

## University of Houston Master Specification

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### SECTION 26 0800 - COMMISSIONING OF ELECTRICAL SYSTEMS

Maintain Section format, including the UH master spec designation and version date in the center columns of the header and footer. Complete the header and footer with Project information.

Revise this Section by deleting and inserting text to meet Project-specific requirements.

This Section uses the term "Engineer." Change this term to match that used to identify the design professional as defined in the General and Supplementary Conditions.

Verify that Section titles referenced in this Section are correct for this Project's Specifications; Section titles may have changed.

Delete hidden text after this Section has been edited for the Project.

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The Contractor's attention is specifically directed, but not limited, to the following documents for additional requirements:
  - 1. The current version of the *Uniform General Conditions for Construction Contracts*, State of Texas, available on the web site of the Texas Facilities Commission.
  - 2. The University of Houston's *Supplemental General Conditions and Special Conditions for Construction*.

##### 1.2 SUMMARY

- A. Section includes commissioning (Cx) process requirements for the following electrical components, systems, assemblies, and equipment:
  - 1. Electrical equipment connected to Normal power systems, including the following:
    - a. Adjustable Speed Drives (ASD's)/Variable Speed Drives (VSD's).
    - b. Transformers.
    - c. Primary and secondary service electrical systems.
    - d. Distribution and branch-circuit panelboards.
    - e. Lightning protection systems.
    - f. Grounding systems.

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2. Electrical equipment connected to Essential power systems that provide an alternative source of power in the absence of power from the Normal power system, including the following:
  - a. Adjustable Speed Drives (ASD's)/Variable Speed Drives (VSD's).
  - b. Primary and secondary service electrical systems.
  - c. Distribution and branch-circuit panelboards.
  - d. Lighting protection systems.
  - e. Grounding systems.
  - f. UPS.
  - g. Central battery equipment for emergency lighting.
3. Controls and instrumentation, including the following:
  - a. Equipment monitoring systems.
  - b. Energy monitoring and control systems.
  - c. Electrical metering and metering system.
  - d. Demand response systems.
  - e. Lighting control systems.
  - f. Security systems.
  - g. Fire-alarm systems.
4. Systems testing and verification, including Normal and Essential power systems, and transitions from Normal to Essential power systems and back.

### B. Related Requirements:

1. Section 01 9113 "General Commissioning Requirements" for general Cx process requirements and CxA responsibilities.
2. For construction checklists, comply with requirements in various Division 26 sections specifying electrical systems, system components, equipment and products.

### 1.3 DEFINITIONS

- A. BoD: Basis-of-Design Document, as defined in Section 01 9113 "General Commissioning Requirements."
- B. Cx: Commissioning, as defined in Section 01 9113 "General Commissioning Requirements."
- C. CxA: Commissioning Authority, as defined in Section 01 9113 "General Commissioning Requirements."
- D. Essential Power Systems: A power system that a facility transitions to in the absence of Normal power. This power includes all systems classified as "standby" or "emergency," including "legally required."
- E. Low Voltage: 600 V and below.

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- F. Medium Voltage: 601 V and above.
- G. Normal Power Systems: A power system that provides primary power to a facility.
- H. OPR: Owner's Project Requirements, as defined in Section 01 9113 "General Commissioning Requirements."
- I. "Systems," "Assemblies," "Subsystems," "Equipment," and "Components": Where these terms are used together or separately, they shall mean "as-built" systems, assemblies, subsystems, equipment, and components.

### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For electrical testing technician.
- B. Construction Checklists: Include the following and comply with requirements in Section 01 9113 "General Commissioning Requirements" for construction checklists:
  - 1. Instrumentation and control for electrical systems.
  - 2. Instrumentation and control for lighting control systems.
  - 3. Low-voltage power cables.
  - 4. Control voltage power cables.
  - 5. Electrical feeders and branch circuits.
  - 6. Liquid-filled transformers.
  - 7. Dry-type transformers.
  - 8. Instrument transformers.
  - 9. Switchgear and switchboard assemblies.
  - 10. Metal-enclosed bus duct.
  - 11. Busway.
  - 12. Low Voltage Motor-control starters.
  - 13. Low surge protective devices (SPD).
  - 14. Protective relays.
  - 15. Metering devices.
  - 16. Molded-case circuit breakers.
  - 17. Low-voltage power circuit breakers.
  - 18. Grounding systems.
  - 19. Ground-fault protection systems.
  - 20. Panelboards.
  - 21. Receptacles and devices.
  - 22. Adjustable Speed Drive (ASD)/Variable Speed Drive (VSD).
  - 23. Battery systems.
  - 24. Battery chargers.
  - 25. Flooded lead-acid batteries.
  - 26. Flooded lead-calcium batteries.
  - 27. VRLA batteries.
  - 28. UPS systems.

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### 29. Lighting.

