Basis of Design

This section applies to the design and installation relating to emergency power systems.

Background Information – UW Seattle Campus

- The University owns and operates a central plant Emergency and Standby Power System (ESPS). The system consists of a 4.16kV diesel plant and 4.16kV and 2.4kV emergency distribution systems. The generator plant is located in the Power Plant and is operated and maintained by the Power Plant staff. The distribution systems are operated and maintained by Campus Operations High Voltage Shop. Most new facilities shall be served from the campus ESPS system.
- The 2.4kV, 3 phase, 3 wire ungrounded delta emergency distribution system is being phased-out and buildings served from this system are in the process of being converted to 4.16kV. In the future the 2.4kV system will only serve Power Plant loads.
- The 4.16kV, 3 phase, 3 wire, low resistance grounded-wye emergency distribution system is supplied power from a 4.16kV Diesel Generating Plant that is classified as a code compliant emergency generating source. The Medical Center and most University facilities built since 1992 are served from this system. Expansion of the 4.16kV distribution system throughout the campus is in progress. In the future all campus buildings except the Power Plant will be served exclusively by the 4.16kV ESPS systems.
- The ESPS is configured into three major Plants:
  1) UW Medical Center
  2) General Campus Facilities
  3) Power Plant
- During the initial phases of design, consultants shall confer with Campus Engineering to determine the source of emergency power. Designs shall take into account this future service connection so that the facility can be re-fed at minimum future cost and rework to the electrical distribution system. Reserve space to accommodate the future equipment.
- The 4.16kV campus ESPS shall serve most NEC Article 517, 700, 701, and 702 emergency loads. The 4.16kV campus emergency system has been approved by Seattle's DCLU to serve these loads with the following clarifications:
  1) Future high-rise buildings (SBC Section 1807) will also require redundant feeders, or on-site emergency generation equipment.
  2) NEC classified "emergency," "legally required standby," and "optional standby" loads may be powered from the campus ESPS provided the capacity, load pickup, and load shedding requirements of NEC 700-5 are met.
  3) Oil switches and other significant sources of fuel shall not be used in the tunnels or electrical rooms that contain portions of the ESPS.
• NEC Article 702 Optional Standby loads will be permitted on the campus emergency power system only on a selective basis and Campus Engineering must approve each connection of this category. The system is not intended to provide firm or uninterruptible power for computers, lab equipment, etc. It can be used to provide power for life sustaining requirements such as pumped water to fish tanks, protection of facilities and personnel from environmental hazards, and to protect the facilities and equipment from damage, e.g. sanitary lift stations and sump pumps. These loads will be subject to load shed if the generation plant develops problems.

• During the initial phases of design, consultants shall confer with Campus Engineering to determine the source of emergency power. The primary purpose of the campus ESPS is to supply power centrally and thus economically to as many facilities as possible. New connections to the ESPS are limited to loads 200kVA/facility or less. The 200 KVA will be the combined total for “legally required” emergency loads (i.e. egress lighting, fire alarm, etc) and some optional standby loads. Facilities with large emergency power requirements shall require a dedicated on-site generator to prevent overloading of the campus ESPS. Consult with Campus Engineering for requirements and location of on-site generators.

• The 4.16 kV Emergency Power System for the UW Medical Center supplies power for emergency, legally required standby, and optional standby system loads. This system has sufficient capacity to provide power for all the loads currently connected to the system. An Allen Bradley PLC-based Central Monitoring and Control System (CMCS) monitors and controls the system and meets NEC 700-5(b) load management priority requirements. In the event a generator goes off-line or some other critical component fails, the CMCS protects the system by shedding load on a prioritized basis. A hardware and software addition to the existing CMCS system is required when new and existing facilities are added to this system. Typically, the UW Project Manager will issue a purchase order to Allen Bradley IAS for hardware and software procurement and integration. The design engineer is responsible for providing detailed-engineered installation drawings as a part of the overall public works bid documents. These should include detailed terminal strip interconnection diagrams. Sample documents are available from previous projects. Contact Campus Engineering for more information.

Design Criteria – UW Seattle Campus

• Most new facilities shall be served from the campus ESPS system or provided with on-site generators for large block load applications.

