SECTION 220800 - PLUMBING SYSTEMS COMMISSIONING

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specification sections "General Conditions", "Special Requirements" and "General Requirements" form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.2 DESCRIPTION

A. General provisions and other plumbing and fire protection systems are specified in other Sections of Division 15.

B. Commissioning is an ongoing process and shall be performed throughout construction. Commissioning requires the participation of Division 16 to ensure that all systems are operating in a manner consistent with the Contract Documents. Division 16 shall be familiar with the commissioning plan issued by the CA as it applies to the work of Division 16 and shall execute all commissioning responsibilities assigned to them in the Contract Documents.

C. Commissioning shall conclude with the completion of all required deferred testing, training and system documentation as specified and required to ensure the proper operation of the plumbing equipment and systems provided by this Division.

D. This Section covers plumbing systems commissioning, as required to demonstrate that the equipment and systems of Division 15 are ready for safe and satisfactory operation, as defined by project documents. Commissioning shall include, but shall not be limited to, identification of piping and equipment, cleaning, lubrication, start-up, check-out, and testing, adjusting, and balancing of systems, preparation of equipment and systems documentation and of maintenance and operation manuals, Using Agency training, and preparation of record drawings.

E. This section does not alter the equipment start-up and testing requirements indicated in Division 15 sections of the building specifications. This section is to help define/supplement the requirements of Section 01810, where applicable.

1.3 QUALITY ASSURANCE

A. The plumbing and fire protection (PFP) contractor shall identify an PFP commissioning supervisor. The PFP commissioning supervisor should have a minimum of ten years' experience in plumbing contracting. The PFP commissioning supervisor shall become familiar with the design intent and the requirements of the commissioning process as defined in this Section. The PFP commissioning supervisor shall attend all commissioning meetings and coordinate the commissioning schedule as outline by the commissioning agent. The PFP commissioning supervisor shall assist the CA in coordinating and executing the required commissioning activities.

1.4 PLUMBING AND FIRE PROTECTION CONTRACTOR RESPONSIBILITIES

A. Include and itemize the cost of commissioning in the contract price with an estimated breakdown of hours for meeting and functional testing requirements.

B. The PFP commissioning supervisor shall be responsible for scheduling, supervising, and coordinating the startup, testing, and commissioning activities as specified herein with the CA. Specific requirements of the plumbing contractor and associated subcontractors are identified in this Section and in other Sections of this Division.

C. The CA shall conduct independent verification of installation, pre-functional, start-up and functional testing.

D. PFP commissioning shall take place in three phases. Commissioning requirements for each phase are as follows:

1. Construction Phase

a. Contractor shall attend a Commissioning Scoping meeting and additional commissioning meetings as required throughout the commissioning process. These commissioning meetings will be monthly during early construction and increase in frequency to weekly during the start-up, prefunctional and functional testing phases. Contractor shall assure that all subcontractors who have commissioning responsibilities attend the Commissioning Scoping meeting and other commissioning meetings, as appropriate, during the construction process.
b. Contractor shall report in writing to the CA at least as often as commissioning meetings are scheduled concerning the status of his activities as they affect the commissioning process, the status of each discrepancy identified, the prefunctional and functional testing process, explanations of any disagreements with the identified deficiencies, and proposed resolution and schedule.
c. Contractor shall provide the CA with normal cut sheets and shop drawing submittals of equipment that is to be commissioned.
d. Contractor shall provide documentation to the CA for development of pre-functional and functional performance testing procedures, prior to normal O&M manual submittals. This documentation shall include detailed manufacturer installation, start-up, operating, troubleshooting and maintenance procedures; full details of any owner-contracted tests; fan and pump curves; full factory testing reports, if any; and full warranty information, including all responsibilities of the Department to keep the warranty in force clearly identified. In addition, the installation, start-up and checkout materials that are actually shipped inside the equipment and the actual field checkout sheet forms to be used by the factory or field technicians shall be submitted to the Commissioning Agent. The Commissioning Agent may request further documentation necessary for the development of functional performance testing and the commissioning process. This data request may be made prior to normal submittals.
e. Contractor shall develop and submit to CA, for review prior to equipment or system startup, a complete startup and initial checkout plan using manufacturer's start-up procedures. The commissioning agent shall conduct their own pre-functional testing check in parallel with the contractors.
f. Contractor shall review the commissioning agent's pre-functional checksheets and sign-off on the appropriate areas when contractor and sub-contractors are complete. The prefunctional test sheets will be developed by the commissioning agent. Only when each portion of the pre-functional test sheet is signed off will the contractor be able to move onto the next phase of the start-up and check-out.
g. Contractor shall provide a copy of the O&M manuals and submittals of commissioned equipment, through normal channels, to the CA for review.

