Basis of Design

This section applies to the design relating to connections to the Seattle campus primary electrical distribution systems.

Background Information

- The power system serving the Seattle campus is owned and operated by the University. The University effectively runs its own electrical utility. The systems are operated and maintained by the Campus Operations High Voltage Electric Shop.
- The University’s normal power primary distribution is a 13.8 kV, 3-phase, 3-wire, low resistance grounded wye system. All new services will be connected to this system.
- The University has a campus emergency and standby power system. Refer to the Electrical - Emergency Systems section for detailed information.
- The University receives power from Seattle City Light (SCL) at two locations on campus. The utility "points of service" are located at the secondary connection to the SCL transformers. Four SCL feeders and transformers serve the University’s West Receiving Station at 15th NE and Pacific St. One SCL feeder and transformer serves the University’s East Receiving Station at the Power Plant. Interties connect the two stations and are switched to regulate power flow as required. A 6MW-extraction steam turbine in the Power Plant provides some co-generation. The amount varies with the campus steam load.
- Normal and emergency power is distributed from the receiving stations through tunnels, utilidors and ductbanks. 500kcm metal-clad, interlocked armored cables feed power throughout the campus. #2/0 metal-clad, interlocked armored cable taps in manholes extend service into the buildings and padmount equipment. Relays at the receiving stations provide fault and overload protection for the 500kcm cable systems but only fault protection for the #2/0 cables. Fuses at the building disconnect switches provide overload protection for these #2/0 cables.
- Equipment and conductors from the "points of service" to individual building secondary main breakers are designated as "service conductors" and include primary fused disconnect switches, service transformers, and secondary conductors to the secondary main breakers.
- The building transformer secondary main breaker shall be designated as "service disconnect" and "service overcurrent protection".
- The Consultant shall coordinate all field design investigative work around the medium voltage systems and equipment with the High Electric Shop Lead or Supervisor. Field visits may require that a high voltage worker accompanying the Engineer.
Design Criteria

- Medium voltage cable systems are standardized at 500kcm and #2/0. Code sized conductors can be used downstream of fused load interrupter switches and motor starters. Provide a minimum #2 ground conductor (regardless of the size of the phase conductors), galvanized steel interlocked armor, and a PVC outer jacket to form a complete assembly. The ground conductor size is based on the 500kCM feeder size and the relays being set to protect 500kCM cables for fault protection. **Note that this is a non-standard ground wire size for 2/0 cable assemblies.** The Authority Having Jurisdiction (AHJ) may allow for a separate ground conductor to run parallel and external to the cable assembly so that industry standard cable can be specified. AHJ approval would be required.

- For typical Utility Tunnel details, refer to the following Standard Drawings in the “Utility Tunnels and Trenches” Section 2T.
  1) Drawing-Utility Tunnel Section
  2) Drawing-Utility Trench Section
  3) Drawing-Utility Tunnel Manhole Plan
  4) Drawing – Utility Tunnel Electrical Tray Bracket Detail

- Service conductor ductbanks shall be concrete encased and provided with spare cells for future services or cable replacements. Consider ductbank conductor derating per NEC be when sizing the conductors and raceways. For these purposes, conductors larger than the University standard sizes may be required. For example, where 500kcm feeders need to be routed through a ductbank to reach their destination, they may have to be sized to 750kcm in order to retain the power delivery capacity of the feeder.

- The use of padmount equipment is limited to locations where aesthetics allow. A buried vault to hold the transformer and associated equipment may be required. Generally, locate equipment within building electrical vaults or rooms.

- Cables are generally subject to ambient temperatures of $-20^\circ$ to $+40^\circ$ C ($0$ to $105^\circ$ F).

- Conduits for medium voltage installations are rigid steel in buildings and street crossings; for direct buried or concrete encased applications, schedule 80 PVC may be used. Medium voltage cable shall not be directly buried.

- Conduits for primary medium voltage distribution trunks (500 kcm cable) shall be 5” diameter minimum. Larger conduit may be required to facilitate cable pulls for long runs and multiple bends. Conduits for MV cable downstream of load interrupter switches and MV motor starters (#2/0 cable) shall be sized per code and cable pulling requirements.

- Bends for 5” conduit used for primary medium voltage distribution trunks (500 kcm cable) shall have 5’ radius minimum, to facilitate cable pulling operations. Radii for bends of smaller diameter conduit for MV cable downstream of load interrupter switches and MV motor starters (#2/0 cable) shall be per code and cable pulling requirements.

- Termination and pulling vaults for medium voltage distribution shall be 7’Dx10’Wx10’L minimum to allow installation of MV load break elbows for taps to future facilities. Installation of smaller vaults shall not be allowed unless coordinated and approved in writing by UW Engineering Services.

- Grounding systems shall be provided for all primary distribution ductbanks, utility tunnels, manholes, pulling vaults, transformer pads, switch pads, etc.
- For future projects in the utility tunnels an exposed and accessible personnel safety ground conductor shall be installed along tunnel lengths. Personnel safety ground conductor shall be 250 kcm minimum and shall be installed such that they are readily accessible anywhere in the tunnel.

Design Evaluation

The following information is required to evaluate the design:

- **Programming**: Identification and location of connection to campus primary distribution system.
- **Schematic Design Phase**: Description of overall primary distribution concept. Identification of work related to tunnels, manholes, ductbanks, and raceway and cable routing. One-line diagram. Outline specifications.
- **Design Development Phase**: Drawings showing distribution routing, raceway and conductor sizing and circuiting. Proposed connection hardware information. Preliminary drawings including utility tunnel/trench sections, manhole plans, tray layout, connection details, grounding details for electrical rooms, tunnel sections, ductbanks, manholes, and vaults. Draft specifications.
- **Construction Document Phase**: Complete drawings showing cable tray, raceway and conductor routing and layout. Final connection hardware information, protection methods, final utility tunnel/trench sections, manhole plans, tray layout, connection details, grounding details for electrical rooms, tunnel sections, ductbanks, manholes, and vaults. Complete specifications.

Submittals

- Provide standard industry submittal requirements. In addition, comply with requirements specified in related sections.

Products, Materials and Equipment

- Refer to the requirements specified in individual Electrical sections.

Installation, Fabrication and Construction

- Cable and wire procurement, especially for short lengths of interlock armored cable, can take additional time. The Consultant shall include fair warning to the Contractor in the specifications.
- Cable trays are used in tunnels, manholes, and elsewhere for carrying utility cables. For service reliability and safety, place only one high voltage cable in any individual cable tray unless otherwise directed. Cable trays, in general, shall be sized 9 inches wide in tunnels and 12 inches wide in manholes and shall include fire-resistant tray liners. Tray liners shall be non-asbestos type and shall be marked as such. Apply fireproof tape to cables installed outside of the cable trays.
• In special cases, with prior written approval by UW Engineering Services, two cables may be routed in one cable tray. In such case, provide a tray-dividing barrier. The barrier shall be at least as tall as the armored cable diameter and securely fastened to the tray.

• Do not use cable link boxes for new 13kV splices, connections, and taps. (Cable link boxes are being phased out from the primary distribution system). Utilize cable junction boxes.

• Medium voltage cable splices and connections are often placed in tunnels and manholes open to non-electrical workers. This requires that splices have protective covers and junction boxes have protective cages. The Consultant shall investigate and work with Engineering Services in designing appropriate worker protection barriers.

• Size junction boxes and electrical vaults for terminations to allow future expansion of the cable system.

• Splices may be placed in cable tray or supported on structure walls.

END OF DESIGN GUIDE SECTION