filters have been removed due to excessive suction static pressure on the inlet of the supply fan (reported that the condensate would not drain unless filters were removed). Mechanical contractor to review and confirm proper trap dimensions have been provided as per unit manufacturer's requirements.***

5. Verify unit is installed with ample clearance for Compliance: X
 maintenance and repair of all components. Non-compliance:
 ➤ Verify supply and return fan access and coil pull space.

Remarks:

6. Verify fans have been statically and dynamically Compliance: X
 balanced: Non-compliance:
 ➤ Observe operation for evidence of extensive vibration or noise.

Remarks:

7. Verify installation of premium efficiency motors. Compliance: X
 Non-compliance:

Remarks: ***The motors are Baldor Super-E premium efficiency motors and have a nominal nameplate efficiency of 91.7 %.***

8. Verify unit installation in accordance with equipment submittal:			
	Yes		No
Pre-Filter Section			
2" Pleated Pre-Filter Section	X		

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Filter Rack Blank-off Plates	X		
Access Door	X		
Filter Section			
4" Cartridge-Filter Section	X		
Filter Rack Blank-off Plates	X		
Access Door	X		
Heating Coil Section			
Hot Water Heating Coil	X		
Stainless Steel Drain Pan	X		
Access Section			
Access Door (between coils)	X		
Cooling Coil Section			
Chilled Water Cooling Coil	X		
Stainless Steel Condensate Drain Pan	X		
Supply Fan Section			
Supply Fan	X		
Fan Spring Isolators	X		
Fan Access Door	X		

Remarks:

9. Verify HW coil piping arrangement installation per typical detail on drawing HG-M-01 (Dining Hall Hot Water Conversion):

	Yes		No
HWS Manual Isolation Valve	X		
HWS Strainer and Blowdown Valve w/ Hose End			X
HWS 2-Way Control Valve w/ Unions	X		
HWS Coil Union	X		
HWR Balancing	X		
HWR Coil Union	X		

Remark ***The HWS strainer has not been provided with blow down valve. Mechanical contractor to correct.***

10. Verify installation of HW coil air vents and drain valves.

Compliance: X
Non-compliance:

Remarks:

11. Verify hot water piping and equipment have been:
- Insulated.
 - Identified correctly.
 - All valves have been provided with valve I.D. tags as per campus standard.

Compliance: X
Non-compliance:

Remarks:



12. Verify CHW coil piping arrangement installation per typical detail on drawing HG-M-03 (South Infrastructure Project – AHU-8 arrangement):

	Yes	No
CHWS Manual Isolation Valve (upstream of control valve)	X	
CHWS Strainer and Blowdown Valve w/ Hose End		X
CHWS 2-Way Control Valve w/ Unions		X
CHWS Manual Isolation Valve (downstream of control valve)		X
CHWS Coil Union	X	
CHWR Manual Isolation Valve	X	
CHWR Balancing Valve	X	
CHWR Coil Union	X	

Remark ***The chilled water coil control valve is installed in the CHWR return piping as opposed to the CHWS piping and the manual isolation valves around the control valve have not been installed as required per detail on drawing HG-M-03 (South Infrastructure Project). Are these additional valves required (manual isolation valves on either side of the control valve have not been provided on any other units)? Owner to review and advise.***

The CHWS strainer has not been provided with blow down valve. Mechanical contractor to correct.

The insulation downstream of the chilled water control valve is stained with what appears to be glycol. Is this piping leaking? Mechanical contractor to review.

13. Verify installation of CHW coil air vents and drain valves.

Compliance: X
Non-compliance:

Remarks:

14. Verify chilled water piping and equipment have been:
- Insulated.
 - Identified correctly.
 - All valves have been provided with valve I.D. tags as per campus standard.

Compliance: X
Non-compliance:

Remarks:

15. Verify installation of stainless steel CHW coil condensate drain pan.
- Verify drain pan is pitched towards drain connections.

Compliance: X
Non-compliance:

Remarks:

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16. Verify installation of cooling coil condensate trap and drain assembly.