h. Contractor shall assist in clarifying the proposed operation and control of commissioned equipment in areas where the specifications, control drawings or equipment documentation is not sufficient for writing detailed testing procedures.
i. CA shall prepare the specific functional test procedures as specified herein. The contractors shall review the CA's proposed functional performance test procedures to ensure feasibility, safety and equipment protection and provide necessary written alarm limits to be used during the tests.
j. Commissioning agent shall prepare a preliminary schedule for Division 16 commissioning activities for use by the CA and shall update the schedule as appropriate. The contractor shall update the commissioning activities and notify any delays in the progress meetings. Contractor shall notify the CA during the commissioning meetings when commissioning activities not yet performed or not yet scheduled will delay construction.
k. Plumbing and Fire Protection equipment start-up shall not be initiated until the complete sign-off of the pre-functional check-sheets as developed by the commissioning agent as specified in other Sections of Division 15.
l. Contractor shall provide startup testing for all normal and emergency power equipment and shall execute the plumbing-related portions of the prefunctional checklists for all commissioned equipment during the startup and initial checkout process. The commissioning agent shall conduct an independent start-up once the contractor is complete with their requirements.
m. Contractor shall perform and clearly document all completed startup and system operational checkout procedures, providing a copy to the CA.
n. Contractor shall correct current Professional punch list and CA deficiency items before functional performance testing can begin.
o. The commissioning agent shall generate the functional testing procedure and record to the plumbing contractor. The plumbing contractor shall review and provide support to the functional testing process or applicable systems. Contractor shall open and close disconnects and switches normal and emergency power requirements as directed by the commissioning agent and the functional testing procedures.
p. Contractor shall report in writing to the CA at least as often as commissioning meetings are being scheduled concerning the status of each outstanding discrepancy identified during commissioning, prefunctional and functional performance testing. Report shall include description of the identified discrepancy, explanations of any disagreements, and proposals and schedule for correction of the discrepancy.

2. Acceptance Phase. Contractor shall assist and cooperate with the CA in the commissioning process by:

a. Putting all plumbing and fire protection equipment and systems into operation and continuing the operation during each working day of the test and balance and commissioning effort, as required.
b. For a given system, have all required prefunctional checklists, calibrations, startup and selected functional tests approved by the CA prior to beginning the test and balance process.
c. Providing skilled technicians to execute starting and operation of equipment.
d. The commissioning agent will conduct functional performance testing. The contractor may be required to have a skilled technician present during functional testing although it is suggested that one be available to make adjustments or assist in problem-solving.

e. The commissioning will require full and part load performance verifications as well as simulated testing requirements. The contractor shall be prepared to operate different components of various systems during the functional testing.
f. Correct deficiencies (differences between specified and observed performance) as interpreted by the CA and Professional.
g. Prepare O&M manuals according to the Contractor Documents, including clarifying and updating the original design intention to as-built conditions.
h. Maintain on site redline as built drawings and produce final "As-built" drawings for all project drawings and contractor-generated coordination drawings.
i. Provide specified training of the Using Agency's operating personnel in accordance with the commissioning agent's overview and outline.
j. Coordinate with equipment manufacturers to determine specific requirements to maintain the validity of the warranty.

3. Warranty Period. During the warranty period, the contractor shall:

a. Be available during seasonal or deferred functional performance testing conducted by the CA, according to the specifications.
b. Correct deficiencies and make necessary adjustments to O&M manuals and as-built drawings for applicable issues identified in any seasonal testing.

PART 2 - PRODUCTS

2.1 SYSTEMS TO BE COMMISSIONED

A. The following are systems to be commissioned.

1. Domestic Water Pumping Systems

2. Domestic Hot Water System

2.2 TEST EQUIPMENT

A. All standard testing equipment required to the PFP portion startup, initial checkout shall be provided by the contractor responsible for the equipment or system being tested.

