UNIVERSITY OF CENTRAL ARKANSAS™

A D D E N D U M #2

February 28, 2023

PROPOSAL NUMBER:	UCA-23-040
OPENING DATE:	March 2, 2023
OPENING TIME:	10:00 a.m.
PROJECT:	Schichtl HVAC Upgrades

The attached addendum forms a part of the contract documents and modifies or interprets the proposal documents, as noted below.

Receipt of this addendum is required by acknowledging on Bid Form Section 004113, line item #7.

If you have any questions concerning this addendum, please contact Pam Giblet 501-450-3156.

Cordially,

Pam Giblet

Pam Giblet
Construction and Contract Manager

pettitpettit
CONSULTING ENGINEERS, INC

Established 1949

ADDENDUM NUMBER: TWO (**2**)

TO: PROJECT MANUAL AND DRAWINGS

FOR: UCA Schichtl Hall
HVAC Upgrades
Conway, Arkansas
Pettit & Pettit Project #22-003

DATE: February 28, 2023

BID DATE: March 2, 2023 at 10:00 am

This Addendum forms a part of the Contract Documents and modifies or interprets the Project Manual and Drawings, as noted below.

ADDENDUM ITEMS - Specifications:

A1. ADD Section 019113 – General Commissioning Requirements.

A2. Refer to Section 230515 – Variable Frequency Motor Controls – Buildings & HVAC. REVISE Paragraph 2.01 as follows:

2.01 ACCEPTABLE MANUFACTURERS

A. ABB (ACH 580 Series).
B. Danfoss.
C. Yaskawa
D. Square D.
Note: No other alternate manufacturers will be accepted.

A3. ADD Section 230800 –Commissioning of HVAC Systems.

A4. Refer to Section 230923 – Direct Digital Control System for HVAC. REVISE Paragraph 1.03A as follows:

A. System Installer Qualifications – The installers shall be limited to:
1. Schneider Electric / Wade Company
2. Alerton / Northwest Controls
3. No other installers will be allowed.

A5. DELETE Section 235100 – Double Wall Gas Vent (Category IV). Boiler flues shall be Schedule 80 PVC.

PRE-BID RFI'S:

1. The drawing sheet A1.01 called for R-30 batt insulation. The Specification 09 51 00 -2 / 2.04.D indicated the thickness is 2". There is not a spec section 07 21 00 in the project manual. 2" is a compressed of R-11. Please confirm R-30 or 2" thick for the insulation above acoustical ceiling tiles.

   Response to RFI 1: Insulation needs to be minimum R-30 in the attic space.

END OF THE ADDENDUM

SECTION 01 91 13

GENERAL COMMISSIONING REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY

A. The work under this Section is subject to requirements of the Contract Documents including the Owner's General Conditions and articles of the Construction Manager's General Conditions.

B. General Commissioning of the project will be executed outside of the general contract by an independent consultant to the OR. This document states the requirements of the Construction Manager/General contractor to assist the Commissioning Agent in the execution of his work.

C. Commissioning shall be performed in accordance with the requirements of the Commissioning Standard under which the Commissioning Firm's qualifications are approved or identified within this specification. All quality assurance provisions of the Commissioning Standard such as performance guarantees shall be part of this contract. Commissioning procedures shall be developed by the Commissioning Agent and be in accordance with Commissioning Scope of Work. Where new procedures, requirements, etc. applicable to the Contract requirements have been published or adopted by the body responsible for the Commissioning Standard used (ACG, NEBB, or TABB), the requirements and recommendations in these procedures and requirements shall be considered mandatory.

D. The commissioning process does not reduce the responsibility of the system designers or installing contractors to provide a finished and fully functioning product in accordance with the Contract Documents.

E. This section shall in no way diminish the responsibility of the Division 22, 23, and 26 Contractors, Subs and Suppliers in performing all aspects of work and testing as outlined in the contract documents. Any requirements outlined in this section are in addition to requirements outlined in Division 22, 23, and 26 Specifications.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.

B. The requirements in this section are in addition to those specifically outlined in:

1. Section 23 08 00 – Commissioning of HVAC Systems

1.3 EQUIPMENT AND SYSTEMS TO BE COMMISSIONED

A. Commissioning will be performed for the following systems and equipment:

1. HVAC Systems and controls; including air and water side equipment.

1.4 REFERENCES

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

1. ASHRAE Guideline 1.1 – HVAC&R Technical Process for the Commissioning Process (2007)

2. ASHRAE Guideline 0 – The Commissioning Process (2005)

3. ACG Commissioning Guideline – ACG Commissioning Guideline (2005)

4. NEBB Commissioning Standard – Whole Building Technical Commissioning of New Construction (2019)

5. SMACNA 1429 – HVAC Systems Commissioning Manual, 1st Edition (1994)

6. ANSI/NETA – Standard For Electrical Commissioning of Electrical Power Equipment and Systems (2015)

1.5 DEFINITIONS & ABBREVIATIONS

A. A/E: Architect/Engineer

B. Acceptance Phase: Phase of construction after startup and initial checkout when Functional Performance Testing, O&M documentation review and training occurs.

C. BAS: Building Automation System

D. Basis of Design (BOD): The Engineer's Basis of Design is comprised of two components: The Design Criteria and Design Narrative. These documents record the concepts, calculations, decisions, and product selections used to meet the Owner's Project Requirements and to satisfy applicable regulatory requirements, standards, and guidelines.

