HERNANDO SCHOOL DISTRICT

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REQUEST FOR QUALIFICATIONS
No. 0251-201-2203
For HVAC Commissioning Services

HVAC Replacement
Central High School
Hernando County School District
Brooksville, Florida

REQUEST FOR QUALIFICATIONS
CENTRAL HIGH SCHOOL
HVAC REPLACEMENT
COMMISSIONING SERVICES

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ANNOUNCEMENT

REQUEST FOR QUALIFICATIONS FOR
Commissioning Services
Hernando County School Board
Central High School HVAC Replacement

RFQ #0251-201-2203

The Hernando County School Board ("HCSB"), Brooksville, Florida, invites qualified firms to submit a letter of interest and supporting documentation relating to professional COMMISSIONING SERVICES for Central High School HVAC Replacement. HCSD will negotiate, in accordance with F.S. 287.055, an AIA C103-215 "Standard Form of Agreement Between Owner and Consultant" contract regarding the fee structure, terms and conditions, etc. with the most qualified firm.

Qualifications are requested as follows:
Commissioning Services

Submittals must be received before **10:00 AM on Friday, August 19, 2022** at the Facilities & Construction Department, Hernando County School Board, 8016 Mobley Road, Brooksville, Florida 34601 (352-797-7050).

Submittal Requirements and information related to this RFQ are available on the Public Purchase website. Interested respondents are **required** to register, free of charge, by visiting: www.publicpurchase.com .

A **non-mandatory** site visit will be held on **Tuesday, August 9th at 10:00 AM**. The meeting will convene at the front office of Central High School, located at 14075 Ken Austin Parkway, Brooksville, FL 34613. The purpose of the meeting will be to allow potential respondents to review existing conditions at the campus. Any questions (or responses) asked at this meeting will be for general information only and HCSB will not be bound to any response by any employee of the District. All questions and responses for official record for this RFQ must be asked via the www.publicpurchase.com posting for this RFQ and must be asked by the deadlines stated below.

REQUEST FOR QUALIFICATIONS
COMMISSIONING SERVICES
HERNANDO COUNTY SCHOOL DISTRICT

I. GENERAL INFORMATION

A. DESCRIPTION

1. Hernando County School Board (HCSB) seeks qualifications from Professional Consultants duly licensed to perform the requested services in accordance with Florida laws & regulations.

2. HCSB is soliciting a Request for Qualification (RFQ) from firms to provide commissioning services for an HVAC replacement project at Central High School, 14075 Ken Austin Parkway, Brooksville, FL. The District plans to use the Construction Manager method of project delivery. Separate RFQ's will be issued for both Design and CM services.

3. Submittals will be evaluated by the Professional Service Advisory Committee (Jury Panel) and ranked according to the criteria described herein. The Most Qualified Firm will enter into fee negotiations and be awarded an AIA C103-215 Agreement in accordance with FS 287.055.

4. HCSB intends to solicit a Professional Engineer for design services for this project. The commissioning firm that is awarded a contract under this RFQ **WILL NOT BE CONSIDERED** to provide design services for this project and their submission for the projects Engineering RFQ will be rejected. The successful commissioning firm awarded a contract under this RFQ also agrees that it will not perform any services or work for the design firm or construction manager (or any of their sub-consultants/contractors) as it relates to this specific project and will not be considered as the Construction Manager.

B. MINIMUM QUALIFICATIONS

Respondents must meet minimum qualifications in order to receive consideration. Respondents shall, at a minimum:

1. Meet the minimum qualifications for licensing for these types of services as required by the State of Florida.

2. Have been in business operating within the State of Florida for a minimum of three (3) consecutive years under the current name and providing the services advertised under this RFQ.

3. Have successfully completed at least **three (3) K-12 educational** HVAC commissioning projects with a total value of each project of at least **Four Million Dollars ($4,000,000)** where the respondent was the commissioning agent for the project.

4. May not be disqualified by Florida Statute 287.133 (2) (a), which states as follows:
"A person or affiliate who has been placed on the convicted vendor list following a conviction for a public entity crime may not submit a bid, proposal, or reply on a contract to provide any goods or services to a public entity; may not submit a bid, proposal, or reply on a contract with a public entity for the construction or repair of a public building or public work; may not submit bids, proposals, or replies on leases of real property to a public entity; may not be awarded or perform work as a contractor, supplier, subcontractor, or consultant under a contract with any public entity; and may not transact business with any public entity in excess of the threshold amount provided in s. 287.017 for CATEGORY TWO for a period of 36 months following the date of being placed on the convicted vendor list."

C. SCOPE OF SERVICES

The primary role of the CxA is to develop and ensure the Owner's Project Requirements (OPR) are achieved through the design, construction, and operation of the facility. The selected commissioning agent will provide all services necessary to assist the Central High School Elementary HVAC Replacement project in meeting District design requirements by providing commissioning services during the design phase, construction phase and acceptance phase of the project.

These services will include, but not be limited to:

COMMISSIONING PROCESS DURING THE DESIGN PHASE:

1. **Review Owner's Project Requirement and Basis of Design.**
    a. Ensure the design incorporates sustainable design issues that relate to building energy using systems that are within the project budget for design and construction.
    b. Ensure project complies with Owner's requirements.

2. **Commissioning Design Review.**
    a. The CxA will review all design and construction documents with a focus on commissioning, design completeness, cost-effectiveness, coordination of trades, and energy efficiency. The CxA will prepare a written list of comments for the Owner for each design submission and GMP package.
    b. Provide the Owner with an independent assessment of the design of the commissioned systems.
    c. Review the design documents and provide review comments.

3. **Commissioning Plan** – The CxA will develop a commissioning plan that encompasses the design, construction, and occupancy operations phases. Before the construction start date, the CxA will develop the initial commissioning plan, including the following:
    a. A project specific description of the equipment to be commissioned.
    b. A description of the roles of the CxA team, including the responsibilities of the Owner, A/E, contractors, and CxA.
    c. Sample prototypical pre-functional checklists (PFCs) for each piece of equipment in the commissioning scope.
    d. Sample prototypical functional test procedures (FTPs) that define acceptable results of the tests to be performed.

4. **Commissioning Specifications.**
    a. Integrate commissioning requirements into the construction bid and contract documents (utilizing building commissioning specifications similar to 019113, and 019115 included in this document as **Appendix C**).

COMMISSIONING PROCESS DURING CONSTRUCTION AND ACCEPTANCE PHASES:

5. **Meetings.**
    a. Kick-Off Meeting – the CxA will plan and conduct a commissioning kick-off meeting within 60 days of the construction contract award or as dictated by the actual construction schedule.
    b. Commissioning Meetings – The CxA will coordinate and direct the commissioning activities in conjunction with the contractor and/or construction manager in a logical, sequential, and efficient manner using consistent protocols, clear and regular communications and consultations with all necessary parties, frequently updated timelines and schedules, and technical expertise. Meetings will be held as necessary to coordinate the commissioning process.
    c. Project Meetings – The CxA will review the minutes of the regular project meetings and attend selected project meetings as needed to resolve the issues and concerns and coordinate the commissioning process.

6. **Construction Phase Commissioning Plan** – the CxA will revise the commissioning plan, including scope and schedule, as necessary.
    a. The CxA will prepare project-specific pre-functional checklists (PFCs) for each piece of

equipment in the commissioning scope with Owner input, and include these in the commissioning plan. Generic PFCs are not acceptable.

a. Prepare project-specific functional test procedures (FTPs) that define acceptable results of the tests to be performed with Owner input, and included those in the commissioning plan. Generic FTPs are not acceptable.
b. Functional Performance Testing will include 100% sampling. Partial sampling will not be acceptable.

