

NC State University Design and Construction Guidelines

Division 26 Electrical Power/Generators

1.0 Purpose

- A. The following guidelines outline the requirements for metering, generators, transfer switches and lightning protection.

2.0 General Requirements

A. Metering

1. All electrical installations are metered for KWH/KWD for utility billing purposes, on the secondary side of the building transformers. NC State shall provide all metering equipment, including meter, meter base, current transformers, potential transformers, wiring, and terminations.
2. The meter shall indicate a 15-minute integrated demand and reset. Graphic or chart type meters are not acceptable. For freestanding switchgear, include a test block to enable the use of plug-in recording current and voltage equipment.
3. Current transformers shall be of dual rating. Two (2) duplex grounded convenience receptacles, supplied from the emergency power system, shall be placed adjacent to the meter location. In freestanding switchgear, the meter shall be factory wired and flush-mounted with minimum 65KA fuse protection. Potential tap points shall be protected with High Interrupting Capacity (HIC) fuses.
4. Metering shall be suitable for connection to the campus automation system. Meter shall accommodate remote read capabilities over the campus network. Panel installation is preferred.
5. Main Distribution switchboards shall be equipped with digital metering to measure the following:
 - a) Voltage: Phase to Neutral and Phase to Phase
 - b) Current: True RMS amperage for each phase and neutral
 - c) Demand: Kilowatts
 - d) Power Factor: Ratio KW/KVA
 - e) Reactive Power: KVAR

- B. Each building or building complex shall have an exterior pad-mounted transformer.

C. Emergency Generators

1. The generator system shall be supplied by the factory-authorized distributor of the engine. The supplier shall have a parts and service facility located within 100

NC State University Design and Construction Guidelines

Division 26 Electrical Power/Generators

miles of the job site, with factory-trained technicians in full time employ and a stock of spare parts. Approved manufacturers are:

- a) Onan
- b) Kohler
- c) Caterpillar
- d) Cummins
- e) Katolight

2. Documentation

- a) The contractor shall submit, at a minimum, the manufacturer, model and catalog numbers, dimensions, construction materials, operating and performance characteristics, controls, finish, and EPA required information.
- b) The contractor shall provide NC State with three (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 NC State's designated employees in the proper system operation and in all required periodic maintenance.

3. Engine Specifications

- a) The prime mover (engine) shall be diesel.
- b) The engine shall be liquid-cooled (radiator cooling system) with thermostatic temperature control and high coolant temperature shutdown.
- c) The engine shall be a model that has been manufactured and successfully operated in similar service for a minimum of five (5) years to establish its reliability.
- d) Noise generated by the generator shall not exceed 60 dBA at 50 feet.
- e) Exhaust shall be located away from building at a distance to prevent air entrainment of the building air intake.
- f) 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.

NC State University Design and Construction Guidelines

Division 26 Electrical Power/Generators

4. Control Systems— Engine generator controls shall be contained in a shock-mounted cabinet. Digital controls and metering shall be used. The following controls and metering shall be provided at a minimum:
 - a) AC Ammeter 92% accuracy, 3.5”
 - b) AC Voltmeter 92% accuracy, 3.5”
 - c) Phase Selector Switch/Current Transformer for each Phase
 - d) Frequency Meter
 - e) Running Time Meter
 - f) Oil Pressure Gauge
 - g) Water Temperature Gauge
 - h) Battery Charging Ammeter
 - i) Voltage Adjusting Rheostat
 - j) Auto-Start-Stop Control
 - k) Safety Shutdown and Alarm Light for:
 - (1) High Water Temperature
 - (2) Low Oil Pressure
 - (3) Engine Overspeed
 - (4) Engine Overcrank
 - (5) Auto-Off-Reset Switch
 - (6) Panel Lighting
 - (7) Molded Case Main Circuit Breaker
5. Fuel Tanks
 - a) Diesel fuel tanks shall be integral base mounted with secondary containment. All tanks shall be sized for a minimum 72 hour engine operation at 80% full rated generator output.
 - b) The contractor shall fill fuel tanks immediately following installation and refill tanks immediately prior to acceptance of the project.
6. Automatic Transfer Switches
 - a) Three phase automatic transfer switch (ATS) shall be rated for continuous duty and shall be either three-pole type with overlapping neutral transfer contacts, or four-pole with full-size neutral contacts.
 - b) ATS shall be Underwriter Laboratories (UL) listed.
 - c) The ATS shall be a closed transition assembly (make before break).
 - d) Provide automatic transfer switch, solid state controlled, rated for all classes of loads, both inductive and non-inductive, and mechanically held

NC State University Design and Construction Guidelines

Division 26 Electrical Power/Generators

on normal and emergency. The transfer switch solid state control system shall include the following minimum features:

- (1) Time delay on engine starting: adjustable from 0 to 6 seconds.
- (2) Time delay on transfer from normal to emergency: adjustable from 0 to 120 seconds.
- (3) Time delay on re-transfer from emergency to normal: adjustable from 1 to 30 minutes.
- (4) Time delay on stop: adjustable from 0 to 8 minutes.
- (5) Under frequency/under voltage relay for emergency source to prevent transfer prior to generator output reaching pre-set levels.
- (6) Test switch to simulate power outage.
- (7) Main shaft auxiliary contacts, minimum one (1) NO and one (1) NC.
- (8) Solid state battery charger with a three (3) ampere minimum charge rate and automatic adjustable float setting.

D. Transformers

1. Three-phase transformers shall be pad-mounted.
2. Transformers (single and three-phase) shall have four (4) spade-type terminals with matching connectors on the secondary side. All four secondary terminals shall connect secondary leads to the main switchgear.
3. Transformers shall have two (2) 2.5% taps above and two (2) 2.5% taps below rated voltage. Transformers to be oil filled with "less hazardous" oil types (i.e. silicon-based and R-Temp).
4. Pad-mounted transformers shall have distribution-type lightning arrestors and include barriers to separate high and low-voltage compartments. Current-limiting fuses to be used throughout. All transformers shall be fused to 150% of transformer rating.
5. All transformers shall 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 shall be accessible without removing any covers.
6. The nominal maximum KVA rating of any single transformer installation shall be as follows:
 - a) 1500 KVA at 277/480 Volts, or at 480 Volts delta
 - b) 1000 KVA or below at 120/208 Volts, or at 240 Volts delta
7. Pad-mounted transformers, 500 KVA or less, shall contain three (3) 15 KV or 25 KV single-phase load-break switches, rated at 200 amps. Current-limiting fuses

NC State University Design and Construction Guidelines

Division 26 Electrical Power/Generators

- shall maintain protection and the switches shall be three individual units, separated by insulated plates.
8. Pad-mounted transformers, 750 KVA or larger, shall have a built-in gang-operated primary disconnect switch, either oil or air type. Protection to be by dry HIC current-limiting fuses.
 9. Pad-mounted transformers shall be dead front, loop feed design.
 10. Transformers shall conform to the latest applicable standards of the National Electrical Manufacturers Association (NEMA) and the American National Standards Institute (ANSI).
- E. The electrical riser diagram for the power distribution systems for each building shall be mounted at the main switchgear in the mechanical/electrical room under clear protective material.
- F. 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.