PART 1 - GENERAL

1.1 SCOPE

A. The purpose of this section is to specify Division 23 responsibilities, Division 22 responsibilities, and Division 32 responsibilities in the commissioning process.

B. Refer to Section 019113 for the systems that will be commissioned.

1.2 RESPONSIBILITIES

A. Mechanical, Controls, Test and Balance (TAB), Plumbing subcontractors and Irrigation subcontractors: The commissioning responsibilities applicable to each of the subcontractors are as follows (all references apply to commissioned equipment only):

1. Attend a commissioning kickoff meeting and other meetings necessary to facilitate the commissioning process.
2. Provide the commissioning agent with normal cut sheets and submittals of commissioned equipment.
3. Provide additional requested documentation, prior to normal O&M manual submittals, to the commissioning agent for development of start-up and functional testing procedures.
4. Provide a copy of the O&M manuals and submittals of commissioned equipment to the commissioning agent for review.
5. Sub-Contractors shall assist (along with the design engineers) in clarifying the operation and control of commissioned equipment in areas where the specifications, control drawings or equipment documentation is not sufficient for writing detailed testing procedures.
6. Sub-Contractors shall review test procedures to ensure feasibility, safety and equipment protection and provide necessary written alarm limits to be used during the tests.
7. Execute the mechanical and electrical-related portions of the pre-functional checklists for all commissioned equipment.
8. Perform and clearly document all completed startup and system operational checkout procedures, providing a copy to the commissioning agent.
9. Address current Engineer of Record punch list items before functional testing. TAB shall be completed with discrepancies and problems remedied before functional testing.
10. Provide skilled technicians to execute starting of equipment and to execute the functional performance tests for sufficient duration to complete the necessary tests, adjustments and problem-solving.
11. Correct deficiencies identified by the commissioning agent, Owner's Representative and Engineer of Record and retest the equipment.
12. Prepare O&M manuals according to the Contract Documents.
13. Provide training of the Owners Representative’s operating staff.
14. Coordinate with equipment manufacturers to determine specific requirements to maintain the validity of the warranty.

B. Mechanical Contractor. The responsibilities of the mechanical contractor, during construction and acceptance phases in addition to those listed in (A) are:

1. Provide startup for all HVAC equipment.
2. Assist and cooperate with the TAB contractor and commissioning agent by:

a. Putting all HVAC equipment and systems into operation as required.
b. Including cost of sheaves and belts that may be required by TAB.
c. Providing test holes in ducts and plenums where directed by TAB to allow air measurements and air balancing. Provide an approved plug.
d. Providing temperature and pressure taps according to the Construction Documents for TAB and commissioning testing.

3. Prepare a preliminary schedule for Division 23 pipe system testing, flushing and cleaning, equipment start-up and TAB start and completion for use by the commissioning agent. Update the schedule as appropriate.
4. Notify the Owner's Representative when pipe and duct system testing, flushing, cleaning, startup of each piece of equipment and TAB will occur.
5. Assist with functional testing on locally controlled equipment not part of the central building automation system.

C. Controls Contractor. The commissioning responsibilities of the controls contractor, during construction and acceptance phases in addition to those listed in (A) are:

1. Sequences of Operation Submittals. The Controls Contractor's submittals of control drawings shall include complete detailed sequences of operation for each piece of equipment, regardless of the completeness and clarity of the sequences in the specifications.
2. Control Drawings Submittal.

a. The control drawings shall have a key to all abbreviations.
b. The control drawings shall contain graphic schematic depictions of the systems and each component.
c. The schematics will include the system and component layout of any equipment that the control system monitors, enables or controls, even if the equipment is primarily controlled by packaged or integral controls.
d. Provide a full points list
e. The Controls Contractor shall keep the commissioning agent informed of all changes to this list during programming and setup.

