# DESIGN GUIDELINE 261000
# MEDIUM VOLTAGE ELECTRICAL DISTRIBUTION

## Scope

This guideline defines the requirements and standards for design of expansions and modifications to the University medium voltage electrical distribution system. The guideline covers basic requirements for system design, services, load estimating, cables and raceways, unit substation configurations and testing.

## Related Sections

**U-M Design Guideline Sections:**
5.7 SBA - Unit Substation Rooms
6.3 DG 260513 - Medium, Low and Control Voltage Cables
6.3 DG 260526 - Grounding and Bonding for Electrical
6.3 DG 260533 - Electrical Materials and Methods
6.3 DG 260543 - Underground Services for Electrical Systems
6.3 DG 260800 - Electrical Acceptance Tests
6.3 DG 261100 - Unit Substations

**U-M Master Specification Sections:**
7.3 MS 260513 - Medium, Low and Control Voltage Cables
7.3 MS 261100 - Unit Substations

**U-M Standard Details:**
26000000 – Series Details

**Reference Documents:**
- American National Standards Institute (ANSI)
- Institute of Electrical and Electronic Engineers (IEEE)
- National Electrical Manufacturers Association (NEMA)
- NFPA 20, "Standard for the Installation of Stationary Pumps for Fire Protection"

## Design Requirements

Use U-M Master Specification 260513, “Medium, Low and Control Voltage Cables” as basis for design and specifying medium voltage power distribution cables. Use U-M Master Specification 261100, “Unit Substations’ as basis for design and specifying medium voltage switches and unit substations. Edit the specification and details to make them project specific. When editing the specification, turn on hidden text and follow the Spec Editor notes.

Proposed designs associated with the University medium voltage distribution system shall be coordinated with the U-M Primary Systems Engineer (UMPSE). Contact the UMPSE through the University Design Manager.

**University Medium Voltage Distribution Systems**

The University medium voltage distribution systems serve three major campuses, Central Campus, North Campus and Michigan Medicine.

The Central Campus primary distribution systems consist of a 13.2 kV looped system and a 2.4 kV radial system. The 2.4 kV system is slowly being eliminated and upgraded for incorporation into the 13.2 kV distribution system. The 13.2kV distribution system is comprised of numerous loop style feeders served from U-M Switching Stations. The loop feeders serve multiple buildings each with one or more unit substations.

The North Campus primary distribution systems consist of a 4.8 kV looped system and a 13.2 kV looped system. The 4.8 kV system will eventually be upgraded to a 13.2 kV system. The distribution systems are comprised of numerous loop style feeders served from U-M Switching Stations. The loop feeders serve multiple buildings each with one or more unit substations.

The Michigan Medicine primary distribution system, in general, consists of a 13.8-kV dual radial system served from a single U-M Switching Station. Additional Michigan Medicine buildings are fed from a 13.2-kV looped system, as noted above, served from a single U-M Switching Station. Each building fed from the 13.2kV looped system is served by a dedicated loop to provide dual primary sources as required for inpatient facilities. Additional information on the primary distribution systems and on the primary system fault capability is available from the UMPSE.

**Electrical Service Requirements**

Coordinate with the UMPSE on the design of electrical services for new buildings or accommodations required for increased loads on existing building electrical services.

New buildings located within the coverage area of the University medium voltage distribution systems shall be served by the 13.2kV system and designed to comply with the standards and requirements noted in this guideline. Coordinate with the UMPSE for incorporation of new building electrical services into existing distribution systems. Avoid adding new loads to the 2.4kV or 4.8kV systems.

The transformer secondary main breaker of unit substations shall be regarded as the building's service disconnect and shall be suitable for use as service entrance equipment.

New 'off site' buildings, (buildings located outside of the coverage area of the University medium voltage distribution systems), shall be served by the local electrical utility and designed to comply with their standards and requirements. The design for off-site buildings may require space for two future 15kV loop switches and one 15kV fused transformer feeder switch, verify with the UMPSE. Transformers and secondary switchgear shall comply with U-M design guidelines and specifications.

If the building design includes an emergency generator, service for an electrically driven fire pump shall be served from both the line side of the unit substation secondary main breaker and from the emergency power distribution system. For building designs that do not include an emergency generator, coordinate with the Design Manager and the UMPSE on the design for

the fire pump power source(s). Request data from the UMPSE or local utility (off site projects) to verify compliance with NFPA 20 requirements for 'reliable power'. The reliability study shall encompass the prior five years in lieu of one year as required by NFPA 20.

**Load Estimate Requirements**

During the Schematic Design Phase, estimate the additional kW demand load associated with proposed project scope. 'Square foot' load estimates based on building types are acceptable at this stage of design. Design Development Phase deliverables shall include a kW demand estimate based on load lists. Drawings submitted for Owner review during the Construction Document Phase shall include finalized kW demand load calculations.

For large chillers (750 Tons and above) perform an economic evaluation for serving the chiller(s) at 4160V or 4800V versus at 480V. The evaluation shall include cost savings that may be obtained by incorporation of a VFD at 480V. Perform this evaluation during the Schematic Design Phase.

**Phasing**

In general, phase rotation shall be A-B-C. The phasing of new installations shall be A-B-C (X-Y-Z) from left to right, top to bottom and front to back, when viewed from the front. Match the phasing of renovations to the existing installations.

**Medium Voltage Cable and Raceway Requirements**

University medium voltage distribution cables are primarily routed underground.

Design raceway systems in such a way that cable pulls do not exceed 500 feet. Provide calculations showing that the required cable pulls do not exceed the manufacturers' recommendations for pulling tensions, sidewall pressures, and cable-bending radius.

For buildings served from the University medium voltage distribution system, the U-M Primary Systems Electrical Shop will furnish and install the medium voltage cables, splices, and terminations. Medium voltage cabling will be installed and terminated to each loop switch. The contractor shall be responsible to furnish and install all manholes, raceways, cable trays, and supports. Coordinate installation through the UMPSE. Medium voltage feeder cables for chillers shall be furnished and installed by the contractor.

**Unit Substations**

Unit substations, fed from looped style distribution systems, shall consist of two 15kV non-fused sectionalizing loop switches, one 15kV fused transformer disconnect switch, transformer with 480V or 208V secondary, and secondary switchgear with main circuit breaker.

Unit substations, fed from radial style distribution systems, shall consist of one 15kV fused transformer disconnect switch, transformer with 480V or 208V secondary and secondary switchgear with main circuit breaker.

Distribution systems designed to serve laboratory research or inpatient facilities shall include double-ended unit substations and may include a main-tie-tie-main arrangement to assist with

maintenance. Distribution systems for all other facilities shall include single ended unit substations unless otherwise required for reliability or limiting shutdowns for maintenance.

**Testing**

Instruct the Contractor to perform testing in accordance with Design Guideline 260800 and to provide the University Project Manager and the UMPSE with test reports. Testing associated with medium voltage distribution systems shall be coordinated and performed in conjunction with the U-M Primary Systems Electrical Shop.