

16200 Electrical Power

Part 1: General

- 1.01 The following guidelines provide information on various electrical power topics.

Part 2: Design Guidelines

- 2.01 **METERING** -All electrical installations are typically metered for KWH/KWD for utility billing purposes. First priority should be to meter from the switchgear. Transformer metering is considered under certain conditions. The contractor shall furnish and install all metering equipment, including meter, meter base, current transformers, potential transformers, wiring, and terminations.
- 2.03 Metering should be accomplished on the secondary side of the building transformers. The meter should indicate a 15-minute integrated demand and reset. Graphic or chart type meters are not acceptable. For freestanding switchgear, a test block should be included to enable the use of plug-in recording current and voltage equipment.
- 2.04 Current transformers should be of dual rating to accommodate increased rating for future additional loads. Two duplex grounded convenience receptacles, supplied from the emergency power system, should be placed adjacent to the meter location. In freestanding switchgear, the meter should be factory wired and flush-mounted with high interrupting fuse protection. Potential tap points should be protected with HIC fuses.
- 2.05 Metering should be suitable for connection to the campus automation system. The standard meter suitable for campus use is the Square D "Power Logic" system or ABB "P3" Alpha Solid State, Polyphase meter. Panel installation is preferred; socket installation is acceptable, upon approval.
- 2.06 **Electrical Equipment Access and Vaults** -Each building or building complex should have a suitable transformer installation, consisting of either an indoor vault or exterior pad-mounted transformer. Indoor vaults should include a drain and sloped floor for oil and water removal. A thermostatically controlled fan should be included to accomplish positive cross-ventilation. Access to indoor vaults should be from the building exterior via a 42" minimum width opening. Lock and keying should conform to the campus master system. Lockset cylinders with temporary Best construction cores should be furnished for indoor vaults. Padlocks, cylinders, and cores will be furnished and installed by the owner.
- 2.07 Designers and contractors shall comply with the university requirements for access to confined space. Designers shall reference and include these requirements in design documents. Equipment spaces shall be designed with suitable clearances to accommodate expected maintenance and operating requirements.

Part 3: Design Guidelines - Emergency Generators

- 3.01 Manufacturer Requirements - The generator system shall be by Onan, Kohler, Katolight, Caterpillar, Cummins, or approved equal, supplied by the factory-authorized distributor of the engine. The supplier shall have a parts and service facility located within 100 miles of the job site, with factory-trained technicians in full time employ and a stock of spare parts.
- 3.02 Documentation - The contractor shall submit all data necessary to evaluate equipment suitability. Data submittal shall include, at a minimum, the manufacturer, model and catalog numbers, dimensions, construction materials, operating and performance characteristics, controls, finish, any other pertinent information, and typical shop drawings.
- 3.03 The contractor shall provide the owner with 3 copies of technical literature on all system components. The technical literature shall consist of a manual of sequential operations, recommended preventive maintenance, parts lists with recommended spares, and all pertinent controls manuals and wiring diagrams. In addition, the contractor shall instruct the owner's designated employees in the proper system operation and in all required periodic maintenance. This instruction shall include 3 copies (minimum) of a written, bound summary of items covered for future reference.
- 3.04 Engine Specifications - The prime mover (engine) shall be diesel. For units up to 75 KW, natural gas may be considered as an alternate. All diesel units shall be equipped with a day-tank sized for a minimum 24 hour operation.
- The engine shall be liquid-cooled (radiator cooling system) with thermostatic temperature control and high coolant temperature shutdown.
- The engine shall be the product of an established United States of America engine manufacturer. It shall be a model that has been manufactured and successfully operated in similar service for a period sufficient to thoroughly establish its reliability.
- The exhaust silencer shall be rated critical grade.
- Exhaust shall be located away from the air intake area of the building.
- The alternator shall be 4-pole, brushless, with drip-proof construction, revolving field type with fully rectified exciter, protected and sized for maximum motor starting loads. Insulation shall be Class F per NEMA MG1-1.65. The rotor is dynamically balanced and permanently aligned to the engine by flexible disk coupling. Voltage regulation shall be solid state temperature compensated with phase controlled sensing. Provide heavy-duty permanently lubricated ball bearings.
- 3.05 Control Systems - Engine-generator controls shall be contained in a shock-mounted cabinet. Digital controls and metering shall be used where practical. The following controls and metering shall be provided at a minimum:
- AC Voltmeter (2% accuracy, 3.5")
 - AC Ammeter (2% accuracy, 3.5")
 - Phase Selector Switch/Current Transformer for each Phase
 - Frequency Meter
 - Running Time Meter
 - Oil Pressure Gauge

