26 20 00 - Low-Voltage Electrical Distribution

1. Introduction

   A. This section pertains to electrical systems under 600 volts, which are defined by the NEC as Low Voltage.

   B. This Construction and Design standard covers electrical systems and is to be used in conjunction with other related sections listed below:

      26 08 01 Electrical Equipment Acceptance Testing

2. References

   A. NFPA 70 National Electrical Code

   B. General Electrical Requirements

3. Design Standards

   A. Primary Electrical Distribution

      1. The primary electric distribution system serving the campus is a private system, owned, operated and maintained by Duke University. The majority of the primary system is rated at 12,470/7,200V. Several portions remain at 4,160/2,400V and are currently being phased out.

      2. All items associated with the design, demolition/installation and testing of all primary distribution components (i.e. switchgear, sectionalizing switches, transformers, manholes, ductbanks, cable pulls, cable terminations, cable splices, etc.) shall be performed by the Duke Utility & Engineering Services (DUES) High Voltage Department.

      3. The Engineer of Record shall coordinate the project requirements with the High Voltage Engineer via the Project Manager for specific information concerning the detailed scope of work to be provided under the contract documents. The selection of the transformer shall be approved by the Project Manager prior to the material purchase by the DUES High Voltage department.

      4. The placement of equipment and the routing of all ductbanks associated with the project shall be coordinated with the DUES Master Plan, the High Voltage Engineer and the Project Manager.

      5. Schedule all utility interruptions via the Project Manager. At minimum, the High Voltage Engineer shall be notified in writing seven (7) days prior to the requested timeframe so that the utility interruptions can be scheduled and all concerned parties

can be notified. Overtime, if required by the schedule, shall be at the expense of the Contractor.

B. Service Entrance(s)

1. Service entrance(s), less than 600V, serving the campus facilities are owned, operated and maintained by Duke University; but, are typically designed by an Engineer of Record and installed by a Contractor.

2. The type of service is determined by the load type and the need for reliability (e.g. dual feed arrangements are required for all research facilities, animal facilities, central utility plants, data centers and specified large departmental facilities).

3. The dual feed arrangement is determined by site and facility conditions. Typically, when a dual feed arrangement is required, the services terminate in load break switches in combination with a unit substation switchgear assembly inside the facility. Both the switches and the switchgear shall have a main-tie-tie-main configuration.

4. Service(s) shall be 480/277V or 208/120V three-phase, four-wire with ground, unless otherwise approved by DUES. Consideration shall be given to a 480V service with interior step-down dry-type transformers for loads greater than 500kVA.

5. Provide all service entrance conductors and ductbank assemblies.

6. The routing and entrance location of all ductbank assemblies associated with the facility shall be coordinated all other utility service entrances.

7. Provide secondary lugs for the termination of the service entrance conductors to transformer secondary spades. Lugs shall be rated and sized appropriately for the service entrance. DUES High Voltage Department shall terminate conductors.

8. Generator service entrance conductors and all ductbank and distribution assemblies shall be separated based on their load type (as defined by NEC).

9. Kirk key interlocks shall be provided between the tie switches/breakers and their corresponding main switches/breakers.

10. The Engineer of Record shall specify that the Contractor provide and maintain a temporary electrical distribution system for all needs during construction. Temporary service(s) shall be separately metered. The Contractor shall be responsible for payment for energy used.

C. Electrical Distribution(s)

1. Electrical distribution systems shall be 480/277V or 208/120V three-phase, four-wire with ground, unless otherwise approved by DUES.

2. Switchboards and panelboards shall be located in protected areas dedicated for the use of electrical distribution. Switchboards and panelboards shall not be located in janitorial closets, storage rooms, in any unprotected area or area where devices may impede access to the panel.

3. Sprinkler Systems in rooms containing electrical service equipment, switchboards, and/or medium voltage equipment: In lieu of a sprinkler system, electrical equipment shall be installed in a 2-hour fire-rated room with smoke detection as allowed in NFPA13. This enclosure shall: be dedicated to electrical equipment only, use only dry-type electrical equipment, and provide only non-combustible storage in the space.

4. Electrical distribution and panel arrangement shall separate lighting loads from receptacle loads. Partial renovations/additions to existing facilities shall make attempt to separate lighting loads from receptacle loads as much as possible. Electrical distribution from generator systems shall be separated based on their load type (as defined by NEC).

5. Lay out and arrange distribution components to minimize the distances of branch circuit homeruns.

6. Lay out and arrange distribution components to provide access and enable future renovations or additions. Components shall be capable of replacement without damage to equipment or building

7. Lay out and arrange distribution components to limit single points of failure for entire mechanical systems during outages or during maintenance.

8. All breakers, fuses and distribution equipment shall have interrupting ratings at least 1.25 times the available fault current as determined by the fault current analysis. Coordinate all relays, breakers, fuses and other over-current protective devices in order to protect the electrical equipment from damage and to isolate the fault to the smallest possible portion of the distribution system.

9. Coordinate locations of all recessed panels to enable future access. Stub-up a number of empty 3/4 inch conduit equal to the sum of spare breakers and spaces (but no fewer than 10) into accessible ceiling space or space designated to be ceiling space in the future.

4. Documentation and Review Requirements

A. Provide detailed site plan that clearly indicates the routing of all ductbank(s). Provide an elevation that clearly indicates the service entrance penetrations into the facility.

B. Provide detailed one-line and riser diagrams (as applicable) for all electrical equipment.

C. Provide scaled floorplans that clearly indicate the location of all equipment and the required clearances.

D. Provide mounting details for an elevated low voltage distribution transformer

E. The Engineer of Record shall provide an arc-flash study for all electrical equipment within new facilities. For existing facilities where an arc-flash study has been performed, the Engineer of Record shall update the existing system model to encompass the project scope of work. For existing facilities where an arc-flash study has not been performed, the Engineer of Record shall perform a fault and coordination study to the depth needed to assure that the specified devices will properly and safely interrupt faults, overloads and that the system is properly coordinated. The available fault current values for service(s) shall be derived from the primary electrical distribution system study. Contact DUES High Voltage Department for this information. See Section 26 05 76 – Arc-Flash Study for full study requirements.

5. Installation and Performance Requirements

A. Provide lugs for Duke DUES High Voltage to terminate secondary cables.

B. Do not mix 277/480V and 120/208V conductors in the same raceway, pullbox or junction box except where control wiring is different voltage than power.

6. As-Built Requirements

A. Provide arc-flash study that reflects the as-built field conditions within the input data and includes a short circuit analysis, a time-current curve coordination and calculations of the incident energy available at each piece of electrical equipment. See Section 26 05 76 – Arc-Flash Study for full study requirements.

B. Provide evidence of proper coordination for all over-current current protective devices. Include plots of coordination curves and a one-line diagram to identify each element.