• Some existing facilities and systems have battery operated fixtures and UPS systems for emergency power. These systems are costly to operate and maintain, therefore they shall be phased out and replaced in major renovation projects. They shall not be installed in new facilities.

• Emergency services for many existing facilities are nothing more than a connection ahead of the main breaker. While these systems are no longer allowed by code, they remain grandfathered by the codes they were installed under and only to the extent allowed by Authority Having Jurisdiction (AHJ). When feasible, renovation and remodel projects for these facilities shall include an upgrade to or addition of a code-compliant emergency power service.

• Many older facilities have no emergency power service. When feasible, renovation and remodel projects for these facilities shall include the addition of an emergency power service.
- Contact Campus Engineering for questions concerning which buildings are on the campus ESPS, new connections to the campus Emergency and Standby Power System (ESPS) and integration into the associated Central Monitoring and Control System (CMCS).

- The University has adopted a policy to connect all elevators to controlled emergency power.
  1) To prevent the campus ESPS system from being overloaded, elevator systems shall be provided with supervisory controls. Elevators not requiring emergency power by code shall require an override to operate on emergency power.
  2) Refer to the Elevator section.

**Design Criteria – UW Tacoma Campus**

- The emergency power service concept for UW Tacoma is based on regionally placed generators serving groups of neighboring facilities.

- Dedicated generators are occasionally allowed in lieu of shared emergency power from the regional generator, after careful consideration and with the approval of Campus Engineering. Battery fixtures and UPS systems are not allowed as these systems are costly to operate and maintain.

**Design Criteria – UW Other Branch Campuses and Remote Facilities**

- Each site has their specific emergency power services. Investigate the existing services and work with Campus Engineering in determining the preferred system.

**Design Criteria – All Locations**

- At a minimum, provide a dedicated emergency panel and associated distribution system. In older University buildings, these panels have been designated as the building’s “X-Panel”. For facilities where battery backup lighting fixtures are the obvious choice, the emergency distribution system (X-Panel concept) shall still be required such that the panel and therefore its distribution can be re-fed from the central ESPS in the future.

**Design Evaluation**

The following information is required to evaluate the design:

- **Programming:** Statement of design intent, including, general description of emergency power provisions, source of emergency power, and distribution. CMCS requirements, if any.

- **Schematic Design Phase:** Overall design concept and scope for the building emergency power system. NEC branches of emergency power being provided. Emergency load estimate and preliminary emergency riser diagrams. Preliminary generator, ATS, and equipment locations. Cost analysis of using on-site generation. Identify CMCS equipment and I/O points, if required. Outline specifications.

- **Design Development Phase:** Complete emergency power riser diagrams. Emergency power one-line diagram and schematic diagrams showing the emergency power infrastructure. Completed equipment layouts. Updated emergency load calculations, including generator-sizing calculations. Finalized CMCS I/O points list and associated raceway routings.
• **Construction Document Phase**: Completed information for the installation of the emergency power system. Completed riser and one-line diagrams. Completed schematic diagrams showing generator control, starting procedures, and sequence of operation. Completed design calculations and load summaries. Equipment installation details. Finalized CMCS interconnection diagrams, raceway routings and equipment installation details.

**Submittals**

- Provide standard industry submittal requirements.
- For generator and other equipment, provide shop drawings including the following:
  1) Catalog information
  2) Equipment layout and elevations
  3) Equipment wiring diagrams and connection drawings
  4) Operation and maintenance manuals
  5) Shop drawings

**Products, Material and Equipment**

- Generators 250kW and larger shall be Caterpillar.
- Generators smaller than 250kW shall be Caterpillar, Onan or Kohler.
- Transformers for the 2.4kV emergency system shall be dual rated 2.4/4.16kV. Transformers shall have delta (primary) to wye (secondary) configuration. The primary side shall have the delta configuration whether it is connected 2.4kV or 4.16kV.
- Refer to requirements under Related Sections.

**Installation, Fabrication and Construction**

- Coordinate generator location with landscape aesthetics, fuel storage and noise mitigation.

END OF DESIGN GUIDE SECTION