B. The commissioning agent shall perform their own system verification and performance check-out. The commissioning agent shall provide their own calibrated equipment as required for this testing.

C. All testing equipment associated with functional performance verification and point-to-point required by the commissioning agent shall be the responsibility of the commissioning agent.

D. Special equipment, tools and instruments (only available from vendor or specific to a piece of equipment) required for the functional testing of that equipment, according to the requirements of the contract documents and the functional test procedures shall be provided to the CA by the installing contractor and shall become the property of the Using Agency at project completion as indicated in the specification.

E. Proprietary test equipment and software required by any manufacturer for programming and / or start-up, whether specified or not, shall be provided by the manufacturer of the equipment.

Manufacturer shall provide test equipment, demonstrate its use and assist in the commissioning process as needed. Proprietary test equipment (and software) shall become the property of the Department upon successful completion of the commissioning process as required in the specifications.

PART 3 - EXECUTION

3.1 SUBMITTALS

A. Plumbing and Fire Protection Contractor shall provide submittal documentation relative to commissioning as required in this Section Part 1.

3.2 STARTUP PLAN AND PREFUNCTIONAL TESTING

A. The plumbing and fire protection contractor and associated subcontractors shall be responsible for the installation of complete systems and sub-systems, fully functional, meeting the design objectives of the Contract Documents. Contractor shall follow the approved start-up, initial checkout, and prefunctional testing procedures. The commissioning procedures and functional testing do not relieve or lessen this responsibility or shift that responsibility to the commissioning agent or CM.

B. Prefunctional testing as directed and performed by the commissioning agent shall be required for each piece of equipment to ensure that the equipment and systems are properly installed and ready for operation, so that functional performance testing to may proceed without delays. Sampling strategies shall not be used for prefunctional testing. The prefunctional testing for all equipment and subsystems of a given system shall be successfully completed and documented prior to functional performance testing of the system. The plumbing contractor and sub-contractors shall sign off on the CA's pre-functional test sheets that they are complete and the system is ready. The commissioning agent will verify and conduct their own independent verification and start-up in parallel to the contractor's verification. Any deficiencies identified during this process shall be noted and reviewed by the contractors. Start-up and functional testing shall not proceed until all the deficiencies are corrected and verified by the commissioning agent.

C. The following procedures shall apply to all equipment and systems to be commissioned.

1. Start-up and Initial Checkout Plan. The Commissioning Agent shall develop the detailed start-up and prefunctional testing plans for all equipment. The primary role of the CA in this process shall be to review the installation for construction completeness and ensure that all components have been installed as per the design documents. Only when pre-functional testing is complete and signed off by all contractors, shall the equipment be started-up by the contractor. Equipment and systems to be commissioned are identified in this Section Part 2.
2. The start-up and initial checkout plan shall consist of the following as a minimum:

    a. The manufacturer's standard written start-up and checkout procedures copied from the installation manuals and manufacturer's normally used field checkout sheets. The plan shall include checklists and procedures with specific boxes or lines for recording and documenting the checking and inspections of each procedure and a summary statement with a signature block at the end of the plan.
    b. First-run checklist for equipment, to in accordance with the manufacturer recommendations and pre-functional check list determined by the CA.

3. The Commissioning Agent shall determine which trade is responsible for executing and documenting each of the line item tasks and note that trade on the form. Each form may have more than one trade responsible for its execution.

D. The CA shall review and approve the procedures and the format for documenting them, noting any procedures that need to be added.

E. Two weeks prior or startup, the contractor shall schedule startup and checkout with the CM and CA. The execution of the startup and checkout shall be directed and performed by the contractor, in accordance with manufacturer's published procedures and with the approved procedures. The CA shall be present for the contractor's required startup and checkout of all systems and equipment to be commissioned.

F. All contractor responsible start-up, checkout forms shall be completed and submitted to the CA for review.

3.3 FUNCTIONAL PERFORMANCE TESTS

A. Functional Performance Verification (FPV) is the dynamic testing of systems (rather than just individual components) under full and part load requirements. The systems are run through all the control sequences of operation and components are verified to be responding as the design intent and documents. Functional performance verification shall include; testing all sequences of operations, verification of system capacity, generating simulated signals to simulate sensor values, conducting simulated conditions to tests all loads and verify system performance during all conditions of operation and verifying design intent. In addition, each system shall be tested through all modes of operation. Proper responses such as power failures, equipment failures, etc. shall also be tested. The commissioning authority develops the functional test sheets and procedures in sequential written form, coordinates the testing, conducts the testing and documents the testing. Each contractor is required to supply personnel to assist during the functional performance testing where applicable.

