

A16.3 Standard of Practice - Campus Electrical Distribution System

GENERAL

Designers shall verify that all applicable portions of these standards are incorporated into the project's design, drawings, specifications and final construction. Requests for variances from these standards shall be submitted in writing to the DCM Project Manager, using the KU Standards Variance Request Form found in [Appendix A1.1](#), for review and written approval or rejection as indicated on the form.

OBJECTIVE OF STANDARD

- To acquaint Designers and other interested parties with the University's main campus primary electrical distribution system.
- To insure consistent specifications for, and installation of cabling, switching, and grounding equipment on the main campus.

BACKGROUND

The University Lawrence Campus electrical service provider is Kansas Power and Light (KPL)(corporate headquarters are Western Resources, Inc). The utility delivers 12,470-Volt power to the Lawrence main campus at two distribution substations. From these two substations, 12,470-Volt electrical power is distributed across the main campus through a combination of looped and radially-fed circuits. The University has developed a masterplan for circuit development, which over time is expected to eliminate all existing radially-fed circuits in favor of four dual-fed looped circuits whose opposite ends will connect at each of the two KPL substations. This plan has assigned all existing and probable future loads to one of these four circuits. For projects that involve modifying an existing building electrical service, or creating a new building electrical service feed from the main campus distribution system, the Designer should refer to the University's plan for system development to determine the extent of system modifications required.

Individual building services fed by these distribution circuits are transformed to under 600-Volt secondary voltages and are metered separately for University management and accounting purposes only. Designers should take special note that all current carrying circuit conductors from the campus distribution substations to the terminations at building service transformers are 350-kcmil conductors. Building service feeders and transformer terminations should be specified and detailed accordingly.

Other University property, including the area located west of Iowa Street known as West Campus, individual buildings located off-campus in Lawrence and in Overland Park, Kansas, is typically fed directly from commercial utility distribution systems.

KPL has provided the following data for use by Designers in completing electrical system design projects on the main Lawrence campus:

Substation Location	Feed	Available Fault Current (Amps)	Impedance (Ohms)
19 th Street Sub. Circuit 16 (East of Iowa on 19 th St.)	East KU	4120 (PH-GRD)	0.2 + j1.44
		4300 (PH-PH)	
		4990 (3-PH)	
WREN Sub., Circuit 22 (15 th & Kasold)	West KU	3400 (PH-GRD)	0.28 + j1.63
		3770 (PH-PH)	
		4380 (3-PH)	

The main campus distribution system is a 3-phase, 3-wire, solidly grounded system. Routing of the conductors includes both cable tray installation in utility tunnels and duct bank buried installations. While some existing building services feed off of the distribution circuit at in-tunnel oil-filled link boxes or disconnect switches, all new service feeds should be from a pad-mounted switchgear.

CURRENT-CARRYING CONDUCTORS

Existing current carrying conductors and all newly specified conductors should be as follows:

- Description: 15-kV, 133 percent insulation level shielded power cable. Specify single conductor cable for installation in conduit and ductbank. Specify three-conductor cable in an armor assembly with PVC jacket for installation in cable tray in tunnels.
- Conductor: Class B concentric stranded annealed copper (ICEA S-68-516 Part 2).
- Strand Shield: Extruded EPR-based semi-conducting shield (ICEA S-68-516 Part 2).
- Insulation: Ethylene propylene rubber "EPR" (ICEA S-68-516 Part 3). Insulation level shall be 133 percent; thickness: 220 mils (ICEA S-68-516 table 3-1). *Crystalline EPR compounds with cross-linked polyethylene are NOT acceptable.*
- Insulation Shield: Semi-conducting EPR-based extrusion applied over the insulation plus a 5-mil overlapping copper tape shield (ICEA S-68-516 Part 4).
- Three Conductor Assemblies: Cabled with fillers in the interstices, and overall binder tape. Enclosed in Aluminum-interlocked tape armor per UL 1072 and ICEA S-68-516.
- Single Conductor Jacket: Chlorosulfanated polyethylene, heavy duty "CSPE or Hypalon" (ICEA S-68-516 Part 4, Paragraph 4.4.10), thickness: 80 mils (ICEA S-68-516 Table 4-3).
- Three Conductor Jacket: Sunlight resistant red PVC jacket in accordance with UL 1072.