Compliance: _____
Non-compliance: X

Remarks: ***See above regarding air flow.***

17. Verify installation of supply fan service switch.
➤ Record overload limits (if applicable).

Compliance: X
Non-compliance: _____

Remarks: ***An adjustable overload has been provided and appears to be set at approximately 32 amps.***

18. Verify installation of vibration isolation and seismic restraint:
➤ Compare with seismic/isolation submittal.
➤ Verify compliance with seismic engineer final report (if applicable).

Compliance: _____
Non-compliance: X

Remarks: ***There are no seismic restraints installed on the suspended chilled water piping or hot water piping. Should seismic restraints be provided to meet local Code requirements? Mechanical contractor to review.***

Has the air handling unit been anchored to the concrete pad? Are anchors required to meet Code requirements? Mechanical contractor to review.

19. Verify all equipment (supply fan, return fan, air handling unit, VFD) have been labeled.

Compliance: X
Non-compliance: _____

Remarks:

20. Verify installation of fire dampers at floor penetrations for supply and return ductwork.
➤ Verify duct access door has been provided at each location.

Compliance: X
Non-compliance: _____

Remarks:



III. Functional Performance Testing

The following test shall be verified per the requirements of the Contract Documents. All measurements will be recorded with the following equipment unless otherwise noted:

1. Temperature/Humidity: Fluke Temperature and Humidity Meter Model 971
2. Voltage/Amperage/Continuity: Fluke 902 HVAC Clamp Meter
3. Air Pressure/Airflow: Shortridge Model M05662 Multi-Meter

A. Control Device Calibration / Verification

1. Verify installation/operation of the **supply air** duct temperature sensor (T1):

Compliance: _____

Non-compliance: X

- Verify calibration to within ± 1 degree F.
- Record sensor location.

Remarks: ***The supply air temperature sensor measured 56.2 deg F through the building automation system versus the measured value of 53.1 deg F. A 3 deg F offset was added and the discharge air temperature measured 53.2 deg F through the building automation system. Item corrected on site.***

The supply air temperature sensor is located in the discharge air ductwork downs stream of the duct smoke detector.

2. Verify installation/operation of the **space** temperature sensor (T4):

Compliance: X

Non-compliance: _____

- Verify calibration to within ± 1 degree F.
- Record sensor location.
- Confirm local set point adjustment capability.

Remarks: ***The space temperature sensor measured 72.5 deg F through the building automation system versus the measured value of 74.5 deg F. A 2 deg F offset was added and the discharge air temperature measured 72.5 deg F through the building automation system. Item corrected on site.***

3. Verify supply fan status is properly reported through the BAS via current switch.

Compliance: X

Non-compliance: _____

- Verify that the current switch has been properly adjusted in accordance with the manufacturer's requirements (applicable for adjustable current switches).
- Record parameters.

Remarks: ***Supply fan status is based on a current switch.***

4. Verify control valve operation, direction and full stroke when adjusted through the BAS:

Compliance: X

Non-compliance: _____

- Hot Water Coil Control 2-Way Valve (V1)
- Chilled Water Coil Control 2-Way Valve (V2)



Remarks:

B. Fan Performance

1. Record fan performance at design flow:

Airflow (CFM)	Total Pressure (inches)	
	Inlet	Discharge

- a. Supply Fan (4,500 CFM)

Remarks: **The supply fan air flow was verified with the air and water balancer against the air and water balancing report. The air flow was measured via traverse of the supply air ductwork (26x18 inch duct with internal lining) and measured a velocity of 2,042 FPM which yielded total of 5,445 CFM which is nearly 20% over the design value of 4,500 CFM. The fan is constant speed and requires a sheave change. Mechanical contractor to correct.**

2. Record motor performance design conditions as noted above:

Voltage (volts)	Amperage (amps)	Frequency (Hz.)

- a. Supply Fan (4,000 CFM)

Remarks: **The motor performance at the disconnect switch measured: 205, 206, 205 volts L-L; 119, 119, 119 volts L-G and 22.6 amps**

C. Sequence of Operations

1. Verify start / stop capability through the building automation system (BAS):
- Verify occupied / unoccupied scheduled operation has been provided.
 - Record parameters.