E. CC: Controls Contractor

F. Certificate of Readiness (COR): The COR is a document produced by the GC/CM and submitted to the CxA that states specifically indicated systems or equipment are complete installed, started-up, have undergone all testing and checkout and are ready to schedule FPTs.

G. Commissioning Agent (CxA): An independent party, not otherwise associated with the A/E team members or the GC/CM oversees, though he/she may be hired as a subcontractor to them. The CxA directs the day-to-day commissioning activities.

H. Commissioning Issue (Cx Issue): Any component or system condition (static or dynamic) that is in non-conformance with the contract documents, commissioning documents, performance requirements and/or industry standards and adversely affects the commissionability, operability, maintainability, or functionality of a system equipment or components.

I. Commissioning Issues log: A formal and ongoing record of Commissioning Issues or concerns and their resolution that have been raised by members of the Commissioning Team during the commissioning process. Also known as the Corrective Action Log (CAL).

J. Commissioning Plan (Cx Plan): An overall document that provides the structure, schedule and coordination planning for the commissioning process. The Cx Plan identifies the project's commissioning goals, commissioning team members and their roles; establishes the scope of commissioning in terms of systems and equipment; and outlines the major commissioning steps during design, construction, acceptance and occupancy phases. The Cx Plan outlines the expectation of the Contractor's organization, scheduling, allocation of resources, documentation, etc., pertaining to the overall commissioning process.

K. Commissioning Final Report: The final document which presents the commissioning process results for the project. Commissioning reports include an executive summary, issues log, deferred our seasonal testing, and recommendation to accept the project.

L. Commissioning Record: A compilation of all commissioning related documents produced as part of the project. This record includes but is not limited to final Cx documents, meeting minutes, start-up documents and more. The Cx Record can be combined with the Cx Final Report or be provided as a stand-alone document.

M. Commissioning Team (CT): The qualified group that will plan and carry out the overall commissioning process. The team is composed of the CxA, OR, A/E Team, GC/CM, Subs, equipment manufacturers and other parties identified by the CxA. The individual participants on the team may change as the design and construction process proceeds. Participation by the OR is not mandatory, but the value of this services to the customer is directly proportional to their participation.

N. Construction Phase: Phase of construction that begins once construction commences and continues until TAB and Functional Performance Testing. This phase includes the commissioning submittal review, development and execution of Pre-Functional Checklists, site observations and equipment startup.

O. Datalogging: Monitoring flows, currents, status, pressures, etc. of equipment using stand-alone data loggers separate from the control system.

P. Deferred Testing: FPT's that are performed later, after substantial completion, due to partial occupancy, equipment, seasonal requirements, design or other site conditions that prevent the test from being executed during the Acceptance Phase of the project.

Q. EC: Electrical Contractor

R. Functional Performance Test (FPT): Testing and documenting of the dynamic function and operation of equipment and systems to verify and demonstration operation in accordance with the OPR, BOD and contract documents. Using manual (direct observation) and/or monitoring methods, systems and equipment are tested under various conditions, such as low cooling or heating loads, high loads, component failures, unoccupied, varying outside air temperatures,

fire alarm, power failure, etc. The systems are run through all the control system's Sequences of Operation and components are verified to be responding as the sequences state. The CxA develops the FPT procedures in a sequential written form, coordinates, oversees, and documents the actual testing, which is usually performed by the installing contractor or vendor. FPT's are performed after Pre-Functional Checklists, startup, TAB and controls checkout are complete and the COR is received. The Subs are responsible for reviewing, understanding, and performing the FPT's.

S. GC/CM: General Contractor / Construction Manager

T. HVAC: Heating, Ventilating and Air Conditioning

U. Indirect Indicators: Indicators of a response or condition, such as a reading from a control system screen reporting a damper to be 100% closed.

V. Manual Test: Using hand-held instruments, immediate control system readouts or direct observation to verify performance (contrasted to analyzing monitored data taken over time to make the “observation”).

W. MC: Mechanical Contractor

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

Y. O&M: Operation and Maintenance

Z. Occupancy Phase: Phase of the project after the Acceptance Phase. During this phase, commissioning requirements are to correct any remaining Commissioning Issues, carry out any required re-testing, deferred or seasonal testing, close-out documentation review and warranty review.

AA. Owner’s Project Requirements (OPR): A written document that details the project requirements and the expectations of the Owner for how the building and its systems must be used and operated. These include project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information.

BB. OR: Owner’s Representative

CC. Over-written Value: Writing over a sensor value in the control system to see the response of a system (e.g., changing the outside air temperature value from 50°F to 75°F to verify economizer operation). See also “Simulated Signal”.

DD. PC: Plumbing Contractor

EE. Pre-Functional Checklist (PFC): A list of items to inspect to verify proper installation of equipment and systems. PFCs are developed and provided by the CxA with execution being completed by the Subs, CxA or a combination thereof depending on the scope of services. PFCs are primarily static inspections and procedures to prepare the equipment or system for initial operations (e.g., belt tension, oil levels OK, labels affixed, gages in place, etc.).

FF. Request for Information (RFI): An official document submitted to the A/E to provide clarity or direction on a specific question or issue that has arisen.