- Identification: Surface printing shall show the manufacturer's name, insulation level, insulation type, jacket type, conductor size, conductor type, voltage rating, and numbered footage markers.
- Temperature: Cable shall be suitable for operation under the following maximum conductor temperatures (ICEA S-68-516 Part 3, Paragraph 3.1):
 - 105 Degrees C: Continuous, wet or dry locations
 - 140 Degrees C: Emergency
 - 250 Degrees C: Short circuit.
- Testing: All cables shall be tested in accordance with the applicable requirements of ICEA S-68-516 and IEEE 383.
- Certification: All cables shall be certified to be in conformance with all applicable requirements of ICEA S-68-516 and IEEE 383.

GROUNDING CONDUCTORS

The main campus electrical distribution system includes a comprehensive grounding grid. The purpose of this grid is to provide a low impedance return path for ground-fault current necessary for the timely operation of the overcurrent protection system, particularly at the campus service entrance substations.

- A separate and parallel bare, stranded No. 4/0 copper grounded conductor is to be provided for all electrical distribution circuits.

Construction Documents: The continuity and integrity of this ground grid is critical to the safe operation of the University's electrical distribution system. For projects involving the extension or modification of the campus electrical distribution system, the Designer shall develop design documents that insure the integrity of the grounded conductor grid. The Designer is responsible for developing a system that is compliant with Article 250 of the NEC, and other relevant articles of the NEC. In particular, the construction documents should detail the following ground connections:

- Ground all electrical equipment enclosures, electrical equipment ground busses, and exposed noncurrent-carrying parts of electrical equipment to the grid.
- Ground all terminal points of metallic conduits.
- When a circuit continues between conduit and cable tray routing, bond the conduit to the cable tray with a grounding bushing connected to the ground conductor in the cable tray.
- Where extending into floor-mounted equipment from below, connect to the equipment ground bus or frame.
- Where extending into a manhole, handhole, cable trench, or nonmetallic box, connect to the ground conductor at the location using grounding bushings.
 - Ground cable trays with a continuous No. 4/0 AWG ground conductor clamped to each tray section at one point in each tray section, at intervals not to exceed 20-feet.

- Connect manhole ground rods to the underground duct system ground conductors. Ground manhole hardware to the ground rod extensions, duct bank counterpoise, or ground grid in the manholes with a No. 6 AWG ground conductor.

SECTIONALIZING SWITCHES

For projects that require modifications to an existing campus distribution circuit, the Designer shall determine, by discussions with University personnel, and by review of the existing University masterplan for electrical distribution, whether existing pad-mount switchgear is available for load connections or if new switchgear must be specified and installed. For projects that require new switchgear, the Designer shall use the following guidelines for creating specifications and detailing installation.

- General:** All new switchgear for campus distribution switching should be outdoor paramount style, with copper bus, switch configuration for two (2) loop switches and two (2) load taps, similar to S&C Model PMH-10. All switch taps should be untapped.
- Nominal Voltage:** 14.4-kV rms, three-phase, three-way.
- Rated Maximum Voltage:** 7.0-kV rms.
- Rated Frequency:** 60-Hz.
- Impulse Withstand Voltage:** 95-kV.
- Main Bus Ampacity:** 600 amperes, continuous.
- Switch Assembly**
 - All switch assemblies should be non-fused.
 - Three-pole, spring-charged stored energy.
 - Capable of withstanding without damages the mechanical and thermal stresses of the circuit breaker momentary and short-time current ratings.
 - 600 amps rated continuous current and loadbreak current at rated maximum voltage.
 - 14-kA rms one-second asymmetrical short-circuit current and 22.4-kA rms momentary asymmetrical short-circuit current at rated maximum voltage.
 - Mount a fault indicator in each switch compartment. Provide a fault indicator viewing window in each switch tap access door.
- Cable Terminations:** Offset spade type suitable for termination of the University standard 350-kcmil circuit conductor cables.
- Switch Cabinet Construction:** The switch cabinet should be as low in profile as possible (preferably 48-inches, maximum), with the following considerations.
 - The Designer shall make provisions in the specification to insure that the switch housing construction allows for initial termination of each conductor cable of the three-phase circuit.
 - In addition, the Designer shall insure that any subsequent re-termination (such as may be required to accomplish phase matching at the switch) can be accomplished in the available cabinet space.

TERMINATIONS

The Designer shall specify termination kits that are certified in writing by the cable manufacturer to be compatible with and suitable for the cable materials. All equipment termination kits should be specified as IEEE 48, class 1.

Equipment Terminations: The Designer shall determine if special equipment termination lugs are required to accommodate the University standard conductor sizes identified in this Standard of Practice and edit specifications sections accordingly.

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