3. An updated as-built version of the control drawings and sequences of operation shall be included in the final controls O&M manual submittal.
4. Assist and cooperate with the Testing, Adjusting and Balancing (TAB) contractor in the following manner:

a. Meet with the TAB contractor prior to beginning TAB and review the TAB plan to determine the capabilities of the control system toward completing TAB. Provide the TAB any needed unique instruments that may be needed.
b. For a given area, have all required pre-functional checklists, calibrations, startup and selected functional tests of the system completed and approved by the commissioning agent prior to TAB.
c. Provide a qualified technician to operate the controls to assist the TAB contractor.

5. Assist and cooperate with the commissioning agent in the following manner:

a. Execute the functional testing of the controls system. Assist in the functional testing of all equipment to be commissioned. Provide two-way radios during the testing.
b. Execute all control system trend logs.

6. The controls contractor shall prepare a written plan indicating in a step-by-step manner, the procedures that will be followed to test, checkout and adjust the control system prior to functional performance testing.
7. Provide a signed and dated certification to the commissioning agent and Owner's Representative upon completion of the checkout of each controlled device, equipment and system prior to functional testing for each piece of equipment or system, that all system programming is complete as to all respects of the Design Intent and Contract Documents, except functional testing requirements.
8. As well as the control points necessary to execute all documented control sequences, provide monitoring, control and virtual points.
9. List and clearly identify on the as-built duct and piping drawings the locations of all static and differential pressure sensors (air, water and building pressure).
10. Controls contractor’s work with commissioning is not complete until signed off by commissioning agent and Owner.

D. TAB Contractor. The duties of the TAB contractor, in addition to those listed in (A) are:

1. Submit the outline of the TAB plan and approach for each system and component to the commissioning agent, Owner's Representative and the controls contractor six weeks prior to starting the TAB.
2. The submitted plan will include:

    a. Certification that the TAB contractor has reviewed the construction documents and the systems with the design engineers and contractors to sufficiently understand the design intent for each system.
    b. An explanation of the intended use of the building control system. The controls contractor will comment on feasibility of the plan.
    c. All field checkout sheets and logs to be used that list each piece of equipment to be tested, adjusted and balanced with the data cells to be gathered for each.
    d. Discussion of what notations and markings will be made on the duct and piping drawings during the process.
    e. Final test report forms to be used.
    f. Detailed step-by-step procedures for TAB work for each system.
    g. List of all measurements to be performed and a description of specific test procedures, parameters, formulas to be used.
    h. Details of how total flow will be determined.
    i. The identification and types of measurement instruments to be used and their most recent calibration date.
    j. Plan for hand-written field technician logs of discrepancies, deficient or uncompleted work by others, contract interpretation requests and lists of completed tests (scope and frequency).

3. A running log of events and issues shall be kept by the TAB field technicians.
4. Communicate in writing to the General Contractor and the controls contractor all setpoint and parameter changes made or problems and discrepancies identified during TAB which affect the control system setup and operation.
5. The TAB shall mark on the drawings where all traverse and other critical measurements were taken and cross reference the location in the TAB report.
6. Provide the commissioning agent with any requested data, gathered, but not shown on the draft reports.
7. Provide calibrated instruments to assist commissioning agent in conducting calibration checks of sensors and any other devices requiring field checkout.
8. Provide a final TAB report for the commissioning agent with details.

9. Conduct functional performance tests and checks on the original TAB.
10. The test and balance contractor is responsible for assisting the commissioning agent throughout the entire commissioning process. This includes assistance with reading airflows, water flows, taking pressure measurements, temperature measurements, and providing any other readings requested by the commissioning agent related to the commissioned equipment.
11. The TAB work will not be complete until signed off by commissioning agent and Owner.

E. Plumbing Contractor. The responsibilities of the plumbing contractor, during construction and acceptance phases in addition to those listed in (A) are:

1. Provide startup for all plumbing equipment.
2. Assist and cooperate with the commissioning agent by putting all plumbing equipment and systems into operation and continuing the operation during each working day of commissioning, as required.
3. Prepare a preliminary schedule for Division 22 pipe system testing, flushing and cleaning, and equipment start-up for use by the commissioning agent. Update the schedule as appropriate.