GG. Sampling: Performing observation, review, testing or other verification on only a fraction of the total number of identical or near identical pieces of equipment, drawings, events, etc. Sampling techniques include random statistical sampling and less form professional judgment methods.

HH. Seasonal Testing: FPTs that are deferred until the system(s) will experience conditions closer to their design conditions.

II. Sequence of Operations (SOO): A written description of how equipment and systems are intended to operate. SOOs include control logic, setpoints, alarm requirements, trend requirements and other information necessary to properly program and commission the system. SOOs are developed by the EOR, and final versions are provided by the CC on the approved controls submittal.

JJ. Simulated Condition: Condition that is created for the purpose of testing the response of a system.

KK. Simulated Signal: Disconnecting a sensor and using a signal generator to send an amperage, resistance or pressure to the transducer and DDC system to simulate a sensor value.

LL. Start-up: The initial starting or activating of dynamic equipment, including executing Pre-Functional checklists.

MM. Subs: Subcontractors

NN. TAB: Testing, Adjusting and Balancing

OO. TABC: Testing, Adjusting and Balancing Contractor

PP. Test Procedures: The step-by-step process which must be executed to fulfill the test requirements. The test procedures are developed by the CxA with assistance and coordination from GC/CM and Subs.

QQ. Test Requirements: Requirements specifying what modes and functions, etc. shall be tested. The test procedures are not the detailed test procedures. The test requirements are specified in the Contract Documents.

RR. Trending: Monitoring of BAS information by logging data at set intervals or when there is a change of value.

1.6 COMMISSIONING TEAM

A. Commissioning requires the participation of all project team members to be an effective and efficient process. This team is made of individuals from the Owner, Design and Construction teams as identified in this section. The commissioning team is fluid, and additional project team members may be added as needed throughout the project.

B. Commissioning Team members appointed by Owner:

1. CxA – Commissioning Agent

2. OR – Owner's Representative, ideally member(s) of the O&M staff

3. A/E – Architect and Engineering design professionals

C. Commissioning Team members appointed by the Contractor(s):

1. GC/CM – General Contractor/Construction Manager

2. MC – Mechanical Contractor

3. EC – Electrical Contractor

4. PC – Plumbing Contractor

5. CC – Controls Contractor

6. TABC – TAB Contractor

7. Equipment Suppliers and Vendors

1.7 COMMISSIONING SUBMITTALS

A. This section identifies the commissioning submittals that the GC/CM and A/E are responsible for providing to the CxA for completion of commissioning related tasks.

B. Construction Documents, RFIs, Sketches and other design documents:

1. The A/E shall provide the CxA all current design documents. When contract document updates are issued, the CxA shall be included on the distribution of those documents.

2. The CxA shall receive copies of all drawing updates that are not provided as part of official document updates, such as sketches.

3. The GC/CM and A/E shall ensure the CxA receives copies of all RFIs related to commissioned systems. This includes both the original RFI submitted to the A/E as well as any response provided. The CxA may provide input on RFIs to the A/E.

C. Construction Submittals:

1. The CxA will identify submittals to the GC/CM that are required concurrent with the submission to the A/E. The CxA's review shall be limited to the equipment being commissioned with the commissioning review focused on confirming compliance with the contract documents. The CxA will provide commissioning review comments to the A/E.

a. The CxA will only review the initial submittal for equipment being commissioned. All re-submittals shall be provided to the CxA, it shall be at the CxA's discretion to review any additional re-submittals.

2. The GC/CM shall provide final approved copies of the submittals to the CxA for development of project specific commissioning documentation.

D. Start-Up Plan:

1. The GC/CM, with assistance from the Subs and equipment vendors responsible for purchase, installation and start-up of equipment, shall develop a Start-Up Plan and executes equipment start-up utilizing the following procedure.

   a. Compile detailed start-up and checkout procedures from equipment manufacturers and industry standard field checkout sheets. Start-up documentation shall include checklists and procedures with specific boxes or lines for recording and documenting inspections of each piece of equipment.

   b. Submit the Start-Up Plan to the CxA for review in discipline specific books/sections which shall include the following at a minimum:

      i. Cover sheet for each Start-Up Plan book/section. Each Start-Up Plan shall have an individual, discipline specific tag (e.g. Mechanical Start-Up Plan (Volume 1, 2, 3, etc.), Electrical Start-Up Plan, Plumbing Start-Up Plan, etc.).

      ii. Table of Contents for each book/section.

      iii. Schedule of start-up activities by equipment (initial Start-Up Plan submittal schedule shall be tentative; start-up schedule shall be updated as construction proceeds and forwarded to CxA so that CxA can witness start-up activities as required).

      iv. Separate tagged divider by specification section with all related systems testing documentation (duct pressure testing, duct cleaning, piping flushing and pressure testing, electrical acceptance testing, etc.).

      v. Separate tagged divider by specification section with start-up checklists and documentation for each item of equipment.

2. The CxA, A/E and OR reviews the Start-Up Plan for content and format. The CxA shall return the Start-Up Plan with comments to GC/CM and the GC/CM shall revise the Start-Up Plan based on CxA comments.

3. The GC/CM shall forward copies of completed Start-Up Plan sections as the work is completed, including all executed start-up checklists, to CxA for review to verify completion of start-up activities. An executed Start-Up Plan must be submitted to CxA prior to scheduling of FPTs.

