

## SECTION 26 08 00

### ELECTRICAL COMMISSIONING

#### PART 1 GENERAL

##### 1.01 SUBMITTALS

- A. Provide submittal documentation, relative to commissioning, to the CA as requested by the CA.
- B. Schedule of equipment and system start-up to Engineer, DPS and CA.
- C. Results of Vendor's shop and field tests.
- D. Qualifications of the independent testing agency (if used) (reference paragraph 3.03 herein).
- E. Required documentation as required by Code, the AHJ, and listed within the Contract Documents and herein.
- F. Equipment and instrumentation calibration certification or documentation for all test instruments.
- G. Documentation that the vendor's storage and handling requirements were met for all equipment and materials.
- H. Equipment Vendor's Recommendations for:
  - 1. Alignment Tolerances.
  - 2. Allowable Vibration Levels.
  - 3. Lubrication Requirements.
  - 4. Cleaning Procedures.
- I. Observed Installation Data:
  - 1. Alignment Readings.
  - 2. Operating Vibration Levels.
  - 3. Test and Inspection Reports.
- J. At completion of Work, Contractor shall submit to DPS certification that equipment has been tested and commissioned and is in operating condition in accordance with contract documents.
- K. Final Reports: Refer to Section 01 45 45 for final report requirements.

##### 1.02 QUALITY ASSURANCE

- A. Testing of the electrical equipment and systems shall comply with "Acceptance Testing Specifications for Electric Power Distribution Equipment and Systems" by the International Electrical Testing Association, Inc.
- B. Contractor shall perform specified services with qualified personnel, or employ and pay for qualified organization to perform specified services. The personnel performing the testing shall be certified by a national organization, with a minimum of five years experience inspecting, testing, and calibrating electrical equipment, systems and devices. Information on the certified personnel shall be submitted to the engineer for approval prior to the start of work.
- C. Contractor shall provide calibrated instruments required for commissioning and testing operations.
  - 1. Make personnel and instruments available to Engineer to facilitate spot checks during testing.
  - 2. Retain possession of instruments; remove from Site at completion of services.
- D. Furnish material, tools, and labor required to perform start-up of each respective item of equipment, instrument and system.
- E. Coordinate the startup of equipment and systems with existing operations or facility equipment so that it does not affect owner's operations.
- F. Provide equipment vendor's authorized service representative to inspect and approve installation where required in individual specification sections.

- G. Comply strictly with specified vendor's, engineer's, and CA's procedures in starting up and commissioning specified systems.

### **1.03 COORDINATION**

- A. Coordinate startup, testing and commissioning services to ensure rapid completion of services.
- B. Promptly report to engineer and CA any deficiencies noted during performance of commissioning and testing services.

### **1.04 JOB CONDITIONS**

- A. Prior to start of testing and commissioning, verify that required "job conditions" are met:
  - 1. Systems installation is complete and in full operation.
  - 2. Ambient conditions are within reasonable range relative to design conditions.
  - 3. Special equipment such as computers, laboratory equipment, and electronic equipment are in full operation.
- B. Verify that requirements for preparation for testing and commissioning have been met for elements of each of systems that require testing.

## **PART 2 PRODUCTS No Requirements**

## **PART 3 EXECUTION**

### **3.01 EQUIPMENT CLEANING**

- A. When no longer required, contractor shall thoroughly clean equipment of temporary protective coatings and foreign materials.
- B. Contractor shall perform cleaning procedures recommended by equipment vendor and as outlined in specification sections.

### **3.02 INSPECTION**

- A. Contractor shall inspect equipment installations and verify, in writing, status of work meets requirements for starting equipment including, but not limited to, the following:
  - 1. Compare equipment nameplate information, including breaker sizes, etc. with latest drawings and documents and report discrepancies to engineer.
  - 2. Check for proper mounting, anchorage, required clearances, physical damage and alignment.
  - 3. Lubrication type, quantity, and date installed.
  - 4. Torque test cable mechanical connections to vendors recommended torque values with a calibrated torque wrench. In absence of vendor data, refer to UL 486 for torque values.
  - 5. Proper drive rotation before connecting coupling, belts, or chains.
  - 6. Exercise all active components.
  - 7. Ensure that all shipping brackets and appurtenances have been removed.
  - 8. Ensure that all resilient mounts are free.
  - 9. Check out of wiring and control systems for proper terminations and continuity.
  - 10. Verify proper equipment grounding.
  - 11. Verify proper motor and electric device voltage ratings.
  - 12. Control systems operational.
  - 13. Auxiliary services connected, i.e., alarm and trip circuits, and safety devices.
  - 14. Instrumentation calibrated (other than control systems covered under Division 25).
  - 15. Verify wiring terminations are complete and breaker/fuse size matches the requirements shown on the drawings.