7. **Reviews.**
    a. Shop Drawings/Submittals – The CxA will review contractor submittals applicable to systems being commissioned to ensure compliance with the commissioning plan, commissioning specifications, and OPR. The CxA will forward comments and concerns in writing to the design team and the Owner. Reviews must be concurrent with A/E reviews, must be conducted in a timely manner, and must not affect the construction schedule of the contractor.
    b. O&M Manuals – The CxA shall review the manuals to ensure proper content and format.
    c. Start-Up Plan – The CxA shall review the start-up plan to ensure operational parameters outlined in the OPR will be met. The review will include start-up training procedures for maintenance personnel who will be operating the equipment after occupancy.
    d. HVAC Control System Programming – The CxA will review the programs before implementation and again after implementation to ensure proper performance of the HVAC system.
    e. Training Program – The CxA will review the training procedures for all equipment included in the commissioning plan to ensure an appropriate transition to operational sustainability by maintenance personnel.
    f. TAB Report – The CxA will review the testing, adjusting, and balancing (TAB) reports prepared by the contractor.
    g. Punch lists – The CxA will review punch lists to ensure that MEP comments are coordinated and consistent with commissioning reports.
    h. h. Record Drawings – The CxA will review the record drawings and identify known discrepancies between these documents and as-installed conditions. The CxA will forward a list of these discrepancies to the Owner, contractor, and design team for incorporation into the record documents.

8. **Scheduling** – The CxA will coordinate all commissioning tasks with the design and construction team to ensure that commissioning activities are included in the master schedule and coordinated with all relevant personnel. The CxA will develop a testing plan for all equipment, systems, and integrated systems.

9. **Pre-Functional Inspections and Checklists** – The Cx team (as coordinated and directed by the CxA) will execute the PFCs in phases (e.g., equipment installation, piping rough-in, electrical rough-in, controls rough-in, feeder and load side termination for electrical systems, etc.) as the work progresses. The purpose of this process is to document that installation occurs per the contract documents as the work is installed rather than waiting until all installation is complete. Resolution of deficiencies shall be documented on subsequent site visits. All elements of equipment and system installation and all PFCs must be complete prior to functional testing.

10. **Equipment and Systems Start-Up** – The CxA reviews equipment start-up procedures, witnesses the start-up of critical systems, and reviews the completed start-up documentation.

11. **Functional Test Procedures** – The CxA will direct execution of the functional test procedures by the

responsible subcontractors. The tests proceed from tests of simple systems to tests of complex systems to tests of integrated systems. The CxA invites O&M personnel to attend and witness testing. The CxA documents test results and recommends systems for acceptance. The CxA will document that specified trends are implemented and operational as required by the commissioning specifications.

12. **Final Commissioning Report** – The CxA will complete the commissioning report at the completion of the construction phase. The final report will be provided to the Owner within four (4) weeks after the start of Owner Occupancy.

13. **Re-testing of Deficient Items.**
    a. Issue Deficiency Log after the first round of testing to highlight all open items.
    b. Provide subsequent functional testing and update the Issue Deficiency Log.

14. **Site Visits.**
    a. During the construction phase of the project, make appropriate jobsite visits to ensure jobsite quality with future building indoor air quality as a priority.
    b. Ensure that the design is being followed.

15. **Create Current Facilities and Operations & Maintenance Plan.**
    a. The plan will include sequence of operation for the building, building occupancy schedule, equipment run time schedules, set points for all HVAC equipment, minimum outside air requirements, changes in schedule or set points, systems narrative describing the mechanical and electrical systems, preventive maintenance plan for building equipment and a commissioning program that includes periodic requirements and tasks for critical facilities.

16. **Review of Contractor Submittals.**
    a. Review all contractor submittals to ensure no deviations from the specifications which would impact energy or water using systems.

17. **Systems Manual and O&M Training Requirements.**
    a. Work with the design team to ensure that the systems manual and O&M training requirements are incorporated within the construction documents.

18. **Verify Systems Manual and Operator/Occupant Training Delivery and Effectiveness.**
    a. Verify that the systems manual is prepared and provided to the Owner and that implementation of training is completed and meets all project requirements.

19. **Verify Seasonal Testing.**
    a. Verify that seasonal testing is provided for all equipment for which it is required.

20. **Develop Plan and Conduct 8-10 Month Operation Review.**
    a. Develop a plan to access and review the operation of energy and water using equipment after 8-10 months of building operation and develop report which documents the findings of the review.

21. **On-going Commissioning Plan.**
    a. Create and distribute an on-going Commissioning Plan to include information regarding the design intent and original settings such as the basis of design, sequence of operations, testing and balancing report, equipment settings original test plans and O&M documentation.

22. Equipment Testing Strategy.

a. The commissioning agent will test all equipment/systems identified in the Commissioning Plan included in the Central High School HVAC Replacement project. Sample testing will not be allowed.

The selected commissioning agent's responsibilities will also be as outlined in the Commissioning Specification Sections 019113 and 019115 of the Commissioning Requirements Specifications included at the end of this document (**Appendix C**).

D. SELECTION PROCESS

1. The ranking and selection of qualified firms will be conducted in two steps in accordance with the Florida Statutes, 287.055, as follows:

   a. Step 1 – Respondents' submittals will be scored individually by each juror, based on their understanding of the material. An average of the individual jurors' final scores will be used to rank all respondents' submittals. The three (3) highest scoring firms will be invited to Interview (Step 2)

   b. Step 2 – Firms participating in this step shall each begin with a score of zero. All firms shall be given an equal amount of time for the interview. Time slots for the interviews will be assigned by the Facilities & Construction Department. Interviews will be scored individually by each committee member. An average of the individual committee members' final scores will be used to rank all firms' interviews. The firm with the highest interview score shall be deemed the most qualified and recommended for selection.

2. The final rankings of the firms will be presented to the School Board for selection. Following selection by the School Board, the Facilities & Construction Department will negotiate, in accordance with F.S. 287.055, a contract regarding the fee structure, terms and conditions, etc. with the selected firm. If the District is unable to reach a timely agreement with the selected firm, negotiations will proceed with the next highest ranked firm, in turn, and in accordance with F.S. 287.055

3. For any lump-sum or cost-plus-a-fixed-fee professional service contract that exceeds the maximum amount established by State law for CATEGORY FOUR, which is $195,000, the Board shall require the firm receiving the award to execute a truth-in-negotiation certificate stating that wage rates and other factual unit costs supporting the compensation are accurate, complete, and current at the time of contracting. Any professional service contract under which such a certificate is required shall contain a provision that the original contract price and any additions thereto shall be adjusted to exclude any significant sums by which the Board determines the contract price was increased due to inaccurate, incomplete, or non-current wage rates and other factual unit costs. All such contract adjustments shall be made within (1) year following the end of the contract.