4. Once all start-up activities are complete, the GC/CM shall submit a complete, compiled Start-Up plan for documentation. Any comments made by the CxA on individual section submissions shall be incorporated.

E. CORs:

1. The GC/CM shall submit completed CORs to the CxA for each piece of equipment or system prior to scheduling and execution of FPTs.

2. At a minimum, COR must confirm and certify that the following:

    a. All previously identified Cx Issues for the related equipment/system have been resolved and verified.

    b. Start-up and checkout activities have been completed successfully and all documents have been submitted to the CxA.

    c. TAB is complete and all documentation has been submitted to the CxA.

    d. Controls programming is complete and operational, including graphical user interface, trending, alarming, scheduling and other systems necessary for a complete BAS.

    e. Subs and/or manufacturers' representatives will be made available as necessary for the execution of FPTs.

3. Each COR shall include the following for both the GC and associated Subs:

    a. Printed Name

    b. Title

    c. Company

    d. Signature

    e. Date

4. Sample COR templates can be provided by the CxA.

F. Training Plan:

1. The GC/CM shall develop and complete the Training Plan as outlined in section 01 79 00.

G. Turnover Documents:

1. The GC/CM shall provide the following turnover documents to the CxA for review:

    a. As-Built Drawings, including final controls SOOs and Setpoints.

    b. O&M Manuals

    c. Owner Training Documents

PART 2 PRODUCTS

2.1 TEST EQUIPMENT

A. All testing equipment required to perform startup and initial checkout and required FPTs shall be provided by the GC/CM, Subs or equipment vendors for the equipment being tested.

B. Special equipment, tools, and instruments (only available from vendor, specific to a piece of equipment) required for testing or maintaining equipment shall be included in the base bid price to the GC/CM and shall be left on site for use by the Owner's O&M staff.

C. Test equipment shall be of sufficient quality and accuracy to test and/or measure system performance with tolerances specified. A testing laboratory shall have calibrated test equipment within the previous 12 months. Calibration shall be NIST traceable. Equipment shall be calibrated according to manufacturer's recommended intervals and when dropped or damaged. Calibration tags shall be affixed or certificates readily available.

D. Reference discipline specific specification sections for additional test equipment requirements.

PART 3 EXECUTION

3.1 COMMISSIONING PROCESS OVERVIEW

A. The following provides a brief overview of the commissioning tasks during the construction, acceptance, and occupancy phases and are listed in the approximate order in which they occur:

1. Submittals for commissioned systems and equipment are provided to the CxA by the GC/CM concurrent to the A/E as part of the normal submittal process.

2. Final approved submittals are forwarded to the CxA by the GC/CM or Subs for use by the CxA during the commissioning process.

3. The CxA develops equipment specific PFCs.

4. Prior to executing onsite work, the CxA will organize and lead a Commissioning Kick-Off meeting. This meeting involves the entire CT and provides a thorough review of the upcoming commissioning tasks, discusses roles and responsibilities and answers any commissioning related questions.

5. The CxA ensures all PFCs are completed prior to equipment start-up and execution of FPTs.

6. The CxA develops project specific FPT plans. These plans are created by using both the contract documents and approved submittals. FPT plans are provided to the GC/CM, Subs, A/E and OR for review and comment.

7. The GC/CM coordinates and executes equipment startup and checkout activities.

8. TAB is executed and documentation is submitted according to the contract documents.

9. The GC/CM submits CORs to the CxA to indicate systems and equipment are ready to begin executing FPTs.

10. The CxA coordinates the execution of the FPTs with the assistance of the Subs.

11. Owner Training is completed by the GC/CM in accordance with the contract documents.

12. The CxA issues the Cx Final Report and Cx Record. These documents may be a single file.

3.2 ROLES AND RESPONSIBILITIES

A. The general responsibilities of various commissioning team members are provided in this subsection. Specific responsibilities will be provided in the Cx Plan.

B. OR's Responsibilities:

1. Develop and provide the approved OPR to the CxA, A/E and GC/CM for information and use.

2. Update the OPR as necessary throughout the project.

3. Facilitate, support and participate in the commissioning process.

4. Provide final approval of the commissioning work.

C. Architect/Engineer Responsibilities:

1. Develop and provide the OR Approved BOD document to the CxA.

2. Attend selected commissioning meetings as needed or requested by the CxA.

3. Provide copies of all design documents including all drawings, specifications and revisions to those documents, sketches, RFIs or other documents that modify the project design.

4. Review and respond to any Design Review Comments. Incorporate any necessary changes in future drawing releases.

5. Review CxA Submittal Review comments. Any comments deemed valuable shall be incorporated into official submittal responses by the A/E. Any comments that are not included shall be provided written responses from the A/E detailing why for record purposes.

6. Participate in the resolution of Commissioning Issues identified during the project as needed or requested by the CxA.

7. Review and comment on FPT plans developed by the CxA to ensure compliance with the design intent of the system and equipment.

8. Review and approval all final Cx Documents produced the CT members.

D. General Contractor/Construction Manager Responsibilities:

1. Incorporate commissioning activities and milestones into the overall project schedule. Provide updates as necessary.

2. Ensure all Subs and equipment vendors fully participate in the commissioning process and execute their responsibilities.