#### 1.5 QUALITY ASSURANCE

- A. Electrical Testing Technician Qualifications: Technicians to perform electrical Construction Checklist verification tests, Construction Checklist verification test demonstrations, Cx tests, and Cx test demonstrations shall have the following minimum qualifications:
1. Journey level or equivalent skill level. Vocational school four-year-program graduate or an Associate's degree in electrical systems, or similar field. Degree may be offset by three years' experience as an apprentice or a journey-level electrician. Generally, required knowledge includes electrical and HVAC&R concepts, building operations, and application and use of tools and instrumentation to measure performance of electrical equipment, assemblies, and systems.
  2. Minimum three years' experience installing, servicing, and operating systems manufactured by approved manufacturer.
- B. Testing Equipment and Instrumentation Quality and Calibration: For test equipment and instrumentation required to perform electrical Cx work, perform the following:
1. Submit test equipment and instrumentation list. For each equipment or instrument, identify the following:
    - a. Equipment/instrument identification number.
    - b. Planned Cx application or use.
    - c. Manufacturer, make, model, and serial number.
    - d. Calibration history, including certificates from agencies that calibrate the equipment and instrumentation.
  2. Test equipment and instrumentation shall meet the following criteria:
    - a. Capable of testing and measuring performance within the specified acceptance criteria.
    - b. Be calibrated at manufacturer's recommended intervals with current calibration tags permanently affixed to the instrument being used.
    - c. Be maintained in good repair and operating condition throughout duration of use on Project.
    - d. Be recalibrated/repared if dropped or damaged in any way since last calibrated.
- C. Proprietary Test Instrumentation and Tools:
1. Equipment Manufacturer's Proprietary Instrumentation and Tools: For installed equipment included in the Cx process, test instrumentation and tools manufactured or prescribed by equipment manufacturer to service, calibrate, adjust, repair, or otherwise work on its equipment or required as a condition of equipment warranty, perform the following:

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- a. Submit proprietary instrumentation and tools list. For each instrument or tool, identify the following:
  - 1) Instrument or tool identification number.
  - 2) Equipment schedule designation of equipment for which the instrument or tool is required.
  - 3) Manufacturer, make, model, and serial number.
  - 4) Calibration history, including certificates from agencies that calibrate the instrument or tool, where appropriate.
- b. Include a separate list of proprietary test instrumentation and tools in operation and maintenance manuals.
- c. Electrical proprietary test instrumentation and tools become property of Owner at the time of Substantial Completion.

### PART 2 - PRODUCTS (Not Used)

### PART 3 - EXECUTION

#### 3.1 CONSTRUCTION CHECKLISTS

- A. Prepare detailed construction checklists for electrical systems, subsystems, equipment, and components. Complete and submit construction checklists.

#### 3.2 CONSTRUCTION CHECKLIST REVIEW

- A. Review and provide written comments on draft construction checklists. CxA will create required draft construction checklists and provide them to Contractor.
- B. Return draft Construction Checklist review comments within 10 days of receipt.
- C. When review comments have been resolved, CxA will provide final construction checklists, marked "Approved for Use, (date)."
- D. Use only construction checklists, marked "Approved for Use, (date)."

#### 3.3 GENERAL TESTING REQUIREMENTS

- A. Certify that electrical systems, subsystems, and equipment have been installed, calibrated, and started and that they are operating according to the Contract Documents and approved Shop Drawings and submittals.

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- B. Certify that electrical instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents and approved Shop Drawings and submittals, and that pretest set points have been recorded.
- C. Set systems, subsystems, and equipment into operating mode to be tested according to approved test procedures (for example, normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).
- D. Measure capacities and effectiveness of systems, assemblies, subsystems, equipment, and components, including operational and control functions to verify compliance with acceptance criteria.
- E. Test systems, assemblies, subsystems, equipment, and components operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and response according to acceptance criteria.
- F. Construction Checklists: Prepare and submit detailed construction checklists for electrical systems, subsystems, equipment, and components.
  - 1. Contributors to development of construction checklists shall include, but are not limited to, the following:
    - a. Electrical systems and equipment installers.
    - b. Electrical instrumentation and controls installers.
- G. Perform tests using design conditions, whenever possible.
  - 1. Simulated conditions may, with approval of Engineer, be imposed using an artificial load when it is impractical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by CxA, and document simulated conditions and methods of simulation. After tests, return configurations and settings to normal operating conditions.
  - 2. Cx test procedures may direct that set points be altered when simulating conditions is impractical.
  - 3. Cx test procedures may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are impractical.
- 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 seasonal testing is specified, complete appropriate initial performance tests and documentation and schedule seasonal tests.
- J. Coordinate schedule with and perform Cx activities at the direction of the CxA.

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- K. Comply with Construction Checklist requirements, including material verification, installation checks, startup, and performance tests requirements described in sections specifying electrical systems and equipment.
- L. Provide technicians, instrumentation, tools, and equipment to complete and document the following:
  - 1. Performance tests.
  - 2. Demonstration of a sample of performance tests.
  - 3. Cx tests.
  - 4. Cx test demonstrations.

### 3.4 Cx TESTS FOR ELECTRICAL SYSTEMS

- A. Verification of Normal Power System Operation:
  - 1. Prerequisites: Acceptance of results for construction checklists for Division 26 electrical components associated with Normal power system.
  - 2. Equipment and Systems to Be Tested: Division 26 electrical equipment.
  - 3. Test Purpose: Verify operation of Normal power system.
  - 4. Test Conditions: Energize components of Normal power system, one at a time.
  - 5. Acceptance Criteria: Proper operation of Normal power system over a 48-hour period.
- B. Verification of Essential Power System Operation:
  - 1. Prerequisites:
    - a. Acceptance of results for construction checklists for Division 26 electrical components associated with Essential power system.
    - b. Completion of "Verification of Normal Power System Operation" tests.
  - 2. Equipment and Systems to Be Tested: Division 26 electrical equipment.
  - 3. Test Purpose: Verify operation of Essential power system.
  - 4. Test Conditions:
    - a. Energize components of Normal power system.
    - b. Simulate a failure of Normal power system.
- C. Verification of Control and Instrumentation:
  - 1. Prerequisites: Acceptance of results for construction checklists.
    - a. Section 26 0943.23 "Relay Based Lighting Controls."
- D. Test Purpose: Verify operation of control and monitoring systems for Normal and Essential power systems.
- E. Test Conditions:

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1. Energize components of Normal power system.
2. Test operation of equipment.

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