II. SUBMITTAL REQUIREMENTS

A. SUBMITTAL INFORMATION

Due Date & Time:	**Friday, August 19, 2022, 10:00 AM**
Copies:	**Three (3) bound hard copies and one (1) .pdf copy on portable media**
Address:	**Submit to: Facilities & Construction Dept., 8016 Mobley Rd, Brooksville, FL 34601**

Comments: **Late submittals will not be considered. It is the responsibility of the Respondent to allow sufficient time for submittals to transit through the US Postal Service and the HCSB distribution system to guarantee delivery prior to the deadline.**

Contact: **Brian Ragan, Facilities & Construction Department**
Hernando County School District
Ragan_b@hcsb.k12.fl.us
352-797-7050

B. SCHEDULE FOR RFQ PROCESS

The schedule is as follows:

Advertisement	July 18 – August 8, 2022
Non-mandatory Site Visit	August 9, 2022 10:00 AM
Final Date for Respondent Questions	August 10, 2022
Due Date for HCSB Responses	August 12, 2022
Submittals Due	**August 19, 2022 10:00 AM**
Step 1 Short List Announced	August 26, 2022
Step 2 Interviews	September 6-13, 2022
Step 2 Scores Announced	September 16, 2022

The above schedule is tentative. Revisions will be issued in a timely manner. Information related to this RFQ, including the schedule, will be distributed via the HCSB Public Purchase web page.

Respondents are required to register on **www.PublicPurchase.com** to receive information related to this RFQ.

C. GENERAL INFORMATION

1. Changes and Clarifications:
   Changes and clarifications to this RFQ will be issued by addenda. Addenda will be distributed via **www.PublicPurchase.com** .

   Respondents may enter questions at any time prior to the date listed in paragraph II.B. All questions must be entered into **www.publicPurchase.com** and HCSB will respond accordingly.

   It is the respondent's responsibility to log in and check for updated information.

2. Conditions of this RFQ:
   All respondents accept the following conditions:

   a. All submittals shall become the property of HCSB and will not be returned.

   b. Late submittals will not be evaluated.

   c. HCSB is governed by the Public Records Law, Chapter 119, Florida Statute (F.S.). Only trade secrets, as defined by F.S, and financial statements may be exempt from disclosure. Any such confidential materials shall be segregated and clearly marked as Confidential. Blanket requests will not be honored.

   d. HCSB reserves the right to reject any or all proposals if deemed unresponsive to this RFQ or for failure to disclose requested information.

e. HCSB shall not be liable for costs incurred by respondents in the preparation of submittals or for costs related to any element of the selection and contract negotiation process.

f. By responding to this RFQ, the respondents acknowledge that they have carefully reviewed the entire RFQ, including appendices and addenda, and furthermore specifically agrees that the Architect-Engineers Agreement and the associated Terms and Conditions are expressly acceptable without reservation.

g. HCSB reserves the right, without invalidating the respondent's submittal, to request clarification of the information provided.

D. SUBMITTAL FORMAT

Submittals must comply with the following requirements. HCSB retains the right to waive any minor irregularity or requirement should it be judged to be in the best interest of the District.

1. Three (3) hard copies and one (1) .pdf version on portable media. The .pdf version is to be submitted as a single bound document, including the cover letter.

2. Each submittal is to include a Letter of Interest bound into the submittal as page 1. The Letter of Interest is to include the following information:

   a. Legal name of the Firm
   b. Mailing Address
   c. Contact information for the person responsible for communications regarding this RFQ

3. The submittal is to be prepared simply and economically, providing a straightforward, concise description of the Respondent's capabilities to satisfy the requirements of this RFQ. Respondents are asked to concentrate on accuracy, completeness and clarity of content.

4. Submittals are to be 8 ½" x 11", permanently bound, with minimum font size 11 point. Fold out pages may be included for charts, graphs and diagrams, but not for text. Fold out pages may be no larger than 11" x 17" and must fold entirely within the section.

5. Submittal shall be formatted and tabbed in the exact form and numeric sequence stated herein. Each section shall be written on a stand-alone basis so that its contents may be evaluated with a minimum of cross-referencing to other sections of the package**. Information which is not readily found in its designated section may be assumed to have been omitted**.

6. Specific information upon which the submittal will be judged is as follows. Response to all items shall be complete.

III. EVALUATION CRITERIA

Submittals will be evaluated and scored according to the Evaluation Form provided in Appendix A.

It is the intent of HCSB to select firms who have prior experience with educational projects. Respondents will be judged not only on prior experience but also on their ability to address issues critical to the success of a project, as outlined in this RFQ document. The following must be submitted (in order by Tab) and are elements that will be used to evaluate each respondent's qualifications.

TAB 01 – FIRM QUALIFICATIONS AND CAPABILITIES

Provide a brief overview of the firm's qualifications and experience related to educational HVAC projects or projects performed in a similar environment**. List the three projects required to meet the minimum qualifications stated in section I, B (3) of this document at a minimum**.

Describe the organization and size of the firm. Establish the lines of authority and communication. Organizational chart may be included.

Provide a copy of the current Annual corporate commissioning certification from a nationally recognized commissioning organization (i.e., BCA, ACG, ASHRAE).

Describe the firm's in-house capabilities, specifically with regard to experience acting as **Commissioning Consultant**.

Describe the firm's current and projected workload.

Establish whether the firm is a certified minority business enterprise as defined by the Florida Small and Minority Business Assistance Act.

TAB 02 – STAFF QUALIFICATIONS

Identify the Principals and other key staff. Provide a brief overview of the individual staff qualifications and relevant experience related to educational HVAC commissioning projects or projects performed in a similar environment.

Present unique qualifications or knowledge that staff may offer, for example certification with a recognized green building rating organization, expertise in software, commissioning certifications, etc.

Unique projects and projects similar to this project where key staff has participated as the commissioning agent whether under the firm's employ or other employ. If not completed as an employee of the submitting firm please indicate so.

TAB 03 – PRIOR EXPERIENCE AND PERFORMANCE

Present at least three (3) relevant projects performed as prime commissioning consultant. Provide information related to the complexity, methodology and significant findings or resolutions. Although projects demonstrating the firm meets this RFQ's minimum qualifications may be listed or duplicated in this section they **MUST** be listed in TAB 01 as instructed above.

Provide names and current contact information for the Owner representative for each project.

Demonstrate success on the above projects. Testimonials and reference letters may be provided.

TAB 04 – PROJECT APPROACH

<u>Describe the firm's policies and procedures with regard to Project Implementation:</u>
Present a plan for setting forth the program for implementing and carrying out the required services to include project planning, performing assessment/investigative work, project status reporting and phased reporting services.

Procedure for investigating existing conditions for pre-commissioning.

Ability to review design documents for future maintenance coordination, energy efficiency, owners objective for the project, including the work of sub- consultants, so as to avoid delays to the project.

<u>Describe the firm's policies and procedures with regard Reporting & Communications:</u>
Describe the firm's policies and procedures with regard to Communication and Reporting:
Ability to produce detailed meeting minutes and field reports. **Provide examples including a sample pages from a commissioning report from a similar project (i.e. A K-12 school)**.

Describe how the proposed organizational structure will insure orderly communications, distribution of information, effective coordination of activities and accountability.

Describe the firm's policies and procedures for project close-out and communicating deficiencies and findings to the owner, engineer and contractor. Describe follow-up procedures through final completion.

TAB 05 – WORK LOCATION

Describe the location of the office where project documents and reports will be produced

Describe the proximity of field staff to the project site and their availability to review site conditions during construction as to not cause delays in the construction of the project.

Describe how the proximity of the firm's office may affect construction phase tasks and coordination with the HCSB project manager. List any Hernando County residents on staff or any Hernando County presence the firm may have.