3. Attend, along with all necessary Subs, commissioning progress and coordination meetings.

4. Provide the CxA copies of all OAC meeting minutes, RFIs and other construction progress or change related documents.

5. Notify the CxA when equipment is ready for observation, PFC and FPT completion.

6. Coordinate with the CxA regarding planning, scheduling and execution of all startup and testing activities. Submit all plans, reports and completed forms to the CxA and A/E for review and approval.

7. Coordinate with appropriate Subs and vendors to ensure timely resolutions to commissioning issues.

8. Review and comment on the FPT plans developed by the CxA.

9. Ensure Subs provide technicians, equipment or other tools requested by the CxA in order to complete commissioning activities including but not limited to the execution of FPTs.

10. Submit CORs to the CxA prior to scheduling FPTs.

11. Compile and submit all closeout and turnover documents to the A/E and CxA for review and approval including but not limited to As-Built drawings and O&M Manuals.

12. Coordinate and execute Owner Training in accordance with the contract documents, specifically section 01 79 00 Minimum Owner Training Requirements.

E. Commissioning Agent's Responsibilities:

1. Organize and lead the Commissioning Team in the execution of all commissioning activities.

2. Develop the Commissioning Plan and Commissioning Specifications that clearly define the commissioning process and team member roles and responsibilities and provide sample documentation.

3. Review the contract documents for constructability, commissionability and maintainability.

4. Review submittal documents for conformance with the contract documents for commissioned systems and equipment.

5. Develop equipment specific Pre-Functional Checklists and project specific Functional Performance Test scripts.

6. Plan and lead commissioning related meetings as necessary to coordinate commissioning tasks and discuss commissioning issues.

7. Conduct periodic site visits to execute PFCs, review progress of installation and document Commissioning Issues.

8. Develop and maintain the Cx Issues Log to track all identified Cx Issues, resolutions and commentary from the GC/CM, Subs, OR and A/E.

9. Provide regular reports on progress of the commissioning activities, including any currently unresolved Commissioning Issues.

10. Review acceptance, testing and other reports generated by the GC/CM and Subs.

11. Verify that TAB work is completed properly by reviewing the TAB report and performing limited verification with the assistance of the TABC.

12. Develop and issue the Cx Final Report. The Cx Record may be included as part of the Cx Final Report or be issued as a separate document.

13. Recommend acceptance of the commissioned equipment and systems to the OR.

14. Direct and witness any seasonal or deferred FPTs that could not be completed during the acceptance phase FPT period.

15. Plan and conduct a project close-out and lessons learned meeting with the OR, GC/CM and A/E.

3.3 SCHEDULING AND COORDINATION

A. Kick-off Meeting: Prior to beginning onsite work the CxA will plan, schedule and conduct a commissioning kick-off meeting. Roles and responsibilities of the Commissioning Team will be clarified at this meeting along with a review of the Cx Plan. The CxA will distribute meeting minutes to all parties.

B. The CxA will work with GC/CM to established protocols to schedule the commissioning activities. The CxA will review the Construction Schedule and verify that PFCs and FPTs are properly scheduled. The GC/CM will integrate all commissioning activities into the master schedule.

C. The GC/CM shall notify the CxA of any changes in the construction schedules that will affect commissioning activities. The CxA will work with the GC/CM and Sub(s) to schedule new dates as necessary. The GC/CM shall notify the CxA a minimum of five (5) days in advance of scheduled commissioning visits if re-scheduling is required.

1. Any time for the CxA to visit the site to execute commissioning tasks on equipment or systems that were identified as being ready by the GC/CM but found to not be will be back charged to the GC/CM at a cost of $2,500 plus expenses per man-day.

D. The GC/CM and Sub(s) shall schedule their representatives as required by the CxA to complete all commissioning activities.

3.4 PRE-FUNCTIONAL CHECKLISTS

A. Objectives and Scope:

1. The objective of PFCs is to verify and document that the equipment/systems are provided and installed according to the contract documents, manufacturers recommendations and industry standards. Each piece of commissioned equipment shall receive a PFC that must be completed and approved prior to start-up.

B. Development of Documents:

1. The CxA is responsible for developing equipment specific PFCs for each piece of commissioned equipment. No equipment shall share completed PFC documents.

2. Sample PFCs are provided in the Cx Plan and can be obtained from the CxA. The samples are provided to give the Subs a general idea of the content and scope of the

PFC process. The sample PFCs are prototypical, and do not reflect specific requirements of this project's plans or specifications.

C. Execution:

1. The CxA is responsible for executing and completing all PFC documentation concurrent with construction progress. Only individuals who have witnessed and reviewed the installation may complete checklist lines. Checklists may only be completed onsite while physically at the piece of equipment – no completion of checklists from offices or jobsite trailers is allowed.

2. Any PFC item or associated Cx Issue marked as complete which is later found to be incomplete and causes re-verification work by CxA or delays during FPTs will be back-charged to the responsible party.

3.5 START-UP AND INITIAL CHECKOUT

A. The GC/CM shall develop the Start-Up Plan and submit to the CxA, A/E, and OR for approval a minimum of thirty (30) days prior to the anticipated start of start-up activities.

B. After receiving approval of the Start-Up Plan, the GC/CM shall organize and lead a Start-Up Coordination Meeting. All CT members shall attend and provide feedback on start-up activities.

C. Subs and/or equipment vendors shall execute equipment start-up per the Start-Up Plan.

D. The GC/CM shall provide the CxA with signed and dated copy of completed Start-Up Plan documents prior to scheduling of FPTs. Only individuals having direct knowledge that a line item task was actually performed shall complete the documentation.