16. The contractor shall ensure that the electrical contractor installs all rough in boxes and associated conduit and boxes as shown on the drawings by marking on a set of drawings.
  17. Ensure that all conductors and boxes and cabinets, devices, etc. are labeled per the project spec's.
- B. Engineer, owner, and CA reserves right to witness all contractor's inspections. Contractor shall invite engineer and owner for all testing sessions. The CA will witness these inspections as called for in the commissioning plan.

### **3.03 ELECTRICAL SYSTEM COMMISSIONING**

A. General:

1. Check installation of equipment to confirm it is complete, including panels, doors, internal partitions, coatings, cover plates, etc.
2. Review factory test results for electrical equipment.
3. Perform the testing and startup required by the equipment vendor.

B. The Contractor shall hire an independent testing agent or utilize the equipment vendor to conduct operating and acceptance tests on new electrical system components and all existing devices which are impacted by the project. The following shall be tested: all service entrance equipment and main distribution equipment (not including panelboards or other items fed from it); generators and transfer switches, fire detection and alarm systems, UPS systems greater than 45kVA, and theater lighting and sound systems.

1. The testing agent shall prepare written reports of values of all test readings and procedures. Reports shall include all breaker settings and modifications to one-line and three-line drawings.
2. The testing agent shall furnish all equipment, instruments and personnel required to conduct tests.
3. Test will be defined in the individual section describing the equipment or system.

C. Wiring Systems:

1. Perform and record ground tests on all grounding conductors.
2. Check wiring identification at both ends of each circuit.
3. Perform continuity and insulation (meggar) resistance testing of all feeders. Submit written test results to DPS as part of operation and maintenance data.
4. Each receptacle on the project shall be tested to ensure that it is labeled and all wiring installed properly with respect to ground, neutral and phase wire with a tester.

D. Grounding:

1. Perform field testing of ground resistance from service neutral connection to ground reference point. Maximum permitted resistance 0.5 ohms.
2. For ground rods, perform fall of potential test with results not greater than five (5) ohms. Contractor shall add length to ground rods or add more ground rods and connections to meet requirement of five (5) ohms or less.

E. Motors:

1. Check rotation of motor in relation to marking on case; confirm that it matches the direction required by the driven equipment.
2. Measure motor amperage and compare to nameplate value.
3. Correct conditions that produce excessive current flow, and which exist due to equipment malfunction.
4. Check bearing vibration levels to confirm that they are within vendor's tolerances. Replace motors or bearings that operate with excessive vibration.
5. Compare overload element rating with motor full-load current rating to verify correct sizing.
6. Program motor protection relays with settings provided by Engineer, if applicable.

