Basis of Design

This section applies to the design and installation of building power distribution systems.

Design Criteria

This section contains the architectural, structural, and mechanical provisions for building electrical systems. The electrical designer shall coordinate these requirements with the other disciplines to ensure these requirements are satisfied.

**Note:** Use Drawing 2, “Typical Building Power Distribution Riser,” as a guide for building power systems.

Coordinate with Construction Management the distribution concepts, including load calculations, calculated fault duties, protective device coordination methods, and grounding practices, being utilized on the design.

Architectural Provisions

Provide separate service entrance electrical rooms for each of the normal and emergency systems in the basement, preferably adjacent to the utility tunnel and on an exterior wall. Equipment access shafts to the outside and walk-in access from the tunnel system shall be provided wherever possible. The design shall take into consideration the possibility of flooding when below grade.

Distribution within the building shall be via readily accessible electrical rooms and/or closets. These must be independent from all other types of rooms or closets, i.e., communications, telephone, custodial, audiovisual, etc.

As a general guide, provide one floor electrical distribution room to serve each 15,000 to 20,000 square feet.

Equipment room and equipment space requirements should exceed minimum National Electrical Code (NEC) requirements and shall be large enough to accommodate the equipment and provide space for future equipment. Eventually, panels will become full, requiring the addition of new panels. This is true even for fairly new facilities and is especially prevalent in laboratory and science buildings. These future wall and floor space provisions shall be shown on the design drawings so that space is reserved. Typically, 6-foot hot sticks are used to work on high-voltage equipment. Provide adequate working space per NEC and the National Electrical Safety Code.

Distribution switchboards, panelboards, and dry transformers over 30 kVA shall be located in electrical rooms. Rooms shall be stacked for riser efficiency and be
centrally located to keep feeder lengths to a minimum. Several rooms may be necessary to accommodate the building configuration and system design. Refer to Drawing 3, “Typical Floor Electrical Room.”

Closets should be a minimum 2 feet deep by 6 feet wide and equipped with full-width double doors opening into a building corridor.

Branch panels shall be located in closets located throughout the floor or wing. In laboratories and similar areas, branch panels may be mounted on or in common corridor walls.

Transformer ambient noise and electromagnetic field (EMF) emissions from electrical equipment and risers can negatively impact the equipment and function in neighboring spaces. This includes spaces immediately above and below these rooms, closets, and risers. Therefore, the space plan shall be reviewed to determine whether modifications are required.

Provide adequately sized access pathways for the repair, maintenance, and eventual replacement of the equipment. Equipment access pathways shall be large enough to allow for the removal of transformers, primary switches, and other large pieces of equipment. These paths of egress shall be shown on the building drawings. Weights of transformers could exceed floor loading if other than slab-on-grade basement areas are necessary for egress. Make sure that lifting eyes and floor loading are accommodated for in the design.

Padmount transformers and switchgear must be accessible by vehicular crane and have sufficient working space per NEC and the National Electrical Safety Code.

Mechanical Provisions

Coordinate with the Mechanical Engineer ventilation requirements in electrical rooms and closets containing transformers or other heat-generating sources. The ventilation shall be supplied and filtered by a ventilation system.

Coordinate fire protection requirements in electrical rooms and vaults with the Architect and the Mechanical Engineer. The system shall satisfy the code while minimizing the risk of electrocution. Sprinklers in high-voltage electrical vaults create extremely hazardous conditions when they discharge, creating an electrocution hazard for workers.

Avoid installation of mechanical piping and ductwork in electrical vaults, rooms, or closets except where required for operation of the electrical equipment. Piping and ductwork must never be installed directly over any transformer or switchgear. Sprinklers installed to protect the electrical equipment are the only exception. Drain lines from the floors above shall not be piped through the electrical rooms below. The University does not permit the use of drip pans as a mitigating means that would
allow the piping to be installed in these areas. Apply NEC 450-47 for all University electrical vaults, rooms, and closets.

**Structural Provisions**

Provide concrete bases and housekeeping pads for all transformers and equipment, seismically designed with structural connections to the floor slab, and channel or angle iron frames for welded equipment fastening.

Coordinate conduit placement in slabs and the penetration of floors, shear walls, structural members, and so forth.