- Water Temperature Gauge
 - Battery Charging Ammeter
 - Voltage Adjusting Rheostat
 - Auto-Start-Stop Control
 - Safety Shutdown and Alarm Light for:
 - High Water Temperature
 - Low Oil Pressure
 - Engine Overspeed
 - Engine Overcrank
 - Auto-Off-Reset Switch
 - Panel Lighting
 - Molded Case Main Circuit Breaker
- 3.06 Provide automatic transfer switch, solid state controlled, rated for all classes of loads, both inductive and non-inductive, and mechanically held on normal and emergency.
- The transfer switch solid state control system shall include the following minimum features:
- Time delay on engine starting: adjustable from 0 to 6 seconds.
 - Time delay on transfer from normal to emergency: adjustable from 0 to 120 seconds.
 - Time delay on re-transfer from emergency to normal: adjustable from 1 to 30 minutes.
 - Time delay on stop: adjustable from 0 to 8 minutes.
- Under frequency/under voltage relay for emergency source to prevent transfer prior to generator output reaching pre-set levels.
- Test switch to simulate power outage.
- Main shaft auxiliary contacts, minimum 1-NO and 1-NC.
- Solid state battery charger with a 3-ampere minimum charge rate and automatic adjustable float setting.
- 3.07 Fuel Tanks - Diesel fuel tanks shall be installed above ground with secondary containment.
- The contractor shall fill fuel tanks immediately following installation and re-fill tanks immediately prior to acceptance of the building.

Part 4: Design Guidelines - Transformers

- 4.01 General Requirements - Transformers for indoor vaults should be conventional type, single phase, with two primary bushings and valve lightning arrestors with the primary winding having a voltage rating of 7200/12470 volts, Y connected or 13800/23900 volts, Y-connected. Dual primary voltage transformers should be considered.
- 4.02 Pad-mounted transformers should be three-phase.

- 4.03 Generally, transformers (single and three phase) should have 4 spade-type terminals with appropriate matching connectors on the secondary side. All four secondary terminals should be used to connect secondary leads to the main switchgear.
- 4.04 Transformers should have four 2.5% taps below rated voltage. Transformers should be oil filled.
- 4.05 Pad-mounted transformers should have distribution-type lightning arrestors and should include suitable barriers to separate high- and low-voltage compartments. Current-limiting fuses should be used throughout. All transformers should be fused as nearly as possible to 150% of transformer rating.
- 4.06 All transformers should be equipped with a dial-type thermometer, liquid level gauge, pressure-vacuum gauge, filling and top filter press connection drain, bottom filter press (to completely drain), and oil sampling valve. All items should be accessible without the necessity of removing any covers.
- 4.07 Ratings - The nominal maximum KVA rating of any single transformer installation should be as follows:
- 1500 KVA at 277/480 volts, or at 480 volts delta
 - 1000 KVA or below at 120/208 volts, or at 240 volts delta
- Pad-mounted transformers, 500 KVA or less, should contain three 15 KV (or 25 KV) single-phase load-break switches, rated at 200 amps. Current-limiting fuses should maintain protection, and the switches should be three individual units, separated by insulated plates.
- 4.08 Pad-mounted transformers, 750 KVA or larger, should have a built-in gang-operated primary disconnect switch, either oil or air type. Protection should be by dry HIC current-limiting fuses. Maximum size of transformers should be 1500 KVA at 277/480 volts and 1000 KVA at 120/208 volts.
- 4.09 Pad-mounted transformers shall be dead front, loop feed design.
- 4.10 Applicable Standards - Transformers shall conform to the latest applicable standards of the National Electrical Manufacturers Association (NEMA) and the American National Standards Institute (ANSI). Acceptable manufacturers are Westinghouse, General Electric, Cooper, Square D, or others as approved that would provide equivalent equipment.
- 4.11 Oil -filled transformers are restricted to less hazardous oil types (Silicon-based, R-Temp)

Part 5: Design Guidelines - Service and Distribution

- 5.01 Metering Requirements - Main Distribution switchboards shall be equipped with digital metering to measure the following:
- Voltage: Phase to Neutral and Phase to Phase
 - Current: True RMS amperage for each phase and neutral
 - Demand: Kilowatts
 - Power Factor: Ratio KW/kva
 - Reactive Power: KVars

- 5.02 Riser Diagram - The electrical riser diagram for the power distribution systems for each building shall be mounted suitably near the main switchgear in the mechanical/electrical room under clear protective material.

Part 6: Design Guidelines - Lightning Protection

- 6.01 All buildings over 75 feet in height shall have a lightning protection system. For all buildings less than 75 feet in height, the designer shall provide a recommendation regarding the inclusion of a lightning protection system for consideration.
- 6.02 Building lightning protection systems shall be designed to comply with the requirements of the latest edition of the *National Electrical Code (NEC)*, Article 270. Grounding conductors and systems shall be designed to comply with the requirements of *NEC*, Article 250.