Appendix A

HERNANDO COUNTY SCHOOL DISTRICT
SUBMITTAL EVALUATION FORM
COMMISSIONING SERVICES

QUALIFICATION BASED SELECTION

Evaluator #:_____ Date:_____
Name of Firm:_____
RFQ #:__0251-201-2203_____

SCORE: Weight x Rating = Score

1. FIRM QUALIFICATIONS AND CAPABILITIES[1]

- ❑ Experience with educational or similar projects __15__x_____=____
- ❑ Organizational structure & established lines of communication __15__x_____=____
- ❑ Documented experience acting as Commissioning Consultant __15__x_____=____

2. STAFF QUALIFICATIONS[1]

- ❑ Qualifications and relevant individual experience __10__x_____=____
- ❑ Unique knowledge, certifications & abilities of staff __15__x_____=____
- ❑ Staff experience in similar commissioning projects __10__x_____=____

3. PRIOR EXPERIENCE AND PERFORMANCE[1]

- ❑ Three examples of successful projects __15__x_____=____
- ❑ Demonstrated success on each of the projects __10__x_____=____
- ❑ Owner references for each of the projects __10__x_____=____

4. PROJECT APPROACH[1]

- ❑ Plan for project implementation __10__x_____=____
- ❑ Method for pre-commissioning __10__x_____=____
- ❑ Documented Communication and Reporting proficiency __10__x_____=____
- ❑ Ability to review documents for energy savings/maintenance __10__x_____=____
- ❑ Approach to Project Close Out __10__x_____=____

5. WORK LOCATION[1]

- ❑ Proximity of firm & availability for Hernando County __10__x_____=____

TOTAL SCORE: _____[4]

NOTES:

1. **Criteria**: Evaluator will review all information presented, including unique characteristics and abilities, in order to rate the firm's qualifications in each category.
2. **Weights**: Weights are assigned to establish the relative importance of the listed criteria.
3. **Ratings**: Evaluator will assess the strength of each firm's qualifications and assign a numerical rating of 1 to 5 with 5 being the highest rating. (Use whole numbers)
4. **Total Score**: Includes the sum of all criteria.

Appendix B

AIA Document C103-215 “Standard Form of Agreement Between Owner and Consultant” is hereby incorporated by reference.

APPENDIX C

DIVISION 01 SECTION 019113
GENERAL COMMISSIONING REQUIREMENTS
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SECTION 019113 – GENERAL COMMISSIONING REQUIREMENTS PART 1.

GENERAL

1.1. RELATED DOCUMENTS

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

1.2. SUMMARY

A. This Section includes general requirements that apply to implementation of commissioning without regard to systems, subsystems, and equipment being commissioned.

B. Related Sections include the following:

1. Division 01 Section "HVAC Commissioning Requirements" for specific requirements for commissioning HVAC systems.

2. Division 01 Section "Electrical Commissioning Requirements" for specific requirements for commissioning electrical systems.

3. Division 01 Section "Plumbing System Commissioning Requirements" for specific requirements for commissioning Plumbing systems.

4. Division 01 Section "Contract Closeout" for specific requirements for closeout at substantial and final completion.

5. Division 01 Section "Contract Closeout" for Specific Requirements for training and demonstration of systems to Owner.

6. Division 01 Section "Contract Closeout" for Specific Requirements related to the Preparation of systems operation and maintenance manuals.

1.3. DEFINITIONS

A. CxA: Commissioning Authority.

B. OPR: Owner's Project Requirements.

C. Systems, Subsystems, and Equipment: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, and equipment.

D. TAB: Testing, Adjusting, and Balancing.

1.4. COMMISSIONING TEAM

A. Members Appointed by Contractor(s): Individuals, each having 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 Contractor, including Project superintendent and subcontractors, installers, suppliers, and specialists deemed appropriate by the CxA.

B. Members Appointed by Owner:

1. CxA: The designated person, company, or entity that plans, schedules, and coordinates the commissioning team to implement the commissioning process. Owner will engage the CxA under a separate contract.

2. All contractor commissioning requirements and costs associated with commissioning the project shall be included in the base bid.

3. Representatives of the facility user and operation and maintenance personnel.

4. Architect and Engineering design professionals.

1.5. OWNER'S RESPONSIBILITIES

A. Assign operation and maintenance personnel and schedule them to participate in commissioning team activities including, but not limited to, the following:

1. Coordination meetings.

2. Training in operation and maintenance of systems, subsystems, and equipment.

3. Testing meetings.

4. Demonstration of operation of systems, subsystems, and equipment.

1.6. CONTRACTOR'S RESPONSIBILITIES

A. Provide utility services required for the commissioning process.

B. Contractor shall assign representatives with expertise and authority to act on behalf of the Contractor and schedule them to participate in and perform commissioning team activities including, but not limited to, the following:

1. Participate in commissioning and construction-phase coordination meetings.

2. Participate in maintenance orientation and inspection.

3. Participate in operation and maintenance training sessions.

4. Participate in final review at acceptance meeting.

5. Certify that Work is complete and systems are operational according to the Contract Documents, including calibration of instrumentation and controls.

6. Evaluate performance deficiencies identified in test reports and, in collaboration with entity responsible for system and equipment installation, recommend corrective action.

7. Review and approve final commissioning documentation.

8. Certify that all pre-test work and pre-testing of functional performance tests are complete and operational prior to scheduling performed testing by CxA. Submit completed functional performance test forms with data from pre-testing.

9. During functional performance testing, a representative from the mechanical contractor,

controls contractor, and test/balance engineer must be present and participate in testing.

C. Subcontractors shall assign representatives with expertise and authority to act on behalf of subcontractors and schedule them to participate in and perform commissioning team activities including, but not limited to, the following:

1. Pre-test all systems/equipment prior to engaging CxA for Functional Performance Testing.

2. Participate in commissioning and construction-phase coordination meetings.

3. Participate in maintenance orientation and inspection.

4. Participate in procedures meeting for testing.

5. Participate in final review at acceptance meeting.

6. Provide schedule for operation and maintenance data submittals, equipment startup, and testing to CxA for incorporation into the commissioning plan. Update schedule on a weekly basis throughout the construction period.

7. Provide information to the CxA for developing construction-phase commissioning plan.

8. Participate in training sessions for Owner's operation and maintenance personnel.

9. Provide updated Project Record Documents to the CxA on a daily basis.

10. Gather and submit operation and maintenance data for systems, subsystems, and equipment to the CxA, as specified in Division 01 Section "Operation and Maintenance Data."

11. Provide technicians who are familiar with the construction and operation of installed systems and who shall develop specific test procedures and participate in testing of installed systems, subsystems, and equipment.

12. The test/balance subcontractor, mechanical contractor, and automatic temperature controls subcontractor must be on-site and provide assistance during all functional performance testing.

D. Contractors and subcontractors must pre-inspect and pre-test all equipment and systems prior to requesting functional performance testing by the CxA. All pre-start/start-up checklists and functional performance test forms must be completed and submitted to Engineer prior to scheduling formal functional performance testing.

1.7. CXA'S RESPONSIBILITIES

A. Organize and lead the commissioning team.

B. Prepare a construction-phase commissioning plan. Collaborate with Contractor and with subcontractors to develop test and inspection procedures. Include design changes and scheduled commissioning activities coordinated with overall Project schedule. Identify commissioning team member responsibilities, by name, firm, and trade specialty, for performance of each commissioning task.

C. Convene commissioning team meetings for the purpose of coordination, communication, and conflict resolution; discuss progress of the commissioning processes. Responsibilities include arranging for

facilities, preparing agenda and attendance lists, and notifying participants. The CxA shall prepare and distribute minutes to commissioning team members and attendees within five workdays of the commissioning meeting.