7. Confirm operation of RTDs for motors and transformers (status, alarm, trip), if applicable.
  8. Verify operation of space heaters, if applicable.
- F. Dry Type Transformers:
1. Verify proper core grounding.
  2. Verify taps, if applicable, are connected to desired tap setting per Engineer.
  3. Measure secondary voltage phase-to-phase and phase-to-ground after final energization and prior to loading.
- G. Switchboards:
1. Check bolt torque for bus sections.
  2. Verify secondary voltage on control power transformers, potential transformers (PTs) and current transformers (CTs).
  3. Verify operation of space heaters, if applicable.
  4. Verify fuse and/or circuit breaker sizes and types correspond to drawings.
  5. Program relays with settings provided by engineer, if applicable.
  6. Verify any mechanical and/or electrical interlocks function as intended in design.
  7. Verify proper operation of ground fault relays.
  8. Verify proper operation of TVSS units. Utilize equipment vendor's representative if necessary.
  9. Perform measurement of resistance of switchboard insulation after assembly is complete. Test voltage shall be 1,000V or as recommended by the equipment vendor. Acceptable minimum resistance shall be 100 megohms (all sections), phase-to-phase, and phase-to-ground with other phases grounded.
  10. Provide ground fault testing in accordance with NETA ATS.
  11. Provide infrared testing of main switchboard and panelboards six months after final acceptance.
- H. Motor Control:
1. Verify that control sequences, time delay and adjustments are as indicated on documents.
  2. Verify proper operation of motor starters, VFDs, and other motor control not covered under Division 23.
- I. Panelboards:
1. Verify GFI and AFI type breakers function properly.
  2. Verify TVSS units operate properly. Utilize equipment vendor's representative if necessary.
  3. Verify lockout devices are installed on fire alarm, kitchen hood, security, and telecom circuits.
  4. Phase balance and show phase balancing to within 20 percent on the record drawings of completed panelboard installation.
- J. Lighting:
1. Each luminaire shall be checked to ensure that all lamps are working and the luminaire(s) are controlled by a light switch. For any lighting control systems ensure that the controls work as specified and where a photocell is involved that works accordingly.
  2. Test all interior lighting controls systems such as stage lighting to ensure that it works per the design requirements. Test operation, sensitivity and time out settings for all occupancy sensors. Test daylight response photosensors and make to ensure lighting is being controlled per recommended light level settings.
- K. Generator (per DPS Section 26 32 13):
1. Perform generator tests for automatic transfer from primary power supply.
  2. Verify alarm signals.

3. Provide for a full factory test and on-site test utilizing portable test load bank for minimum four (4) hours. Simulate power failure including operation for transfer switch, automatic starting, automatic shutdown and return to normal. This testing does not include commissioning. Commissioning shall be performed after system is connected to the building electrical system.

L. Automatic Transfer Switches:

1. Test transfer switches by means of simulated power outage; automatic startup by remote-automatic starting, transfer of load, and automatic shutdown. Prior to these tests, adjust transfer switch timers for proper system coordination.
2. Upon completion of installation and after circuitry has been energized, demonstrate capability and compliance of transfer switches with requirements. Initial testing and re-testing, where necessary, shall be provided at no cost to Owner.

M. Battery and UPS Systems:

1. Require factory-authorized technician to test and start up system.

N. Fire Alarm System (per DPS Section 28 31 11):

1. Testing:

- a) The engineer and DPS shall be present during the contractor's pretest of the system, and subsequent fire department tests of the completed system. If the pretest of the system is unsuccessful, the contractor shall compensate the engineer and DPS for witnessing all subsequent tests until the system is ready for acceptance testing by the Fire Department. The engineer shall provide a written report of each test to the DPS. These requirements shall be included in the specifications so that the contractor will notify the engineer of the times and dates of the tests, and will be aware that he will be responsible for reimbursing the Engineer should there be a need for subsequent tests.
- b) The service of a competent, factory-trained engineer or technician (minimum NICET level 2) authorized by the vendor of the fire alarm equipment shall be provided to technically supervise and participate during all of the adjustments and tests for the system. All testing shall be in accordance with NFPA 72, Chapter 7, as amended in Part I, UFC Standard 10-2.
- c) Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation.
- d) Close each sprinkler system flow valve and verify proper supervisory alarm at the FACP.
- e) Verify activation of all water flow switches.
- f) Open initiating device circuits and verify that the trouble signal actuates.
- g) Open and short signaling line circuits and verify that the trouble signal actuates.
- h) Open and short notification appliance circuits and verify that trouble signal actuates.
- i) Ground all circuits and verify response of trouble signals.
- j) Check presence and audibility of tone at all alarm notification devices.
- k) Check the digital communicator as follows: disconnect the primary phone line (a trouble signal shall be sent through the secondary phone line). Disconnect the secondary phone line (a trouble signal shall be sent through the primary phone line). If another telephone is on the same phone line as the fire alarm system, take the telephone off the hook to check for line seizure by the digital communicator.
- l) Check installation, supervision, and operation of all intelligent smoke detectors using the walk test. Canned smoke (provided by Contractor and acceptable to the fire alarm equipment vendor) will be used at the final inspection to verify actuation of smoke detectors.
- m) Each of the alarm conditions that the system is required to detect should be introduced on the system. Verify the proper receipt and the proper processing of the signal at the FACP and the correct activation of the control points.