B. No system, equipment or component thereof shall be tested until the contractor and the CM has certified, in writing, that the system, equipment and / or components are complete, have been tested, adjusted and balanced and are ready for validating and performance testing. Functional Performance Verification is scheduled by the commissioning agent after the pre-functional testing requirements are complete and signed-off by the CM and the CA. Functional Performance Verification will not be conducted until a written notice of completion by the CM confirming that the system is ready for FPV.

C. Functional testing shall be conducted by the contract with assistance, coordination and documentation by the commissioning agent. Functional testing may not proceed until the systems have been properly installed, started-up and all deficiencies have been corrected.

D. Functional testing is intended to begin upon completion of a system. Functional testing may proceed prior to the completion of systems or sub-systems at the discretion of the CA and CM. Beginning system testing before full completion shall not relieve the Contractor from fully completing the system, including all prefunctional checklists.

E. The contractor shall provide personnel to operate the systems while functional performance testing is commencing.

F. The contractor shall review the commissioning functional performance testing procedure supplied by the commissioning agent. After functional testing commences, the contractor and

the commissioning agent shall sign the functional test record and provide the Department and the CM a copy to review. All deficiencies either corrected in the field or outstanding shall be documented on the functional test forms for review by all parties.

G. All Functional Testing must be completed and approved by the commissioning agent and the CM before the project will be considered substantially complete.

3.4 TESTING DOCUMENTATION, NON-CONFORMANCE AND APPROVALS

A. The commissioning agent shall clearly list any outstanding items of the initial start-up and prefunctional procedures that were not completed successfully, at the bottom of the testing form or on an attached sheet. The testing form and any outstanding deficiencies shall be provided to the CM within two days of test completion. The CA shall review the contractor's startup testing reports and shall submit either a non-compliance report or an approval form to the contractor. The CA shall work with the contractor and others as necessary, to correct and retest deficiencies or uncompleted items. The contractor shall correct all areas that are deficient or incomplete in the checklists and tests in a timely manner, and shall notify the CA as soon as outstanding items have been corrected and resubmit an updated start-up report with a Statement of Correction on the original non-compliance report. When all requirements are satisfactorily completed, the CA shall recommend approval of the startup and prefunctional testing of each system and schedule the functional testing of the equipment or system.

B. As functional performance testing progresses and a deficiency is identified, the CA shall discuss the issue with the executing contractor and the commissioning team.

1. When there is no dispute of the deficiency and the contractor accepts responsibility for correcting it, the CA shall document the deficiency and the contractor's response and intentions and the testing shall proceed, if possible. Corrections of minor deficiencies identified may be made by the contractor during the functional performance testing, at the discretion of the CA. Every effort shall be made or expedite the testing process and minimize unnecessary delays, while not compromising the integrity of the commissioning effort.
2. When the identified deficiency is corrected, the contractor shall sign the statement of correction at the bottom of the non-compliance form, certifying that the equipment is ready to be retested, and return the form to the CA. The CA shall schedule the retest of the equipment or system involved.
3. If there is a dispute about an identified deficiency, the CA shall document the deficiency and the contractor's response, and provide a copy to the contractor. Every attempt shall be made to resolve the dispute at the lowest management level possible. When the dispute resolution has been decided, the appropriate party corrects the deficiency, signs the statement of correction on the non-compliance form and returns the form to the CA. The CA shall schedule the retest of the equipment or system involved. Final interpretive authority shall be the Professional. Final acceptance authority shall be the Department.