D. At a mutually agreed upon time, conduct an initial construction-phase coordination meeting for the purpose of reviewing the commissioning activities and establishing tentative schedules for operation and maintenance submittals; operation and maintenance training sessions; TAB Work; and Project completion.

E. Observe and inspect construction and report progress and deficiencies. In addition to compliance with the Contract Documents, inspect systems and equipment installation for adequate accessibility for maintenance and component replacement or repair.

F. Prepare Project-specific test and inspection procedures and checklists.

G. Schedule, direct, witness, and document tests, inspections, and systems startup.

H. Compile test data, inspection reports, and certificates and include them in the systems manual and commissioning report.

I. Certify date of acceptance and startup for each item of equipment for start of warranty periods.

J. Review Project Record Documents for accuracy. Request revisions from Contractor to achieve accuracy. Project Record Documents requirements are specified in Division 01 Section "Project Record Documents."

K. Review and comment on operation and maintenance documentation and systems manual outline for compliance with the Contract Documents. Operation and maintenance documentation requirements are specified in Division 01 Section"Operation and Maintenance Data."

L. Assemble the final commissioning documentation, including the commissioning report and Project Record Documents.

1.8. COMMISSIONING DOCUMENTATION

A. Commissioning Plan: A document, prepared by CxA, that outlines the schedule, allocation of resources, and documentation requirements of the commissioning process, and shall include, but is not limited to the following:

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 detailed description of submittals that are required to support the commissioning processes. Submittal dates shall include the latest date approved submittals must be received without adversely affecting commissioning plan.

2. Description of the organization, layout, and content of commissioning documentation (including systems manual) and a detailed 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 observations to be made.

8. Description of requirements for operation and maintenance training, including required training materials.

9. Description of expected performance for systems, subsystems, equipment, and controls.

10. Schedule for commissioning activities with specific dates coordinated with overall construction schedule.

11. Identification of installed systems, subsystems, and equipment, including design changes that occurred during the construction phase.

12. Process and schedule for documenting changes on a continuous basis to appear in Project Record Documents.

13. Process and schedule for completing prestart and startup checklists for systems, subsystems, and equipment to be verified and tested.

14. 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. Test Checklists: CxA, with assistance of Contractor and Subcontractors, shall develop test checklists for each system, subsystem, or equipment including interfaces and interlocks, and include a separate entry, with space for comments, for each item to be tested. Prepare separate checklists for each mode of operation and provide space to indicate whether the mode under test responded as required. Provide space for testing personnel to sign off on each checklist. Specific checklist content requirements are specified in Division 01 Section "HVAC Commissioning Requirements", "Electrical Commissioning Requirements" and "Plumbing System Commissioning Requirements". Test checklists will be jointly developed as the project progresses. Each checklist, regardless of system, subsystem, or equipment being tested, shall include, but not be limited to, the following:

1. Name and identification code of tested item.

2. Test number.

3. Time and date of test.

4. Indication of whether the record is for a first test or retest following correction of a problem or issue.

5. Dated signatures of the person performing test and of the witness, if applicable.

6. Individuals present for test.

7. Deficiencies.

8. Issue number, if any, generated as the result of test.

C. Certificate of Readiness: Certificate of Readiness shall be signed by Contractor, Subcontractor(s), Installer(s), and CxA certifying that systems, subsystems, equipment, and associated controls are ready for testing. Completed test checklists signed by the responsible parties shall accompany this certificate.

D. Test and Inspection Reports: CxA shall record test data, observations, and measurements on test checklists. Photographs, forms, and other means appropriate for the application shall be included with data. CxA shall compile test and inspection reports and test and inspection certificates and include them in systems manual and commissioning report.

E. Corrective Action Documents: CxA shall document corrective action taken for systems and equipment that fail tests. Include required modifications to systems and equipment and revisions to test procedures, if any. Retest systems and equipment requiring corrective action and document retest results.

F. Issues Log: CxA shall prepare and maintain an issues log that describes design, installation, and performance issues that are at variance with the Contract Documents. Identify and track issues as they are encountered, documenting the status of unresolved and resolved issues.

1. Creating an Issues Log Entry:

    a. Identify the issue with unique numeric or alphanumeric identifier by which the issue may be tracked.
    b. Assign a descriptive title of the issue.
    c. Identify date and time of the issue.
    d. Identify test number of test being performed at the time of the observation, if applicable, for cross-reference.
    e. Identify system, subsystem, and equipment to which the issue applies.
    f. Identify location of system, subsystem, and equipment.
    g. Include information that may be helpful in diagnosing or evaluating the issue.
    h. Note recommended corrective action.
    i. Identify commissioning team member responsible for corrective action.
    j. Identify expected date of correction.
    k. Identify person documenting the issue.

2. Documenting Issue Resolution:

    a. Log date correction is completed or the issue is resolved.
    b. Describe corrective action or resolution taken. Include description of diagnostic steps taken to determine root cause of the issue, if any.
    c. Identify changes to the Contract Documents that may require action.
    d. State that correction was completed and system, subsystem, and equipment is ready for retest, if applicable.
    e. Identify person(s) who corrected or resolved the issue.
    f. Identify person(s) documenting the issue resolution.

3. Issues Log Report: On a periodic basis, but not less than for each commissioning team meeting, CxA shall prepare a written narrative for review of outstanding issues and a status update of the issues log. As a minimum, CxA shall include the following information in the issues log and expand it in the narrative:

    a. Issue number and title.
    b. Date of the identification of the issue.
    c. Name of the commissioning team member assigned responsibility for resolution.

d. Expected date of correction.

G. Commissioning Report: CxA shall document results of the commissioning process including unresolved issues and performance of systems, subsystems, and equipment. The commissioning report shall indicate whether systems, subsystems, and equipment have been completed and are performing according to the Contract Documents. The commissioning report shall include, but is not limited to, the following:

1. Lists and explanations of substitutions; compromises; variances in the Contract Documents; record of conditions; and, if appropriate, recommendations for resolution. This report shall be used to evaluate systems, subsystems, and equipment and shall serve as a future reference document during Owner occupancy and operation. It shall describe components and performance that exceed requirements of the Contract Documents and those that do not meet requirements of the Contract Documents. It may also include a recommendation for accepting or rejecting systems, subsystems, and equipment.

2. Commissioning plan.

3. Testing plans and reports.

4. Corrective modification documentation.

5. Issues log.

6. Completed test checklists.

7. Punch Lists.

8. Test/Balance Reports.

9. Listing of off-season test(s) not performed and a schedule for their completion.

10. All commissioning documents must be submitted to the building Owner within 90 days of the date of receipt of the Certificate of Occupancy.

H. Systems Manual: CxA shall gather required information and compile systems manual. Systems manual shall include, but is not limited to, the following:

1. Project Record Documents as specified in Division 01 Section "Project Record Documents."

2. Final commissioning plan.

3. Commissioning report.

4. Operation and maintenance data as specified in Division 01 Section "Operation and Maintenance Data."

1.9. SUBMITTALS

A. Test Checklists and Report Forms: CxA shall submit sample checklists and forms to Contractor quality-control manager and subcontractors for review and comment. Submit two copies of each checklist and report form.

B. Test and Inspection Reports: CxA shall submit test and inspection reports.

C. Corrective Action Documents: CxA shall submit corrective action documents.

1.10. QUALITY ASSURANCE

A. Instructor Qualifications: Factory-authorized service representatives, experienced in training, operation, and maintenance procedures for installed systems, subsystems, and equipment.