Compliance: _____
Non-compliance: X

Remarks: **The individual unit occupancy schedule will index the air handling unit to occupied and unoccupied mode.**

Presently, this air handling unit is scheduled for occupied operation Monday through Sunday 6:00 AM to 5:00 PM. Owner to review and advise if schedule is acceptable.

Unoccupied Mode

2. Verify unit operation when indexed to unoccupied mode; verify that the following occurs:
- The supply fan is disabled.
 - The chilled water coil control valve and hot water coil control valve are closed.

Compliance: X
Non-compliance: _____



Remarks: **Functional performance testing of the occupied / unoccupied operations was performed by manually adjusting the occupied / unoccupied mode point.**

3. Verify that if the space temperature drops below the unoccupied space temperature set point of 60 deg F the following will occur:

Compliance: X
Non-compliance:

- The unit will be indexed to warm-up mode (see below) until the space temperature rises above set point.
- Record parameters.

Remarks: **When the unit is indexed to unoccupied mode and the space temperature drops below the unoccupied space heating set point of 63 deg F the unit is enabled.**

When the unit is indexed to unoccupied mode and the space temperature rises above the unoccupied space cooling set point of 78 deg F the unit is enabled.

Warm-Up Mode

4. Verify that if, at the start of occupied mode, the space temperature is below 68 deg F the following occurs:

Compliance: X
Non-compliance:

- The supply fan is enabled and will run continuously.
- The discharge air temperature set point is reset to 100 deg F.

Remarks: **The discharge air temperature set point was set at 110 deg F when the unit was indexed to occupied mode and the space temperature was below 68 deg F.**

5. Verify that warm-up mode is terminated when the space temperature rises above 72 deg F.

Compliance: X
Non-compliance:

Remarks:

Occupancy Override

6. Verify that if that the air handling unit will be indexed to occupied mode through the local thermostat:

Compliance: X
Non-compliance:

- The air handling unit will be indexed to occupied mode for 2 hours.

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Remarks: ***The occupancy override function was functionally tested at the local thermostat.***

The space thermostat has been provided with a factory programmed 90 minute override set point limit. Each push of the local occupancy override button will index the unit to 30 minutes of occupied operation up to a maximum limit of 90 minutes. Per the sequence of operations the override is to last 2 hours and be adjustable. Do the current parameters meet the intended operation? Owner to review and advise.

Occupied Mode

7. Verify the following when the unit is indexed to occupied mode:

Compliance: X
Non-compliance:

- The supply fan is enabled and will run continuously.

Remarks:

HW Coil Operation

8. Verify that that hot water coil control valve will modulate open to maintain the discharge air temperature set point:

Compliance: X
Non-compliance:

- Verify that valve operation is contingent on (global) availability of the hot water plant.

Remarks: ***The hot water coil control valve will modulate open to maintain the discharge air temperature which is reset from 68 deg F to 110 deg F based on the deviation between the space temperature and the space temperature set point.***

The operation of the hot water coil control valve is contingent on the status of the heating hot water plant.

CHW Coil Operation

9. Verify that the chilled water coil control valve will modulate open to maintain the space temperature set point:

Compliance: X
Non-compliance:

- Verify that valve operation is contingent on (global) availability of the chiller plant.



Remarks: ***The chilled water coil control valve will modulate open to maintain the space temperature set point.***

The operation of the chilled water coil control valve is contingent on the status of the chilled water plant (chilled water pumps in dining hall).

D. Alarms and Safeties

1. Verify that if the **supply fan** fails to prove status when enabled the following will occur:
 - The supply and exhaust fans are disabled.
 - The outdoor air and exhaust air dampers are closed.
 - An alarm is generated through the BAS and displayed on the graphic.

Compliance: X
Non-compliance:

Remarks: ***The fan failure alarms have been programmed to generate a failure alarm when the fan status does not match the ON command (no delay). The fan failure alarm was confirmed through the web-enabled graphics.***

A fan hand alarm has also been programmed to generate a hand alarm when the fan status does not match the OFF command (no delay). The fan hand alarm was confirmed through the web-enabled graphics. This alarm will be displayed but is not a critical alarm (i.e. no exclamation point on the graphic).