F. Irrigation/Landscaping Contractor. The responsibilities of the irrigation contractor, during construction and acceptance phases in addition to those listed in (A) are:

1. Provide startup for all irrigation equipment.
2. Assist and cooperate with the commissioning agent by putting all irrigation equipment and systems into operation and continuing the operation during each working day of commissioning, as required.
3. Prepare a preliminary schedule for Division 32 pipe system testing, flushing and cleaning, and equipment start-up for use by the commissioning agent. Update the schedule as appropriate.

1.3 RELATED WORK

A. Refer to Section 019113 Commissioning for a listing of all sections containing related work.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

A. Divisions 22, 23 and 32 shall provide all test equipment necessary to fulfill the testing requirements.

B. Refer to Section 019113 Commissioning for additional requirements.

PART 3 - EXECUTION

3.1 STARTUP

A. Divisions 22, 23 and 32 have start-up responsibility and are required to complete systems and sub-systems so they are fully functional, meeting the design objectives of the Contract Documents. The commissioning procedures and functional testing do not relieve or lessen this responsibility or shift that responsibility partially to the commissioning agent or Owner's Representative.

B. Functional testing is intended to begin upon completion of a system.

3.2 FUNCTIONAL TESTING

A. This section presents representative functional testing requirements for Division 22, 23 and 32 systems and equipment.

B. Parties Responsible to Execute Functional Test

1. Controls contractor shall operate the controls as needed.
2. Test and balance contractor shall take readings and assist with set up of equipment.
3. HVAC mechanical contractor or vendor shall assist in testing sequences as needed.
4. Plumbing contractor or vendor shall assist in testing sequences as needed.
5. CxA shall witness, direct and document testing.

C. Testing and Acceptance criteria

1. Test each sequence in the sequence of operations, and other significant modes and sequences not mentioned.
2. Ability of system to maintain the temperature and humidity range within prescribed tolerance
3. All alarms
4. For the conditions, sequences and modes tested, the BAS, integral components and related equipment respond to changing conditions and parameters appropriately as expected, as specified and according to acceptable operating practice

D. Required Monitoring

1. All points requested by the CxA shall be trended by the controls contractor. The trending shall be for seven (7) days per week, 24 hours per day at five minute intervals or as requested by the CxA.

E. BAS Functional Testing

1. A significant part of the BAS functional testing requirements is the successful completion of the functional tests of equipment the BAS controls or interlocks with. Uncompleted equipment functional tests or outstanding deficiencies in those tests lend the required BAS functional testing incomplete.
2. Integral or stand-alone controls are functionally tested with the equipment they are attached to, including any interlocks with other equipment or systems.

3. In addition to the controlled equipment testing, the following tests are required for the BAS, where features have been specified. The following testing requirements are in addition to and do not replace any testing requirements elsewhere in the specifications.

   a. All specified functions and features are set up, debugged and fully operable

   b. Power failure and battery backup and power-up restart functions if applicable

   c. Global commands features

   d. Security and access codes

   e. Occupant over-rides (manual, telephone, key, keypad, etc.)

   f. O&M schedules and alarms if applicable

   g. Scheduling features fully functional and setup, including holidays

   h. Date and time setting in central computer and verify field panels read the same time

   i. Demonstrate functionality of field panels using local operator keypads and local ports (plug-ins) using portable computer/keypad

   j. All graphic screens and value readouts completed

   k. Set-point changing features and functions

   l. Sensor calibrations

   m. Final as-builts or redlines (per spec) control drawings, final points list, program code, set-points, schedules, warranties, etc. per specs, submitted for O&Ms.

   n. Verify that points that are monitored only, having no control function, are checked for proper reporting to BAS.

   o. Communication time between network controllers and field controllers.

   p. Labeling of points.

3.3 WRITTEN WORK PRODUCTS

A. Written work products will consist of the filled out start-up, initial checkout and pre-functional checklists.

END OF SECTION