**Laboratory Buildings**

Because laboratory buildings need constant renovation to keep up with changing technology, they are divided into lab modules. Each lab (one or more modules) periodically needs to be isolated from the rest of the building to facilitate the renovation without impacting the remainder of the building. Provide circuiting isolation for each lab module. All electrical systems shall be down fed to minimize the number of floor penetrations.

If utility corridors can be provided to serve a variety of purposes through laboratory areas, it is highly desirable to provide local panelboards in these utility corridors, dedicated to individual or small groups of laboratories. The many panelboards are best served via an exposed bus–duct system in the utility corridor with local disconnects to each panelboard. These bus–ducts then make it convenient to provide power for spot loads that exceed the per-square-foot average. This approach also helps to minimize the number of floor penetrations.

Lab areas will be designed with the capacity of at least 1 power outlet per 30 square feet. Dedicated circuits will be supplied for all refrigerators, centrifuges, and specialty devices. Provide hospital-grade receptacles in all hospital and health care facilities per NEC. Provide hospital-grade receptacles in all research laboratories and procedure rooms in the Health Sciences and other physical sciences.

Refer to Drawing 1, “Laboratory Demand Load,” to approximate power required for laboratory areas. Laboratory power systems shall be flexible to allow the anticipated increase in laboratory loads. Local distribution shall be provided based on the calculated load. However, more generous conduit sizing, sleeving, and space allocated in principal electrical cabinets or closets shall be provided. These measures make it convenient to bring in new feeders to supply additional power for load increases.

Dedicated receptacles and isolated ground receptacles are often required for special or sensitive equipment. Extensive use of dedicated receptacles in laboratories can quickly use all the circuit breakers in the branch circuit panelboard. The Electrical
Engineer shall ensure that these needs are identified on the room data sheets and that adequate panel space is provided. Define this early in the design process.

Design Evaluation

The following information is required to evaluate the design:

- **Programming Phase**
  - Space planning and provisions for power distribution systems
  - Statement on power distribution system layout and basis of design

- **Schematic Design Phase**
  - Design requirements and location of electrical rooms and closets
  - Preliminary power one-line diagram and riser diagram
  - Electrical load estimate
  - Outline specifications

- **Design Development Phase**
  - Preliminary plans for electrical rooms and closets
  - Identification of equipment access pathways
  - Identification of electrical EMF and noise mitigating requirements
  - Electrical room ventilation provisions
  - Seismic and housekeeping pad design details
  - Updated power one-line diagrams and riser diagrams
  - Preliminary load calculations
  - Draft specifications

- **Construction Documents Phase**
  - Final plans for electrical rooms and closets
  - Final power one-line diagrams and riser diagrams
  - Final detail drawings of sections, elevations, and schedules for power distribution equipment
  - Completed load calculations
  - Completed specifications

Submittals

- Provide industry standard submittal requirements.
Products, Materials, and Equipment

Refer to the requirements specified in these standards.

Installation, Fabrication, and Construction

Refer to the requirements specified in these standards.

END
NOTES:

- EXCLUDING LIGHTING AND SPECIAL EQUIPMENT.
- EXCLUDING RELATED STORAGE, OFFICE, OR RECEPTION AREA.
- MINIMUM TRANSFORMER AND FEEDER SIZES NOTED.
  (INCLUDES 40% SPARE CAPACITY)

SD–E–142

Drawing 1: Laboratory Demand Load
ELECTRICAL:
Building Power Distribution
November 2004

Drawing 2: Typical Building Power Distribution Riser

NOTES:
1.) USE CABLE & CONDUIT RISERS, AND FEEDERS NOT TO EXCEED 800A EACH.
2.) A SINGLE RISER MAY FEED NO MORE THAN TWO DISTRIBUTION PANELS, OR THREE 480V BRANCH PANELS.
3.) FOR SMALLER BUILDINGS, OR LOADS, A SINGLE DISTRIBUTION BOARD MAY SERVICE UP TO 3 FLOORS WHEN LOCATED ON THE MIDDLE FLOOR.

SD-E-131
NOTE:
ADDITIONAL ROOMS OR CLOSETS MAY BE REQUIRED ON EACH FLOOR. ADDITIONAL SPACE MAY BE REQUIRED FOR LIGHTING CONTROL PANELS, CRITICAL OR EQUIPMENT BRANCH PANELS, FIRE ALARM PANELS, SUPERVISORY CONTROL PANELS, AND SPACE FOR FUTURE PANEL(S).

Drawing 3: Typical Floor Electrical Room