The fan enable/disable command has been provided with a 2 minute minimum OFF time that will not allow the fan to re-start for 2 minutes after the fan has been disabled.

2. Verify the following information is available and accurate at the operator's workstation:				
		Yes		No
a.	Occupied/Unoccupied Schedule	X		
b.	Occupied/Unoccupied Status	X		
c.	Supply Fan Start/Stop	X		
d.	Supply Fan Status	X		
e.	Hot Water 2-Way Valve Command (V1)	X		
f.	Chilled Water 2-Way Valve Command (V2)	X		
g.	Space Temperature (T2)	X		
h.	Supply Air Temperature (T1)	X		
i.	Outdoor Air Temperature	X		
j.	Outdoor Air Humidity/Enthalpy	X		
k.	Graphic Display			X

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Remarks: ***The graphic includes what appears to be a utility meter at the top of the graphic that is displaying 0.00 kW and a demand of 0. What is this meter for? Has this been properly mapped back? ATC contractor to review.***

ADDITIONAL NOTES:

- 1. The programming logic has been provided with additional high and low space air temperature alarms. The high and low space temperature conditions have been set-up to generate an alarm when the space temperature is above 76 deg F or below 64 deg F, respectively. Both alarms have been provided with an additional 5 minute delay once the alarm condition is proven. Both alarms were confirmed through the web-enabled graphics. Are these set points acceptable? Owner to review and advise.***

RFQ No. DEFK11023

STATE OF WEST VIRGINIA
Purchasing Division

PURCHASING AFFIDAVIT

West Virginia Code §5A-3-10a states: No contract or renewal of any contract may be awarded by the state or any of its political subdivisions to any vendor or prospective vendor when the vendor or prospective vendor or a related party to the vendor or prospective vendor is a debtor and the debt owed is an amount greater than one thousand dollars in the aggregate.

DEFINITIONS:

"Debt" means any assessment, premium, penalty, fine, tax or other amount of money owed to the state or any of its political subdivisions because of a judgment, fine, permit violation, license assessment, defaulted workers' compensation premium, penalty or other assessment presently delinquent or due and required to be paid to the state or any of its political subdivisions, including any interest or additional penalties accrued thereon.

"Debtor" means any individual, corporation, partnership, association, limited liability company or any other form or business association owing a debt to the state or any of its political subdivisions. "Political subdivision" means any county commission; municipality; county board of education; any instrumentality established by a county or municipality; any separate corporation or instrumentality established by one or more counties or municipalities, as permitted by law; or any public body charged by law with the performance of a government function or whose jurisdiction is coextensive with one or more counties or municipalities. "Related party" means a party, whether an individual, corporation, partnership, association, limited liability company or any other form or business association or other entity whatsoever, related to any vendor by blood, marriage, ownership or contract through which the party has a relationship of ownership or other interest with the vendor so that the party will actually or by effect receive or control a portion of the benefit, profit or other consideration from performance of a vendor contract with the party receiving an amount that meets or exceeds five percent of the total contract amount.

EXCEPTION: The prohibition of this section does not apply where a vendor has contested any tax administered pursuant to chapter eleven of this code, workers' compensation premium, permit fee or environmental fee or assessment and the matter has not become final or where the vendor has entered into a payment plan or agreement and the vendor is not in default of any of the provisions of such plan or agreement.

Under penalty of law for false swearing (*West Virginia Code §61-5-3*), it is hereby certified that the vendor affirms and acknowledges the information in this affidavit and is in compliance with the requirements as stated.

WITNESS THE FOLLOWING SIGNATURE

Vendor's Name: Sustainable Engineering Solutions, LLC.

Authorized Signature:  Date: 1/10/11

State of CT

County of Hartford, to-wit:

Taken, subscribed, and sworn to before me this 10th day of January, 20 11.

My Commission expires 3/31, 20 13.

AFFIX SEAL HERE

NOTARY PUBLIC 