E. Subs shall clearly list outstanding items or initial start-up tests that are not completed successfully. Completed forms documenting any outstanding deficiencies shall be provided to CxA within two (2) working days of completion.

3.6 FUNCTIONAL PERFORMANCE TESTS

A. Objective and Scope:

1. The purpose of FPTs is to document and verify that all equipment and systems are operating according to the design intent and as defined in the contract documents and approved submittals. The process of FPTs facility bringing a system from a state of substantial completion to fully dynamic operation.

2. Each component and system are operated through all modes of operation (occupied, unoccupied, etc.) where specific equipment and system responses are required. All control SOOs are tested and verified, including all safeties and alarms.

3. FPTs are only performed on dynamic pieces of equipment. Static system components (i.e. panelboards, louvers, etc.) do not undergo FPTs.

B. Development of Documents:

1. The CxA will develop project specific test procedures and forms to verify and document equipment and system operation. These test procedures are developed from a combination of the contract documents and approved submittals.

a. The GC/CM shall provide all documents requested by the CxA for the development of FPT test procedures.

b. The GC/CM shall authorize the Subs and equipment vendors to assist the CxA in development of the test procedures as requested by the CxA.

2. Once developed, the CxA will issue the FPT test procedures to the CT for review and comment. It is imperative that all members thoroughly review these procedures for feasibility, safety, and warranty protection as well as conformance to the design intent. If necessary, the CxA will coordinate a meeting to discuss any concerns. Based on CT feedback, the CxA will make any necessary updates to the FPT test procedures.

   a. Failure to properly review FPT test procedures and identify any feasibility or other issues by the GC/CM, Subs or equipment vendors during the review period that are identified during test execution will be handled as non-conformance Cx Issues.

C. Execution:

1. Prior to scheduling FPT execution, complete CORs must be received by the CxA and all associated documentation. All start-up, checkout, TAB and other testing must be complete and final prior to FPTs.

2. The GC/CM shall provide the CxA a minimum of fourteen (14) days' notice for when FPTs may begin.

3. The CxA will conduct an FPT coordination meeting with the CT. This meeting will serve to schedule the execution of FPTs, answer any questions and remind each CT member of their roles and responsibilities.

4. The GC/CM shall ensure that the Subs and/or equipment vendors provide trained technicians familiar with the project to assist in the execution of FPTs.

5. The Subs and/or equipment vendor technicians will execute the FPT test procedures. The CxA will direct and document the results of the FPT.

6. FPTs will be completed under design conditions whenever possible. Simulated conditions or signals may be used when not practical under design conditions as the discretion and direction of the CxA. The CxA will determine how to best simulate the conditions needed for the test.

7. If any line of an FPT test procedure is unsuccessful or fails, that line item and/or test section will be deemed to be in non-conformance and identified as a Commissioning Issue.

8. When an FPT is completed and any identified Commissioning Issues are resolved, the CxA, GC/CM, Subs and/or equipment vendor shall sign off that testing is complete and successful, and the equipment is ready to be turned over to the Owner.

D. Deferred Testing:

1. If any FPT cannot be completed due an unforeseen condition outside the control of the GC/CM or CxA, execution shall be deferred based on the recommendation of the CxA and approval of the OR. The affected testing shall be completed as soon as practical.

2. Costs associated with deferred testing are the responsibility of the GC/CM, Subs and equipment vendors. Deferred tests are tests that have not been performed, therefor any costs associated with those tests have not been utilized.

E. Seasonal Testing:

1. Seasonal testing are FPTs that are executed during the opposite season of the initial

FPTs. The intent of seasonal testing is to verify equipment operation during both weather extremes.

2. Seasonal testing shall be executed during ASHRAE design condition months. If possible, scheduling should be flexible to coordinate testing on days as close to design condition as possible.

3. The GC/CM shall ensure participation by the Subs and/or equipment vendors. The same technician made available during the initial FPTs shall be made available for seasonal testing.

4. Costs associated with seasonal testing shall be covered by the CxA, Subs and equipment vendors for their respective resources.

3.7 NON-CONFORMANCE AND COMMISSIONING ISSUES

A. The CxA will document any observations, installation issues or operational non-conformance issues as Commissioning Issues and be tracked in the Commissioning Issues Log.

B. All Commissioning Issues identified prior to the execution of FPTs must be resolved by the GC/CM and Subs and verified by the CxA prior to scheduling FPTs.

C. Non-conformance Commissioning Issues identified during the execution of FPTs must be completed prior to release of the GC/CM and Subs retainage.

D. Commissioning Issues will be handled in the following manner:

1. When there is no dispute on the Cx Issue and Subs accept responsibility for remedial action:

   a. The CxA documents the Cx Issue in the Cx Issues Log and distributes to the CT.

   b. The GC/CM facilitates the resolution of the issue and assigns Cx Issues to the appropriate Subs and equipment vendors.

   c. Subs and equipment vendors make necessary modifications and submit written response to GC/CM stating necessary changes have been made. GC/CM reviews the work and forwards the response to the CxA if they agree that the Cx Issue is resolved.

   d. The CxA verifies the resolution is satisfactory and indicates the Cx Issue as corrected.

