

Compliance: The design and construction of all building electrical systems shall be in complete compliance with the National Electric Code. This code is to be viewed as the “final authority” for establishing the minimum requirements of electrical devices, equipment and systems. The requirements of these *UIUC Facilities Standards* often exceed the minimum requirements of the Code, requiring further compliance.

Emergency Generator: A diesel powered engine generator set shall be provided as the required emergency power source for each new building 25,000 square feet or larger. Renovations of buildings of this size shall include addition of emergency generator if possible. Emergency generators shall not be located within buildings. In addition to using up valuable indoor building space, potential problems include: engine exhaust fume discharge, indoor radiated noise, remote exhaust discharge noise, ventilation, cooling and heating requirements, remote fluid cooler requirements, fuel storage and transfer issues, fire protection, electrical power and control requirements as well as compliance with all applicable codes.

Transformer Rooms: Each building shall incorporate one or more transformer rooms (see *Equipment Rooms, Electrical* section within these *General Guidelines* for requirements.) These should generally be located on the lowest level of the building, adjacent to the electrical service entrance. This room shall house the building’s transformer(s), switch gear and associated equipment.

Unit Substations: When the design maximum demand is approximately 150 KVA or more, the transformer and switchgear shall be of the “unit substation” type, with all components in one factory assembled unit. Each unit substation shall consist of a primary switch section, transformer section, main fused switch section and secondary distribution section(s). The secondary distribution section does not need to be the same depth as the rest of the unit substation or attached, and it can be of the switchboard type. All units shall be front aligned. (See *Sections 26 11 16 – Secondary Unit*

Substations and 26 22 13 - Transformers for requirements and sizing criteria.) The main switch section shall incorporate metering (see *Section 26 27 13 – Electric Metering*).

Smaller Buildings: In smaller buildings, a single unit substation shall be installed that supports the building loads. A 277/480 volt, three-phase, four-wire system to serve lighting and mechanical equipment shall be utilized with a 208Y/120V to support receptacle loads. This is preferred and shall be done when the project budget can support it. It is preferred to install one or more motor control centers to serve mechanical equipment, in lieu of installing distributed motor starters, when it is cost effective to do so and the project budget can support it.

Transformer Redundancy: A building with expected maximum demand of over 750 KVA, generally, shall have two separate main transformers of equal capacities located either in separate transformer rooms in different parts of the building or in a double-ended arrangement in one transformer room. This is recommended for reasons of safety, reliability and equipment handling. Buildings with large auditoriums or assembly areas shall have two transformers as required to insure reliability of the lighting.

Overcurrent Protection / Coordination: Each overcurrent protective device shall be properly sized for the protection of the connected downstream component. Fusible switch type equipment shall be used where required. All protective devices, including the primary fuses, the secondary main protection device and the secondary distribution protection devices shall be coordinated for a purely selective system.

Harmonics: Electrical design shall take power system harmonics into consideration. Each transformer shall be K factor rated where applicable.

Electrical Closet Location: Electrical closets shall be vertically “stacked” to the greatest degree possible, thus facilitating distribution riser configuration.

Panels: Each distribution panel located within the building shall be served by a

dedicated circuit breaker within the distribution section of the unit substation. Distribution and branch panels may be located in electrical closets that are directly accessible from a public corridor. These closets shall be labeled "Electrical". They may also be located in public corridor walls and, if so, shall be flush-mounted. Each panel shall only serve electrical devices that are located on the same floor as the panel. The only acceptable exception to this is an emergency panel, which may serve multiple floors. Branch panels shall be located such that branch circuits will not exceed 100 ft. in total developed length. Each flush-mounted panel shall be fitted with four spare 1 in. conduits that extend above the suspended ceiling or to a point near the structural ceiling. Each new distribution or branch panel shall have 42 spaces and shall have a minimum of nine spare spaces when the entire installation is complete.

Emergency Panels: Generally, emergency panel(s) shall be located in the main electrical room and shall serve only lighting and devices required by Life Safety Code as well as other critical equipment as deemed appropriate and necessary. Critical equipment includes:

- Sump pumps
- Sewage ejectors
- Hot water perimeter heating pumps
- DDC panels -
 - At a minimum, controls required to operate perimeter HW generation equipment and pumps
- Pneumatic control air compressors
- Steam condensate pump units
- Elevators (as required)
- Card access systems
- Security systems
- Cold room cooling units, condenser water pump/controls as applicable
- Critical lab equipment, HVAC
- Research animal HVAC, other support systems
- Critical computer equipment, HVAC
- Critical telecom equipment, HVAC
- Critical lab exhaust systems -
 - At a minimum, one of multiple ganged exhaust fans

Circuiting: Wall outlets shall be served by 20 Amp circuits with a maximum of six duplex outlets per circuit. Lighting and outlets shall be served by separate dedicated circuits. Circuits that serve outlets located in corridors shall serve corridor outlets only. They shall not also serve outlets located in other spaces (e.g. offices or laboratories where computers or other critical equipment may be in operation). These outlets are used by custodial staff to power cleaning equipment, resulting in the occasional tripping of a circuit breaker. Each substantial piece of hard-wired single-phase electrical equipment shall be served by a dedicated circuit. Every piece of hard-wired three-phase electrical equipment shall be served by a dedicated circuit. Equipment that incorporates duplex units for the sake of redundancy such as air compressor units, sump pump units and condensate pump units shall be served by two separate power and control circuits such that one unit can continue to operate when the other has failed. Each piece of equipment or system shall be served by a dedicated control circuit that is wired so as to be disabled when the power circuit is disabled. Standard control circuits shall be 120 volt.

Outlets: The density of portable electrical devices used within University buildings, especially laboratory buildings, is quite high. Also, the usage of spaces changes often. Therefore a generous number/distribution of 20 Amp duplex outlets shall be provided in new or remodeled areas. For example, even the smallest and simplest office area shall have at least two duplex outlets. A 20 Amp duplex outlet shall be provided every 50 ft. (maximum) in corridors and public areas for use by custodial staff. Mechanical equipment rooms, electrical equipment rooms, elevator machine rooms, janitor closets and other service and support areas shall not be overlooked with regard to the need for an adequate number/distribution of outlets. The location of outlets shall be coordinated with the layout of modular furniture/partitions with integral raceway. Generally, outlets shall be flush-mounted in walls. Flush-mounted floor outlets are not allowed. However, recessed floor boxes with hinged/removable covers that contain power and/or voice/data receptacles may be installed to serve

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equipment that is located remotely from the nearest wall.

Exterior Outlets: An exterior outlet shall be provided adjacent to each piece (or grouping) of mechanical equipment (at the ground and roof levels) to facilitate service.

Motor Starters: Each three-phase motor shall be served by a magnetic starter with a hand-off-auto switch, as opposed to a manual starter. This facilitates the future application of automatic controls.

Flexible Design: As mentioned previously, the usage of spaces within University buildings, especially laboratory spaces, changes often. Remodeling is a common occurrence. Therefore, the building electrical systems shall be designed with sufficient flexibility and spare capacity to accommodate substantial future changes. Generally, a spare capacity of 25% (minimum) shall be provided throughout each electrical system, from the reserve transformer capacity to the number of spare spaces in each branch panel.

Panel Identification Label: Every electrical unit substation, switchboard, automatic transfer switch and panel shall be identified with a label designating the building number, the room number where the equipment is located, and the room number where the equipment is fed from. (For example: if a lighting panel is located in building #0014, room #435 and fed from a unit substation, located in room #12 in the basement, then the panel will be labeled as 0014-LP435-12). See F&S for additional information regarding equipment labeling.