

**SECTION 260800 - COMMISSIONING OF ELECTRICAL**

**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.
- B. The OPR and BOD documentation are included by reference for information only.
- C. Division 01 section LEED v4 for additional LEED requirements.

**1.2 SUMMARY**

- A. This section includes commissioning process requirements for Electrical systems, assemblies, and equipment.
- B. Related Sections:
  - 1. Division 01 Section "General Commissioning Requirements" for general commissioning process requirements.

**1.3 DESCRIPTION**

- A. Commissioning: Commissioning is a systematic process of ensuring that all building systems, including the mechanical and electrical systems, have been installed in the prescribed manner, are functionally checked and capable of being operated and maintained to perform with the design intent and have documentation to support proper installation and operation. The Commissioning Agent (CxA) shall provide the Owner with an unbiased, objective view of the system's installation, operation and performance. This process does not eliminate or reduce the responsibility of each system designer to provide a complete design or installing subcontractors to provide a finished product. Commissioning is intended to enhance the quality of each system installation, startup and transfer to beneficial use by the Owner.
- B. Commissioning during the construction phase is intended to achieve the following specific objectives, according to the Contract Documents:
  - 1. Verify that applicable equipment and systems are installed according to the manufacturer's recommendations and to industry accepted minimum standards and that they receive adequate operational checkout by installing contractors.
  - 2. Verify and document proper performance of equipment and systems.
  - 3. Verify that Operation & Maintenance documentation is complete and transferred to Owner.
  - 4. Verify that the Owner's operating personnel are adequately trained.

5. Verify a contract is in place for a post occupancy review with O&M staff within 10 months after Substantial Completion.
- C. The Commissioning process shall be a team effort and encompass, as well as coordinate, the traditionally separate functions of system documentation, system installation, equipment startup, control system calibration, testing, balancing and verification and performance checkouts.
- D. The CxA will work closely with the construction team, cooperating on and coordinating all Cx activities with the CM, Owner's representative, Trade Contractors, subcontractors, manufacturers and equipment suppliers.
- E. The Cx process shall not reduce the responsibility of the CM to comply with the Contract Documents.

#### **1.4 DEFINITIONS**

- A. Refer to Division 01 Section and "General Commissioning Requirements" for definitions.

#### **1.5 SUBMITTALS**

- A. Refer to Division 01 Section and "General Commissioning Requirements" for CxA's role.
- B. Refer to Division 01 Section "Submittals" for specific requirements. In addition, provide the following:
- C. In addition, provide the following:
  1. Certificates of readiness
  2. Certificates of completion of installation, prestart, and startup activities.
  3. O&M manuals
  4. Test reports

#### **1.6 QUALITY ASSURANCE**

- A. Test Equipment Calibration Requirements: Contractors will comply with test equipment manufacturer's calibration procedures and intervals. Recalibrate test instruments immediately after instruments have been repaired resulting from being dropped or damaged. Affix calibration tags to test instruments. Furnish calibration records to CxA upon request.

#### **1.7 COORDINATION**

- A. Refer to Division 01 Section "General Commissioning Requirements" for requirements pertaining to coordination during the commissioning process.

## **PART 2 - PRODUCTS**

### **2.1 TEST EQUIPMENT**

- A. All standard testing equipment required to perform startup, initial checkout and functional performance testing shall be provided by the Contractor for the equipment being tested. For example, the electrical contractor of Division 26 shall ultimately be responsible for all standard testing equipment for the electrical systems and controls systems in Division 26. A sufficient quantity of two-way radios shall be provided by each contractor.
- B. Special equipment, tools and instruments (specific to a piece of equipment and only available from vendor) required for testing shall be included in the base bid price to the Owner and left on site, except for stand-alone data logging equipment that may be used by the CxA.
- C. Proprietary test equipment and software required by any equipment manufacturer for programming and/or start-up, whether specified or not, shall be provided by the manufacturer of the equipment. Manufacturer shall provide the test equipment, demonstrate its use, and assist in the commissioning process as needed. Proprietary test equipment (and software) shall become the property of the Owner upon completion of the commissioning process.
- D. Data logging equipment and software required to test equipment will be provided by the CxA, but shall not become the property of the Owner.
- E. All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified in the Specifications. If not otherwise noted, the following minimum requirements apply: Temperature sensors and digital thermometers shall have a certified calibration within the past year to accuracy of 0.5°F and a resolution of + or - 0.1°F. Pressure sensors shall have an accuracy of + or - 2.0% of the value range being measured (not full range of meter) and have been calibrated within the last year.

## **PART 3 - EXECUTION**

### **3.1 GENERAL DOCUMENTATION REQUIREMENTS**

- A. With assistance from the installing contractors, the CxA will prepare Pre-Functional Checklists for all commissioned components, equipment, and systems
- B. Shop Drawings (including red-line drawings):
  - 1. The contractor will verify all equipment, systems, instrumentation, wiring and components are shown correctly on red-lined drawings.
  - 2. Preliminary shop drawings will be made available to the Commissioning Team for use to generate Prefunctional Checks and should be submitted prior to the start of Functional Performance Testing.
  - 3. Changes, as a result of Functional Testing, must be incorporated into the final as-built drawings, which will be created from the red-lined drawings.