2. When there is a dispute about the Cx Issue regarding whether the issue is valid or who is responsible:

   a. The CxA documents the Cx Issue in the Cx Issues Log and distributes to the CT.

   b. The GC/CM facilitates the resolution of the issue. If assistance is needed, additional parties may be brough into the discussions, including the CxA. Final interpretive authority is with the A/E. Final acceptance authority is with the OR.

   c. The CxA documents the final interpretation and resolution process.

   d. If Subs and equipment vendors are to make necessary modifications and submit written response to GC/CM stating necessary changes have been made. GC/CM reviews the work and forwards the response to the CxA if they agree that the Cx Issue is resolved.

e. The CxA verifies the resolution is satisfactory and indicates the Cx Issue as Corrected.

f. If the A/E or OR are going to accept the Cx Issue as is, the Cx Issues Log shall be updated to indicate the issue as Accepted.

E. Costs associated with verification or re-testing of Cx Issues:

1. Costs Subs or equipment vendors to re-verify Cx Issues identified during the project, if they are responsible for the issue, will be theirs.

2. If Subs are not responsible for a Cx Issue but are required for verification or re-testing, cost recovery may be negotiated with the GC/CM.

3. Time for the CxA to conduct verification of Cx Issue resolutions or re-testing due to Cx Issues being reported as resolved but found to not be will be back charged to the responsible Subs at a cost of $2,500 plus expenses per man-day.

3.8 OWNER TRAINING

A. The GC/CM is responsible for execution of Owner Training as outlined in section 01 79 00.

END OF SECTION 01 91 13

SECTION 23 08 00

COMMISSIONING OF HVAC SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

A. The work under this Section is subject to requirements of the Contract Documents including the Owner's General Conditions and articles of the Construction Manager's General Conditions.

B. General commissioning requirements are detailed in Division 01.

C. The commissioning process does not reduce the responsibility of the system designers or installing contractors to provide a finished and fully functioning product in accordance with the Contract Documents.

D. This section shall in no way diminish the responsibility of the Division 23 Contractors, Subs and Suppliers in performing all aspects of work and testing as outlined in the contract documents. Any requirements outlined in this section are in addition to requirements outlined in Division 01 and 23 Specifications.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.

B. The requirements in this section are in addition to those specifically outlined in:

1. Section 01 91 13 – General Commissioning Requirements

1.3 HVAC EQUIPMENT AND SYSTEMS TO BE COMMISSIONED

A. The following equipment and systems shall be commissioned as part of this project. All general references to equipment and systems within this document refer only to those identified below:

1. Air Handling Units
2. Air Terminal Boxes
3. Exhaust Fans
4. Boilers
5. Pumps
6. Unit Heaters
7. Air / Dirt Separator

8. Expansion Tank
9. Ultraviolet (UV) Lights
10. Variable Frequency Drives
11. Relief Fans
12. Air Distribution
13. Building Automation and Control Systems

1.4 REFERENCES

A. Refer to Section 01 91 13 for applicable references for work associated with this section.

1.5 DEFINITIONS & ABBREVIATIONS

A. Refer to Section 01 91 13 for definitions and abbreviations for terms in this section.

1.6 COMMISSIONING TEAM

A. Refer to Section 01 91 13 for commissioning team members.

1.7 COMMISSIONING SUBMITTALS

A. Refer to Section 01 91 13 for additional information regarding commissioning submittals.

B. The following are the minimum submittals that the CxA will review. Additional submittals may be reviewed at the CxA's discretion:

1. 23 0515 Variable Frequency Motor Controls – Buildings & HVAC
2. 23 0516 Expansion Compensation in Heating, Ventilation and Air conditioning Systems
3. 23 0519 Meters and Gauges for HVAC
4. 23 0523 Valves
5. 23 0529 Hangers and Supports for HVAC Piping and Equipment
6. 23 0553 Identification for HVAC Piping and Equipment
7. 23 0566 UVC Emitter Ultra Violet Disinfection
8. 23 0593 Testing, Adjusting, and Balancing for Heating, Ventilating and Air Conditioning

9. 23 0713 Duct Insulation for Heating, Ventilating and Air Conditioning

10. 23 0716 HVAC Equipment Insulation

11. 23 0719 HVAC Piping Insulation

12. 23 0923 Direct Digital Control System for HVAC

13. 23 2123 Hydronic Pumps

14. 23 3300 Air Duct Accessories

15. 23 3423 HVAC Power Ventilators

16. 23 3616 Air Terminal Units – Variable Volume

17. 23 3700 Air Inlets and Outlets

18. 23 5216 Condensing Boilers

19. 23 7313 Central Station Air Handlers

C. TAB Plan:

1. The GC/CM, with assistance from the TABC, shall develop a TAB Plan and execute TAB utilizing the following procedure.

2. Compile detailed TAB forms according to the TABC's certifying agency standard. TAB documentation shall include specific boxes or lines for recording and documenting data of each piece of equipment.

3. Submit the TAB Plan to the CxA for review and include the following at a minimum:

   a. Table of Contents.

   b. Detailed description of how TAB will be completed. Specifically, the TAB Plan shall identify any diversity in system designs and how the TAB process will account for this.

   c. Schedule of TAB activities by equipment (initial TAB Plan submittal schedule shall be tentative; TAB schedule shall be updated as construction proceeds and forwarded to CxA).

   d. Separate tagged divider by system and equipment with TAB forms and documentation.