B. Test Equipment Calibration: Comply with test equipment manufacturer's calibration procedures and intervals. Recalibrate test instruments immediately whenever instruments have been repaired following damage or dropping. Affix calibration tags to test instruments. Instruments shall have been calibrated within six months prior to use.

1.11. COORDINATION

A. Coordinating Meetings: CxA shall conduct coordination meetings of the commissioning team to review progress on the commissioning plan, to discuss scheduling conflicts, and to discuss upcoming commissioning process activities.

B. Pretesting Meetings: CxA shall conduct pretest meetings of the commissioning team to review startup reports, pretest inspection results, testing procedures, testing personnel and instrumentation requirements, and manufacturers' authorized service representative services for each system, subsystem, equipment, and component to be tested.

C. Testing Coordination: 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 inspecting.

1. Schedule times for tests, inspections, obtaining samples, and similar activities.

D. Manufacturers' Field Services: CxA and Contractor shall coordinate services of manufacturers' field services.

1.12. ALTERNATES

A. Refer to Division 01 Section, “Alternates” for description of work under this section affected by alternates.

PART 2. PRODUCTS (NOT USED) PART 3.

EXECUTION

3.1. OPERATION AND MAINTENANCE TRAINING REQUIREMENTS

A. Training Preparation Conference: Before operation and maintenance training, CxA shall convene a training preparation conference to include Owner's operation and maintenance personnel, Contractor, and subcontractors. In addition to requirements specified in Division 01 Section "Demonstration and Training," perform the following:

1. Review installed systems, subsystems, and equipment.

2. Review instructor qualifications.

3. Review instructional methods and procedures.

4. Review training module outlines and contents.

5. Review course materials (including operation and maintenance manuals).

6. Inspect and discuss locations and other facilities required for instruction.

7. Review and finalize training schedule and verify availability of educational materials, instructors, audiovisual equipment, and facilities needed to avoid delays.

8. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

B. Training Modules: Develop an instruction program that includes individual training modules for each system, subsystem, and equipment as specified in Division 01 Section "Demonstration and Training."

END OF SECTION

DIVISION 01 SECTION 019115
HVAC COMMISSIONING REQUIREMENTS
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SECTION 019115 - HVAC COMMISSIONING REQUIREMENTS PART 1.

GENERAL

1.1. RELATED DOCUMENTS

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

1.2. SUMMARY

A. This Section includes requirements for commissioning the HVAC system and its subsystems and equipment. This Section supplements the general requirements specified in Division 01 Section "General Commissioning Requirements."

B. Related Sections include the following:

1. Division 01 Section "General Commissioning Requirements" for general requirements for commissioning processes that apply to this Section.

C. The following **new or modified** systems and/or equipment shall be commissioned:

1. Air Flow Monitoring Stations.
2. Air curtains.
3. Air Separators.
4. Automatic Glycol Feeders.
5. Automatic Temperature Control System.
6. Boilers and burners.
7. Carbon Monoxide Detector.
8. Condensate overflow alarms.
9. Condensate pumps.
10. Condensing Units.
11. Conventional Hydronic Control Valves.
12. Dampers
13. Demand Meter/ATC Interface.
14. Differential Pressure Bypass Valves.

15. Differential Static Pressure Controllers.
16. Dishwasher Exhaust Fans.
17. Dryer Duct Booster System.
18. Duct smoke detectors.
19. Ductless heat pumps and air conditioning units.
20. Dust Collector Systems.
21. Electric Heaters/Radiant Heat Panels.
22. Electric Heating Coils.
23. Energy recovery ventilators (Including variable frequency drives).
24. Exhaust air systems including fume hoods and laboratory exhaust systems.
25. Expansion tanks
26. Exhaust Fans and ventilation fans.
27. Flame Failure Alarms.
28. Flow measuring stations.
29. Flow Switches.
30. Freeze protection pumps.
31. Greenhouse ventilation/heating systems.
32. Heating and Ventilating Units
33. High temperature alarms.
34. Hydronic Unit Heaters.
35. Hot water systems.
36. Hot Gas Reheat coils.
37. HVAC controls and sequences of operation.
38. Kiln Ventilation Fans.
39. Kitchen ventilation system.
40. Lighting interface to ATC system.
41. Low Water Cut-Offs.

42. Makeup water meter flow rates and alarms.

43. Pumps.

44. Pressure Independent Control Valves.

45. Remote lift station interlocks.

46. Single Zone VAV Units.

47. Split System Condensing Units.

48. Unit Heaters.

49. Variable frequency drives.

50. Variable refrigerant volume systems (indoor and outdoor units).

51. Variable refrigerant volume system ATC interface and systems integration.

52. Ventilation Fans.

53. Water meter/ATC interface.

54. Welding Hood Exhaust/Make-up Air Systems.

1.3. DEFINITIONS

A. Architect: Includes Architect identified in the Contract for Construction between Owner and Contractor, plus consultant/design professionals responsible for design of HVAC, electrical, communications, controls for HVAC systems, and other related systems.

B. CxA: Commissioning Authority.

C. Systems, Subsystems, and Equipment: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, and equipment.

D. TAB: Testing, Adjusting, and Balancing.

1.4. CONTRACTOR'S RESPONSIBILITIES

A. The following responsibilities are in addition to those specified in Division 01 Section "General Commissioning Requirements."

B. Contractor:

1. Attend procedures meeting for TAB Work.Certify that TAB Work is complete.

2. Assist performing functional performance tests.

C. Mechanical Contractor:

1. Attend TAB verification testing.

2. Provide measuring instruments and logging devices to record test data, and data acquisition equipment to record data for the complete range of testing for the required test period.

3. Assist performing functional performance tests.

D. HVAC Instrumentation and Control Contractor: With the CxA, review control designs for compliance with the Contract Documents, controllability with respect to actual equipment to be installed, and recommend adjustments to control designs and sequence of operation descriptions. Assist with performing functional performance tests.

E. TAB Subcontractor:

1. Contract Documents Review: With the CxA, review the Contract Documents before developing TAB procedures.

    a. Verify the following:
        i. Accessibility of equipment and components required for TAB Work.
        ii. Adequate number and placement of duct balancing dampers to allow proper balancing while minimizing sound levels in occupied spaces.
        iii. Adequate number and placement of balancing valves to allow proper balancing and recording of water flow.
        iv. Adequate number and placement of test ports and test instrumentation to allow reading and compilation of system and equipment performance data needed to conduct both TAB and commissioning testing.
        v. Air and water flow rates have been specified and compared to central equipment output capacities.
    b. Identify discontinuities and omissions in the Contract Documents.
    c. This review of the Contract Documents by the TAB Subcontractor satisfies requirements for a design review report as specified in Division 23 Section "Testing Adjusting & Balancing for HVAC & Plumbing."
    d. Assist performing functional performance tests.

2. Additional Responsibilities: Participate in tests specified in Division 23 Sections "Instrumentation & Controls of HVAC & Plumbing Systems."

F. Electrical Contractor:

1. With the Mechanical Contractor, coordinate installations and connections between and among electrical and HVAC systems, subsystems, and equipment.