- n) When the system is equipped with optional features, the vendor's manual shall be consulted to determine the proper testing procedures. This is intended to address such items as verifying controls performed by individually addressed or grouped devices, sensitivity monitoring, verification functionality and similar.
2. Final Inspection:
- a) At the final inspection, a factory-trained representative of the vendor of the major equipment shall demonstrate that the system functions properly in every respect. The contractor is responsible for providing all tools and equipment necessary to demonstrate that the system functions as specified herein. Submit a request for a formal inspection at least five working days prior to the date the inspection is to take place. Any or all of the required tests shall be conducted by the contractor at his own expense and additional tests required for the system to demonstrate compliance with all contract documents shall also be incurred by the Contractor. The contractor shall furnish all appliances, equipment, instruments, connecting devices, two-way radios and personnel for the tests. Any costs incurred by DPS for repeat tests, due to the failure of the contractor to adequately demonstrate that the system complies with the contract requirements, shall be borne by the Contractor.
- O. Kitchen Hood Fire Control Panel (per DPS Section 23 38 13):
- 1. The completed system must be tested in the presence of the DPS. The proper operation of the panel must be demonstrated.
  - 2. Panel testing and demonstration will be in addition to tests and inspections required by Code Authorities having jurisdiction.
- P. Telecommunications Systems (per DPS Section Division 27):
- 1. Testing:
    - a) All cables and terminations shall be 100% tested for defects in installation and to verify cable performance under installed conditions. The contractor, prior to system acceptance, shall verify all conductors of each installed cable. Any defect in the cabling system installation including but not limited to cable, connectors, feed-through couplers, patch panels, and connector blocks shall be repaired or replaced in order to ensure 100% useable conductors in all cables installed prior to final acceptance of the telecommunications system.
    - b) Testing results documentation must be provided on all installed cabling. Contractor shall use a Fluke Model DSP4300 in-house for testing both fiber optic and copper media. Contractor to provide calibration certificate.
    - c) Fiber testing shall be done using an approved tester as outlined above to achieve bi-directional testing for all links. Test results documentation shall be furnished to DoTS upon completion of testing. Printed documentation is required and electronic documentation from the tester shall be included in the final submittal. Tests will be performed to the TIA/EIA – 568B.3 Standards. Terminated fibers shall not exceed 1.5-db loss from connector to connector.
    - d) Copper cable testing will require Permanent Link testing using the Fluke DSP4300 and PM-06 personality modules. Printed documentation is required and electronic documentation from the tester shall be included in the final submittal.
  - 2. Inspection:
    - a) DoTS Project Manager shall inspect wiring installation after wire is installed and before closing the ceiling.
    - b) DoTS Project Manager shall inspect quality and workmanship of terminations on an on-going basis.
- Q. Special Systems:
- 1. Test each PA/Intercom speaker to ensure that each one works at an acceptable sound level and without distortion.
  - 2. Test each security device and ensure that each works and that the overall system is operational.

3. Test the clock system to ensure that the system and each device is operating correctly.
4. Test each voice enhancement system to ensure it is operational.
5. Test lightning protection systems per vendor's instructions.

**3.04 ELECTRICAL SYSTEM STARTUP**

- A. Energize switchgear.
- B. Check voltages at mechanical equipment.
- C. Check polarity for all receptacles.
- D. Check lighting levels throughout building, within office spaces, on roof and at parking and storage areas.

**3.05 ACCEPTANCE FOR OPERATION**

- A. Each piece of equipment installed by this contract shall carry "Acceptance for Operation Checklist." Each checklist shall be signed by the contractor's representative and DPS, or owner's representative. Each list shall have applicable blanks filled in and attached to items indicating that it is prepared for operation.
- B. Owner will accept equipment and systems for operation when construction has been substantially completed by contractor. "Acceptance for Operation" shall mean owner will assume operational and routine maintenance duties. "Acceptance for Operation" does not relieve contractor from responsibilities related to defective materials and workmanship; neither does it constitute final acceptance of materials and equipment.
- C. After owner has accepted a system for operation, contractor shall continue to perform the following as requested and scheduled by owner at no additional cost to owner until final acceptance:
  1. Troubleshooting, adjustments, and repairs until system operation and performance is accepted by owner.
  2. Assist instrument and control personnel with instrument calibration.
  3. Craft labor as required.
- D. After owner has accepted a system for operation, contractor shall continue to supply technical services when needed until final acceptance.

**END OF SECTION 26 08 00**