4. The CxA, A/E and OR reviews the TAB Plan for content and format. The CxA shall return the TAB Plan with comments to GC/CM and the GC/CM shall revise the TAB Plan based on CxA comments.

5. The GC/CM shall forward copies of the completed TAB Plan to CxA, A/E and OR for review. Any comments that require re-TAB are the responsibility of the GC/CM until results are acceptable.

6. After the completed TAB Plan is approved, the CxA will execute on-site verification of selected readings reported in the TAB Plan. The TABC must supply the technician who performed the measurements and the equipment used for verification.

7. Once all TAB activities are complete, the GC/CM shall submit a complete, compiled TAB Plan for review documentation. Any comments made by the CxA shall be incorporated.

PART 2 PRODUCTS

2.1 TEST EQUIPMENT

A. Refer to Section 01 91 13 for additional test equipment requirements.

B. If not otherwise specified, the following minimum requirements apply.

1. Temperature sensors and digital thermometers shall have a certified accuracy of 0.5°F and a resolution of ±0.1°F.

2. Pressure sensors shall have an accuracy of ±2.0% of the value range being measured (not full range of meter).

PART 3 EXECUTION

3.1 COMMISSIONING PROCESS OVERVIEW

A. Refer to Section 01 91 13 for an overview of the commissioning process.

3.2 ROLES AND RESPONSIBILITIES

A. Refer to Section 01 91 13 for roles and responsibilities of additional team members.

B. Controls Contractor Responsibilities

1. Include costs for all commissioning requirements in contract price.

2. Review and provide feedback on the FPT test procedures developed by the CxA.

a. Ensure all test procedures are executable with the control system as programmed. This includes overriding all points as indicated.

b. Verify all graphics, trend logs and alarms are programed and active as indicated in the contract documents and FPT test procedures.

3. Any tasks indicated within the FPT scripts do not override any other start-up and checkout tasks identified in Division 23. It is the CC responsibility to ensure the system is fully operational and operating in automatic mode prior to execution of FPTs.

4. Provide trained and certified technician familiar with the project programming to execute the FPT test procedures at the direction of the CxA.

C. TAB Contractor Responsibilities

1. Include costs for all commissioning requirements in contract price.

2. Develop the TAB Plan in coordination with the GC/CM.

3. Make revisions to TAB work as identified by the CxA, A/E and/or OR for conformance with the contract documents.

4. Make the certified technicians and equipment used in creating the completed TAB Plan available to the CxA for TAB Verification activities.

3.3 SCHEDULING AND COORDINATION

A. Refer to Section 01 91 13 for scheduling and coordination requirements.

3.4 PRE-FUNCTIONAL CHECKLISTS

A. Refer to Section 01 91 13 for PFC requirements.

3.5 START-UP AND INITIAL CHECKOUT

A. Refer to Section 01 91 13 for Start-Up and Checkout requirements.

3.6 TESTING, ADJUSTING AND BALANCING

A. The GC/CM shall develop the TAB Plan and submit to the CxA, A/E, and OR for approval a minimum of thirty (30) days prior to the anticipated start of TAB activities.

B. After receiving approval of the TAB Plan, the GC/CM shall organize and lead a TAB Coordination Meeting. All CT members shall attend and provide feedback on TAB activities.

C. The TABC shall execute TAB activities per the TAB Plan.

D. Once the completed TAB Plan has been reviewed, the CxA will conduct on-site TAB verification.

1. TABC shall supply the technician(s) who took the original readings and the equipment used as reported in the completed TAB Plan.

2. The CxA will identify a sample of readings that the TABC shall reproduce. The CxA shall confirm that the equipment and techniques used to gather the measurements are correct and the readings are accurate.

3. Any discrepancies identified will be identified as Cx Issues and tracked on the Cx Issues Log.

    a. If issues are limited or minor in nature, the CxA will recommend only the identified issues be remedied.

    b. If issues are numerous or the CxA that identified issues are systemic, the CxA will reject the completed TAB Plan and require the process to be repeated.

E. The GC/CM shall notify the CxA of any changes to the TAB schedules that will affect commissioning activities. The CxA will work with the GC/CM and TABC to schedule new dates as necessary. The GC/CM shall notify the CxA a minimum of five (5) days in advance of scheduled commissioning visits if re-scheduling is required.

1. Any time for the CxA to visit the site to execute commissioning tasks on equipment or systems that were identified as being ready by the GC/CM but found to not be will be back charged to the GC/CM at a cost of $2,500 plus expenses per man-day.

F. The GC/CM shall provide the CxA with signed and dated copy of completed TAB Plan documents prior to scheduling of FPTs. Only individuals having direct knowledge that a line item task was actually performed shall complete the documentation.

G. The TABC shall clearly list outstanding items or initial TAB tasks that are not completed successfully. Completed forms documenting any outstanding deficiencies shall be provided to CxA within two (2) working days of completion.

3.7 FUNCTIONAL PERFORMANCE TESTS

A. Refer to Section 01 91 13 for FPT requirements.

3.8 NON-CONFORMANCE AND COMMISSIONING ISSUES

A. Refer to Section 01 91 13 for information regarding Non-Conformance and Cx Issues.

3.9 OWNER TRAINING

A. The GC/CM is responsible for execution of Owner Training as outlined in section 01 79 00.

END OF SECTION 23 08 00