C. During the functional performance testing of multiple units of similar equipment, the CA will test all of the installed equipment and components identified. If, under such a testing procedure, three or more, identical pieces of equipment (size along does not constitute difference) fail to perform to the requirements of the Contract Documents (mechanically or substantively) due to manufacturing defects not allowing it to meet its submitted performance spec, all identical units may be considered unacceptable by the CA. In such case, the contractor shall provide the CA with the following:

1. Within one week of notification from the CA, the contractor or manufacturer's representative shall examine all other identical units making a record of the findings. The findings shall be provided to the CA within two weeks of the original notice.
2. Within two weeks of the original notification, the contractor shall provide the CA and the Professional a signed and dated, written explanation of the problem, cause of failures, etc. and proposed solution, including full equipment submittals for corrective or replacement equipment, if appropriate. The proposed solution shall not be for less than the specification requirements of the original installation.
3. When approved, two examples of the proposed solution shall be installed by the contractor and the CA shall schedule and conduct functional testing of the proposed solution. Upon completion of the functional testing of the proposed solution, the CA shall recommend the acceptance or disapproval of the proposed solution to the Department.
4. Upon acceptance of the proposed solution by the Department, the contractor shall replace or repair all identical items, at their expenses and extend the warranty accordingly, if the original equipment warranty had begun. The replacement/repair work shall proceed with reasonable speed beginning within one week of approval of the proposed solution.

D. Cost of Retesting

1. The cost for CA and/or CM personnel to conduct the retesting of a functional performance testing requirements necessitated because a specific prefunctional or startup test item, reported to have been successfully completed, but found to be incomplete or faulty, shall be the responsibility of the contractor.
2. For a deficiency identified during the functional testing, not related to any prefunctional checklist or start-up fault, the CA and CM shall direct the retesting of the equipment once at "no charge" for their time. However, all costs for any subsequent retesting shall be the responsibility of the contractor.
3. Items left incomplete, which later cause deficiencies or delays during functional testing may result in backcharges to the responsible party.

3.5 OPERATION AND MAINTENANCE (O&M) MANUALS

A. The following O&M manual requirements do not replace O&M manual documentation requirements elsewhere in these specifications.

B. Division 16 shall compile and prepare documentation for all equipment and systems covered in Division 16 and deliver this documentation to the CM for inclusion in the O&M manuals according to this section prior to the training of Using Agency personnel.

C. The CA shall receive a copy of the O&M manuals for review.

D. Operation and maintenance documentation, in hardback 3-ring loose-leaf binders except full size drawings and diskettes, shall cover all plumbing systems. Documentation shall include the following: operations and maintenance documentation directory; emergency information; operating manual; emergency information; maintenance manual; test reports; and construction documents.

E. The operation and maintenance documentation package shall be submitted as one comprehensive package to the CM and CA before systems start-up and commissioning, and shall be updated, revised and completed during, and at completion of, commissioning.

3.6 TRAINING OF USING AGENCY PERSONNEL

A. The plumbing commissioning supervisor shall be responsible for training coordination and scheduling of required training and for ensuring that all required training is completed. The CA shall oversee the content and adequacy of the training of Using Agency personnel.

B. Prepare and submit a syllabus describing an overview of the program, describing how the program will be conducted, when and where meetings are to be held, names and company affiliations of lecturers, description of contents and outline for each lecture, and recommended reference material and outside reading. Obtain direction from the Using Agency on which operating personnel shall be instructed in each system. Proposed training schedules, materials, and lesson plans shall be submitted to the CA for review of the content and adequacy of the training of Using Agency personnel for commissioned equipment or systems.

C. Training responsibilities shall include:

1. Provide the CA with training plan one week before the planned training.
2. Provide designated Using Agency personnel with comprehensive orientation and training in the understanding of the systems and the operation and maintenance of each piece of equipment.
3. Training shall normally start with classroom sessions followed by hands-on training on each piece of equipment.
4. During any demonstration, should the system fail to perform in accordance with the requirements of the O&M manual or sequence of operations, the system will be repaired or adjusted as necessary and the demonstration repeated.
5. The appropriate trade or manufacturer's representative shall provide the instructions on each major piece of equipment. This person may be the startup technician for the piece of equipment, the installing contractor or manufacturer's representative. Practical building operating expertise as well as in-depth knowledge of all modes of operation of the specific piece of equipment is required. More than one party may be required to execute the training.
6. The controls contractor shall attend sessions other than the controls training, for each type of equipment controlled by the BAS, to discuss the interaction of the BAS as it relates to the equipment being discussed.
7. The training sessions shall follow the outline in the Table of Contents of the operation and maintenance manual and illustrate whenever possible the use of the O&M manuals for reference.

3.7 WRITTEN WORK PRODUCTS

A. Written work products of Contractors shall consist of the start-up and initial checkout plan and the filled-out start-up, initial checkout and prefunctional checklists.

END OF SECTION 220800