2. Attend TAB verification testing.

1.5. COMMISSIONING DOCUMENTATION

A. The following are in addition to documentation specified in Division 01 Section "General Commissioning Requirements."

B. Test Checklists: CxA with assistance of Contractor shall develop test checklists for HVAC systems, subsystems, and equipment, including interfaces and interlocks with other systems. CxA shall prepare separate checklists for each mode of operation and provide space to indicate whether the mode under test responded as required. In addition to the requirements specified in Division 01 Section "General Commissioning Requirements," checklists shall include, but not be limited to, the following:

1. Calibration of sensors and sensor function.

2. Testing conditions under which test was conducted, including (as applicable) ambient conditions, set points, override conditions, and status and operating conditions that impact the results of test.

3. Control sequences for HVAC systems.

4. Strength of control signal for each set point at specified conditions.

5. Responses to control signals at specified conditions.

6. Sequence of response(s) to control signals at specified conditions.

7. Electrical demand or power input at specified conditions.

8. Power quality and related measurements.

9. Expected performance of systems, subsystems, and equipment at each step of test.

10. Narrative description of observed performance of systems, subsystems, and equipment. Notation to indicate whether the observed performance at each step meets the expected results.

11. Interaction of auxiliary equipment.

12. Issues log.

1.6. SUBMITTALS

A. The following submittals are in addition to those specified in Division 01 Section "General Commissioning Requirements."

B. Testing Procedures: CxA shall submit detailed testing plan, procedures, and checklists for each series of tests. Submittals shall include samples of data reporting sheets that will be part of the reports.

C. Certificate of Readiness: CxA shall compile certificates of readiness from Contractor certifying that systems, subsystems, equipment, and associated controls are ready for testing.

D. Certificate of Completion of Installation, Prestart, and Startup: CxA shall certify that installation, prestart, and startup activities have been completed. Certification shall include completed checklists provided by TAB Subcontractor as specified in Division 23 Section "Testing Adjusting & Balancing for HVAC & Plumbing."

E. Test and Inspection Reports: CxA shall compile and submit test and inspection reports and certificates, and shall include them in systems manual and commissioning report.

F. Corrective Action Documents: CxA shall submit corrective action documents.

G. Certified TAB Reports: CxA shall submit verified, certified TAB reports.

1.7. ALTERNATES

A. Refer to Division 01 Section, “Alternates” for description of work under this section affected by alternates.

PART 2. PRODUCTS (NOT USED) PART 3.

EXECUTION

3.1. TESTING PREPARATION

A. Prerequisites for Testing:

1. Certify that HVAC systems, subsystems, and equipment have been completed, calibrated, and started; are operating according to the Contract Documents; and that Certificates of Readiness are signed and submitted.

2. Certify that HVAC instrumentation and control systems have been completed and calibrated; are operating according to the Contract Documents; and that pretest set points have been recorded.

3. Certify that TAB procedures have been completed, and that TAB reports have been submitted, discrepancies corrected, and corrective work approved.

4. Test systems and intersystem performance after approval of test checklists for systems, subsystems, and equipment.

5. Set systems, subsystems, and equipment into operating mode to be tested (e.g., normal shut down, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).

6. Verify each operating cycle after it has been running for a specified period and is operating in a steady-state condition.

7. Inspect and verify the position of each device and interlock identified on checklists. Sign off each item as acceptable, or failed. Repeat this test for each operating cycle that applies to system being tested.

8. Check safety cutouts, alarms, and interlocks with duct detectors and life-safety systems during each mode of operation.

9. Annotate checklist or data sheet when a deficiency is observed.

10. Verify equipment interface with monitoring and control system and TAB criteria; include the following:

    a. Automatic Glycol Feeder operation and ATC interlocks.
    b. All pump status alarms, pump operation, flow rates, and controls.
    c. All temperature alarms.
    d. Boiler temperatures, flow rates, low water cut-off interlock, flame failure interlocks, and amperage.
    e. Carbon monoxide system including makeup air unit exhaust air fans, operation, temperature and fluid/air flow rates.
    f. Differential bypass valves and transmitters.
    g. Duct Smoke detectors operation and interlocks with filtration system.
    h. Duct dryer booster air flow rates, amperage, and set point.
    i. Ductless heat pumps and air conditioning units with air flow rates, fluid flow rates, and temperatures.
    j. Dust Collector System Control.
    k. Electric heating equipment volts, amps, and temperature rise.
    l. Fan filter module flow rates.
    m. Finned tube radiation operation and control.
    n. Greenhouse Heating and Ventilation Equipment.
    o. Head pressure controls for air cooled condensing/heat pump units.
    p. Heating and ventilation unit operation, temperatures, fluid flow rates and air flow rates.
    q. Hydronic unit heater/baseboard radiation temperature and flow rates.
    r. Kitchen ventilation supply and exhaust air flow rates and temperatures, including optical and exhaust sensors.
    s. Lift station interlocks/alarms.
    t. Lighting interface and start/stop by ATC system.
    u. Minimum outdoor-air intake in each operational mode and at minimum and maximum airflows.
    v. Minimum outdoor-air intake in each operational mode and at minimum and maximum airflows.
    w. Operation of heat pump units in both heating and cooling cycles.
    x. Operation of variable refrigerant flow systems in all modes.
    y. Operation/Accuracy of air and fluid flow measuring stations at various flow rates.

z. Pump flow rates, pressure and amperage at each operating mode. aa. Sequences of operation of all HVAC equipment.
bb. Set point and operation of high temperature alarms. cc. Split system condensing units.
dd. Supply and return air flow rates for all HVAC equipment.
ee. Supply, outside air, exhaust and return air flow rates for ERVs in each operating mode.
ff. Test all flow switches including operation and alarms. gg. Test boiler low water cut-off and flame failure alarms. hh. Test freeze protection pumps.
ii. Test operation and air temperatures of hot gas re-heat coils. jj. Test safeties and operation of air curtains.
kk. Total exhaust airflow and total outdoor-air intake. ll. Unit heaters operation and control.
mm. Variable speed drive parameters at each operated mode.

11. Verify proper responses of monitoring and control system controllers and sensors to include the following:

    a. For each controller or sensor, record the indicated monitoring and control system reading and the test instrument reading. If initial test indicates that the test reading is outside of the control range of the installed device, check calibration of the installed device and adjust as required. Retest malfunctioning devices and record results on checklist or data sheet.
    b. Report deficiencies and prepare an issues log entry.

12. Verify that HVAC equipment field quality-control testing has been completed and approved. CxA shall direct, witness, and document field quality-control tests, inspections, and startup specified in individual Division 23 Sections.

B. Testing Instrumentation: Install measuring instruments and logging devices to record test data for the required test period. Instrumentation shall monitor and record full range of operating conditions and shall allow for calculation of total capacity of system for each mode of operation. For individual room cooling tests, provide temporary heaters to impose a cooling load. Operational modes include the following:

1. Heating/Cooling Mode.

2. Occupied and unoccupied.

3. Warm up and cool down.

4. Economizer cycle/relief air fan operation.

5. Emergency power supply.

6. Fluid flow rates and temperatures for all water cooled equipment.

7. Life-safety and safety systems.

8. Duct detectors.

9. Fire safety.

10. Temporary upset of system operation.

11. Partial occupancy conditions.

12. Special cycles.

13. ERV/Single Zone VAV Unit supply/exhaust air flow at partial CO2 levels.

14. Variable refrigerant volume units in heating/cooling modes.

15. Lead/lag/standby modes of operation where redundant equipment is indicated.

16. All alarms.

17. Kitchen make-up air unit and exhaust air fan at full, partial, and minimum air flow rates.

18. Flow switch shut-down and alarm.

19. Condensate overflow safety switch shut-down and alarm.

20. Condensate pump operation.

21. Hot gas re-heat coils in dehumidification mode.

22. Test operation and accuracy of air/fluid flow measuring stations.

3.2. TAB VERIFICATION

A. TAB Subcontractor shall coordinate with CxA for work required in Division 23 Section "Testing Adjusting & Balancing for HVAC & Plumbing." TAB Subcontractor shall copy CxA with required reports, sample forms, checklists, and certificates.