4. The contracted party, as defined in the Contract Documents will create the as-built drawings.

C. Operation and Maintenance Data:

1. Contractor will provide a copy of O&M literature within 45 days of each submittal acceptance for use during the commissioning process for all commissioned equipment and systems.
2. The CxA will review the O&M literature once for conformance to project requirements.
3. The CxA will receive a copy of the final approved O&M literature once corrections have been made by the Contractor.

D. Demonstration and Training:

1. Contractor will provide demonstration and training as required by the specifications.
2. A complete training plan and schedule must be submitted by the Contractor to the CxA four weeks (4) prior to any training.
3. A training agenda for each training session must be submitted to the CxA one (1) week prior to the training session.
4. The CxA shall be notified at least 72 hours in advance of scheduled tests so that testing may be observed by the CxA and Owner's representative. A copy of the test record shall be provided to the CxA, Owner, and Architect.
5. Engage a Factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain specific equipment.
6. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, trouble shooting, servicing, and maintaining equipment.
7. Review data in O&M Manuals.

### **3.2 CONTRACTOR'S RESPONSIBILITIES**

- A. Perform commissioning tests as per the written procedure and at the direction of the CxA.
- B. Attend construction phase controls coordination meetings.
- C. Participate in Electrical systems, assemblies, equipment, and component maintenance orientation and inspection as directed by the CxA.
- D. Provide information requested by the CxA for final commissioning documentation.
- E. Include requirements for submittal data, operation and maintenance data, and training in each purchase order or sub-contract written.

- F. Prepare preliminary schedule for Electrical system orientations and inspections, operation and maintenance manual submissions, training sessions, equipment start-up and task completion for the owner. Distribute preliminary schedule to commissioning team members.
- G. Update schedule as required throughout the construction period.
- H. During the startup and initial checkout process, execute the related portions of the prefunctional checklists for all commissioned equipment.
- I. Perform all verification and functional performance tests in the presence of the CxA as required.
- J. Provide measuring instruments and logging devices to record test data, and provide data acquisition equipment to record data for the complete range of testing for the required test period.
- K. Gather operation and maintenance literature on all equipment, and assemble in binders as required by the specifications. Submit to CxA 45 days after submittal acceptance.
- L. Coordinate with the CxA to provide 72-hour advance notice so that the witnessing of equipment and system start-up and testing can begin.
- M. Notify the CxA a minimum of two weeks in advance for start of the testing work.
- N. Participate in, and schedule vendors and contractors to participate in the training sessions.
- O. Provide written notification to the CM/GC and CxA that the following work has been completed in accordance with the contract documents, and that the equipment, systems, and sub-system are operating as required.
  - 1. Electrical equipment including switchgear, panel boards, motor control centers, lighting, receptacles, and all other equipment furnished under this Division.
  - 2. Lighting Control System.
- P. The equipment supplier shall document the performance of their equipment.
- Q. Provide a complete set of red-lined drawings to the CxA prior to the start of Functional Performance Testing.
- R. Provide training for the Owner's operating staff using expert qualified personnel, as specified.
- S. Equipment Suppliers
  - 1. Provide all requested submittal data, including detailed start-up procedures and specific responsibilities of the Owner, to keep warranties in force.
  - 2. Assist in equipment testing per agreements with contractors.
  - 3. Provide information requested by CxA regarding equipment sequence of operation and testing procedures.
- T. Refer to Division 01 Section "General Commissioning Requirements" for additional Contractor responsibilities.

**3.3 OWNER'S RESPONSIBILITIES**

- A. Refer to Division 01 Section "General Commissioning Requirements" for Owner's Responsibilities.

**3.4 DESIGN PROFESSIONAL'S RESPONSIBILITIES**

- A. Refer to Division 01 Section "General Commissioning Requirements" for Design Professional's Responsibilities.

**3.5 CxA'S RESPONSIBILITIES**

- A. Refer to Division 01 Section "General Commissioning Requirements" for CxA's Responsibilities.

**3.6 TESTING PREPARATION**

- A. Certify in writing to the CxA that Electrical systems, subsystems, and equipment have been installed, "meggered" feeder insulation resistance testing, calibrated, and started and are operating according to the Contract Documents.
- B. Certify in writing to the CxA that Electrical instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents, and that pretest set points have been recorded.
- C. Certify in writing that testing procedures have been completed and that testing reports have been submitted, discrepancies corrected, and corrective work approved.
- D. Place systems, subsystems, and equipment into operating mode to be tested (e.g., normal shutdown, normal, auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).
- E. Inspect and verify the position of each device and interlock identified on checklists.
- F. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.
- G. Testing Instrumentation: Install measuring instruments and logging devices to record test data as directed by the CxA.

