ELECTRICAL POWER SYSTEM

General

The various codes applicable to the University's electrical power system are based upon a model of a single utility service connected to a single premises. The University's electrical system consists of multiple utility services, a cogeneration facility, and a comprehensive primary distribution network connected to hundreds of premises. Thus applying the codes to the University's electrical system is not straightforward. To meet the level of safety intended by the codes, apply the codes as described herein.

Electrical System Description

Utility Services

The Detroit Edison Company provides the following primary and secondary services to the University:

1. Three 13.2 kV primary services to the Central Heating Plant (CHP) on Central Campus.
2. Two 13.2 kV primary services to the University of Michigan Hospitals (UMH).
3. Two 13.2 kV and two 4.8 kV primary services to the North Campus Switching Station.
4. Eleven 13.2 kV and 4.8 kV primary services to individual buildings.
5. Over 250 secondary services of various voltages to individual buildings.

Cogeneration Facility

The University produces steam and generates electricity at the Central Heating Plant, a cogeneration facility that contains the following:

1. Three steam turbine driven 13.2 kV generators with a total capacity of 35 megawatts.
2. One steam turbine driven 2.4 kV generator with a capacity of 4 megawatts.
3. Two gas turbine driven 13.2 kV generators with a total capacity of 7 megawatts.

Primary Distribution Network

The University distributes power to most of its buildings through the following circuits:

1. 13.2 kV and 2.4 kV primary feeders from the CHP to most Central Campus and Athletic Campus buildings.
2. 13.8 kV primary feeders from the Hospital Switching Station to the UMH buildings.
3. One 13.2kV primary feeder from the CHP to select UMH loads.

4. 13.2 kV and 4.8 kV primary feeders from the North Campus Switching Station to most North Campus buildings.

Application of the Codes

General

1. New electrical systems shall comply with the current codes.
2. Existing electrical systems under addition or renovation shall be upgraded to comply with the current codes.
3. Existing electrical systems in an area undergoing non-electrical renovation are not required to be upgraded to comply with the current codes. However:
   a. No work of any discipline shall degrade the existing electrical systems in any way.
   b. Upgrade the electrical systems as much as possible and practical.
4. The University's electrical system is considered "reliable" as defined in NFPA 20 Appendix A.
5. The Central Heating Plant is considered an "on-site power production facility" as described in NEC Section 695-3(2).

Application of NFPA 70, the National Electrical Code

1. The service points at which the Detroit Edison utility services end and the University premises wiring begin, are defined as the connections of the secondary buses or terminals of the Detroit Edison owned step-down transformers, fused cut-out switches, or service drop conductors, to the University owned cables.
2. The source ends (Central Heating Plant or switching station ends) of the University primary distribution cables are feeders and shall comply with NEC Article 220, "Feeders".
3. The load ends (building ends) of the University primary distribution cables shall be treated as utility services up to the building service disconnecting means and shall comply with NEC Article 230, "Services".
   a. Conductors shall be maintained outside of the building or shall be enclosed in two inches of concrete until they enter the room containing the building service disconnecting means.
   b. Primary disconnect switches, unit substation transformers and pad-mount transformers shall be treated as utility owned service equipment.
      - Access shall be restricted to qualified personnel only.
      - The switches shall not be used as the building service disconnecting means.
   c. The line side terminals of the secondary main disconnecting device(s) shall be treated as the building service point.

Application of the National Electrical Safety Code

In addition to complying with the NEC, the Central Heating Plant, switching stations, substation rooms, manholes and other areas containing primary equipment or cables shall comply with the National Electrical Safety Code.

Application of the BOCA Building Code and Life Safety Code

1. In low rise buildings, provide emergency power for egress lighting, emergency signs and the fire alarm system.
    a. Provide a natural gas fueled engine-generator set whenever possible because the savings in maintenance costs will offset the high initial cost.
    b. As an alternative to an engine-generator set, consider providing a fuel cell system.
    c. When an engine-generator set can not be provided, provide individual battery packs.
    d. Do not provide a central battery/inverter system due to its high maintenance costs.
    e. Because the normal power source is sufficiently reliable, do not connect low rise building fire pumps, elevators or similar equipment to the engine-generator set.
2. In high rise buildings, provide emergency power for egress lighting, emergency signs and the fire alarm system. Provide standby power for fire pumps, elevator(s), smoke exhaust systems, stairwell pressurization systems and other standby systems as required by codes.
    a. Provide a single natural gas fueled engine-generator set with multiple automatic transfer switches.
        - Provide the fire pump automatic transfer switch as an integral part of the fire pump controller.
        - Provide the elevator system automatic transfer switches as part of the building's power distribution system, not integral to the elevator controllers.
    b. Consider supplying more than one building from a single engine-generator set.
    c. Consider installing the engine-generator set in an adjacent parking structure or lot to minimize noise and vibration.
3. Only as a temporary measure when an engine-generator set can not be provided at the time, provide two separate services to the building and provide multiple transfer switches.
    a. Obtain one service from the University electrical system and the other from Detroit Edison.
    b. Do not obtain both services from the University electrical system because both services will be connected together at times for system maintenance or load balance.
    c. Do not obtain either service from a 4.8kV or 2.4kV primary circuit because these circuits are being phased out.

d. Do not obtain both services from Detroit Edison unless they originate at different Detroit Edison switching stations.

e. The University's long range goal is to provide emergency and standby power to every high-rise building from engine-generator sets. Design the electrical distribution system so that an engine-generator set can be connected in the future.

4. In low rise and high rise buildings with special needs, special power may be required by codes or may be requested by the Owner for hazardous labs, animal rooms, freezer farms, radio transmitters, telecom switching stations or other critical loads.

   a. When possible, provide the special power from the same natural gas fueled engine-generator set that supplies the emergency and standby power. Use a separate automatic transfer switch to feed the special loads.

   b. If no engine-generator set exists and special power is required within minutes of a loss of normal power, provide a dedicated natural gas fueled engine-generator set.

   c. If no engine-generator set exists and special power is required within a few hours of a loss of normal power, provide a University standard generator connection box for connecting a portable generator.

Electrical System Requirements

Distribution Network

The University's long range goal is to convert the entire distribution network to 13.2kV.

1. Connect new unit substations to 13.2kV primary circuits, not to 4.8kV or 2.4kV circuits.

2. Coordinate with the Utilities and Maintenance Services Department to establish the specific circuits and connection points.

Unit Substations

Provide indoor unit substations consisting of primary load break switches, dry type transformers, and secondary switchgear distribution sections.

1. Provide double-ended substations with two main and one tie secondary circuit breakers for health care and medical research buildings. Provide single-ended substations with one main secondary circuit breaker for classroom, library, housing facility and similar buildings.

2. Provide substations with a secondary voltage rating of 480 volts, three phase.

1. Size substations only for the anticipated peak load plus spare capacity for future growth. Do not oversize the substations and thus increase initial costs and transformer losses.