B. Contractor, HVAC Contractor, and CxA shall witness TAB Work.

C. TAB Preparation:

1. TAB Subcontractor shall provide CxA with data required for "Pre-Field TAB Engineering Reports" specified in Division 23 Section "Testing Adjusting & Balancing for HVAC & Plumbing."

    a. CxA shall use this data to certify that prestart and startup activities have been completed for systems, subsystems, and equipment installation.

D. Verification of Final TAB Report:

1. CxA shall select, at random, 10 percent of report for field verification.

2. CxA shall notify TAB Subcontractor 10 days in advance of the date of field verification; however, notice shall not include data points to be verified. The TAB Subcontractor shall use the same instruments (by model and serial number) that were used when original data were collected.

3. Failure of an item is defined as follows:

a. For all readings a deviation of more than 10 percent.

4. Failure of more than 10 percent of selected items shall result in rejection of final TAB report.

E. If deficiencies are identified during verification testing, CxA shall notify the HVAC Contractor and Architect and shall take action to remedy the deficiency. Architect shall review final tabulated checklists and data sheets to determine if verification is complete and that system is operating according to the Contract Documents.

F. CxA shall certify that TAB Work has been successfully completed.

3.3. TESTING

A. Test systems and intersystem performance after test checklists for systems, subsystems, and equipment have been approved.

B. Contractors and subcontractors must pre-inspect and pre-test all equipment and systems prior to requesting functional performance testing by the CxA. All pre-start/start-up checklists and functional performance test forms must be completed and submitted to Engineer prior to scheduling formal functional performance testing.

C. Perform tests using design conditions whenever possible.

1. Simulate conditions by imposing an artificial load when it is not practical to test under design conditions and when written approval for simulated conditions is received from CxA. Before simulating conditions, calibrate testing instruments. Set and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.

2. Alter set points when simulating conditions is not practical and when written approval is received from CxA.

3. Alter sensor values with a signal generator when design or simulating conditions and altering set points are not practical. Do not use sensor to act as signal generator to simulate conditions or override values.

D. Scope of HVAC Contractor Testing:

1. Testing scope shall include entire HVAC installation, from central equipment for heat generation and refrigeration through distribution systems to each conditioned space. It shall include measuring capacities and effectiveness of operational and control functions.

2. Test all operating modes, interlocks, control responses, responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.

E. Detailed Testing Procedures: CxA, with HVAC Contractor, TAB Subcontractor, and HVAC Instrumentation and Control Contractor, shall prepare detailed testing plans, procedures, and checklists for HVAC systems, subsystems, and equipment.

F. HVAC Instrumentation and Control System Testing:

1. Field testing plans and testing requirements are specified in Division 23 Section "Instrumentation & Controls of HVAC & Plumbing Systems". The CxA, HVAC Contractor, Equipment Provider/Manufacturer and the HVAC Instrumentation and Control Contractor shall collaborate to prepare testing plans.

2. CxA shall convene a meeting of appropriate entities to review test report of HVAC instrumentation and control systems.

G. Energy Supply System Testing: HVAC Contractor shall prepare a testing plan to verify performance of gas systems and equipment. Plan shall include the following:

1. Sequence of testing and testing procedures for each equipment item and pipe section to be tested, identified by pipe zone or sector identification marker. Markers shall be keyed to Drawings for each pipe sector showing the physical location of each designated pipe test section. Drawings keyed to pipe zones or sectors shall be formatted to allow each section of piping to be physically located and identified when referred to in system testing plan.

2. Tracking checklist for managing and ensuring that all pipe sections have been tested.

H. Heat-Generation System Testing: HVAC Contractor shall prepare a testing plan to verify performance of air handling units, heat pumps, condensate receivers, and auxiliary equipment, energy recovery ventilators, energy recovery modules, variable refrigerant volume units, unit heaters, radiant heat panels, single zone VAV units, hot gas re-heat coils, hydronic unit heaters, welding makeup air units, heating and ventilating units, carbon monoxide makeup air units, boilers and baseboard radiation units. Plan shall include the following:

1. Sequence of testing and testing procedures for each item of equipment and section of pipe to be tested, identified by identification marker. Markers shall be keyed to Drawings for each pipe sector showing the physical location of each item of equipment and pipe test section. Drawings shall be formatted to allow each item of equipment and section of piping to be physically located and identified

when referred to in the system testing plan.

2. Tracking checklist for managing and ensuring that all pipe sections have been tested.

3. Variable refrigerant flow equipment volts, amps, temperatures, and modes of operation.

I. Refrigeration Heat Rejection System Testing: HVAC Contractor shall prepare a testing plan to verify performance of heat pumps, rooftop units, refrigerant compressors, condensers, variable refrigerant volume systems, ductless units, single zone VAV units, condensing units, ERV units, hot gas re-heat coils, dust collectors, unit heaters and other refrigeration systems. Plan shall include the following:

1. Sequence of testing and testing procedures for each item of equipment and section of pipe to be tested, identified by identification marker. Markers shall be keyed to Drawings showing the physical location of each item of equipment and pipe test section. Drawings shall be formatted to allow each item of equipment and section of piping to be physically located and identified when referred to in the system testing plan.

2. Tracking checklist for managing and ensuring that all pipe sections have been tested.

3. Variable refrigerant flow equipment volts, amps, temperatures and modes of operation.

J. HVAC Distribution System Testing: HVAC Contractor shall prepare a testing plan to verify performance of air, air handling units, steam, and hydronic distribution systems, special exhaust ERV unit supply and exhaust, kitchen ventilation systems, single zone VAV units, fume hood exhaust fans and other distribution systems. Include HVAC terminal equipment and unitary equipment. Plan shall include the following:

1. Sequence of testing and testing procedures for each item of equipment and section of pipe to be tested, identified by identification marker. Markers shall be keyed to Drawings showing the physical location of each item of equipment and pipe test section. Drawings shall be formatted to allow each item of equipment and section of piping to be physically located and identified when referred to in the system testing plan.

2. Tracking checklist for managing and ensuring that all pipe sections have been tested.

3. Equipment, air flow rates, air temperatures, fluid flow rates, safeties, freeze protection pump operation, and demand controlled ventilation.

K. Deferred Testing:

1. If tests cannot be completed because of a deficiency outside the scope of the

HVAC system, the deficiency shall be documented and reported to Owner. Deficiencies shall be resolved and corrected by appropriate parties and test rescheduled.

2. If the testing plan indicates specific seasonal testing, appropriate initial performance tests shall be completed and documented and additional tests scheduled.

L. Testing Reports:

1. Reports shall include measured data, data sheets, and a comprehensive summary describing the operation of systems at the time of testing.

2. Include data sheets for each controller to verify proper operation of the control system, the system it serves, the service it provides, and its location. For each controller, provide space for recording its readout, the reading at the controller's sensor(s), plus comments. Provide space for testing personnel to sign off on each data sheet.

3. Prepare a preliminary test report. Deficiencies will be evaluated by Architect to determine corrective action. Deficiencies shall be corrected and test repeated.

END OF SECTION