**3.7 GENERAL TESTING REQUIREMENTS**

- A. Provide technicians, instrumentation, and tools to perform commissioning tests at the direction of the CxA.

- B. Scope of Electrical testing shall include the entire Electrical installation, from the incoming power equipment throughout the distribution system. Testing shall include measuring, but not limited to resistance, voltage, and amperage of system(s) and devices.
- C. Test all operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.
- D. The Electrical contractor and other contracted subcontractors, including the fire alarm Subcontractor shall prepare detailed testing plans, procedures, and checklists for Electrical systems, subsystems, and equipment with guidance from CxA.
- E. Tests will be performed using design conditions whenever possible.
- F. Simulated conditions may need to be imposed using an artificial load when it is not practical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.
- G. The CxA may direct that set points be altered when simulating conditions is not practical.
- H. If tests cannot be completed because of a deficiency outside the scope of the Electrical system, document the deficiency and report it to the Owner. After deficiencies are resolved, reschedule tests.
- I. If the testing plan indicates specific seasonal testing, complete appropriate initial performance tests and documentation and schedule seasonal tests.

### **3.8 ELECTRICAL SYSTEMS, SUBSYSTEMS, AND EQUIPMENT TESTING PROCEDURES**

- A. Equipment Testing and Acceptance Procedures: Testing requirements are specified in individual Division 26 sections. Provide submittals, test data, inspector record, infrared camera data and certifications to the CxA.
- B. Electrical Instrumentation and Control System Testing: Field testing plans and testing requirements are specified in Division 26. Assist the CxA with preparation of testing plans.
- C. Fire Detection and Alarm System Testing: Provide technicians, instrumentation, tools and equipment to test performance of designated systems and devices at the direction of the CxA. The CxA shall determine the sequence of testing and testing procedures for each fire alarm panel, initiation and control device and notification appliance to be tested.
- D. Electrical Distribution System Testing: Provide technicians, load banks, infrared cameras, instrumentation, tools and equipment to test performance of designated systems and devices at the direction of the CxA. The CxA shall determine the sequence of testing and testing procedures for each equipment item and pipe section to be tested

E. The work included in the commissioning process involves a complete and thorough evaluation of the operation and performance of all components, systems and sub-systems. The scope of commissioning work shall include but not limited to the following equipment and systems :

1. Lighting Controls
2. Power Distribution System (UPS-backup, Normal, and Emergency)
3. Fire Alarm System

**3.9 DEFICIENCIES/NON-CONFORMANCE, COST OF RETESTING, FAILURE DUE TO MANUFACTURER DEFECT**

A. Refer to Division 01 Section “General Commissioning Requirements” for requirements pertaining to deficiencies/non-conformance, cost of retesting, or failure due to manufacturer defect.

**3.10 APPROVAL**

A. Refer to Division 01 Section “General Commissioning Requirements” for approval procedures.

**3.11 DEFERRED TESTING**

A. Refer to Division 01 Section “General Commissioning Requirements” for requirements pertaining to deferred testing.

**3.12 OPERATION AND MAINTENANCE MANUALS**

A. The Operation and Maintenance Manuals shall conform to Contract Documents requirements as stated in Division 01.

B. Refer to Division 01 Section “General Commissioning Requirements” for the AE and CxA roles in the Operation and Maintenance Manual contribution, review and approval process.

**3.13 TRAINING OF OWNER PERSONNEL**

A. Refer to Division 01 Section “General Commissioning Requirements” for requirements pertaining to training.

B. Electrical Contractor. The electrical contractor shall have the following training responsibilities:

1. Provide the CxA with a training plan four weeks before the planned training.
2. Provide designated Owner’s personnel with comprehensive training in the understanding of the systems and the operation and maintenance of each major piece of commissioned electrical equipment or system.

3. Training shall be recorded by the CxA and start with classroom sessions, if necessary, followed by hands on training on each piece of equipment, which shall illustrate the various modes of operation, including startup, shutdown, fire/smoke alarm, power failure, etc.
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 start-up 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 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.
7. Training shall include:
  - a. Use the printed installation, operation and maintenance instruction material included in the O&M manuals.
  - b. Include a review of the written O&M instructions emphasizing safe and proper operating requirements, preventative maintenance, special tools needed and spare parts inventory suggestions. The training shall include start-up, operation in all modes possible, shut-down, seasonal changeover and any emergency procedures.
  - c. Discuss relevant health and safety issues and concerns.
  - d. Discuss warranties and guarantees.
  - e. Cover common troubleshooting problems and solutions.
  - f. Explain information included in the O&M manuals and the location of all plans and manuals in the facility.
  - g. Discuss any peculiarities of equipment installation or operation.
8. Hands-on training shall include start-up, operation in all modes possible, including manual, shut-down and any emergency procedures and preventative maintenance of all pieces of equipment.
9. The electrical contractor shall fully explain and demonstrate the operation, function and overrides of any local packaged controls, not controlled by the central control system.
10. Training shall occur after functional testing is complete, unless approved otherwise by the Owner's.

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