16300 Transmission and Distribution

Part 1: General

1.01 NC STATE University operates and maintains underground medium voltage electrical distribution systems on all of the three main campuses. Refer to the following guidelines for assistance in designing connections and extensions to the distribution systems.

1.02 All new facilities, facility additions, and facility modifications requiring new or modified primary electric system service are served by the underground duct bank and manhole system. All electric facilities associated with a project, such as duct banks, manholes, medium voltage cable, transformers, sectionalizing switches, lightning arrestors, terminations, and associated materials, must be included in the project budget and design.

Part 2: Design Guidelines

2.01 All electrical design should conform to the requirements of the latest edition of the following:

National Electrical Code

North Carolina Construction Manual, sections 112.4 and 112.7

North Carolina Department of Insurance (all published standards and requirements)

NC State General Electrical Specifications

National Electrical Safety Code

State Construction Electrical Guidelines (http://interscope2.doa.state.nc.us/sco/main.htm)

2.02 Documentation - Plans and specifications should include sufficient detail to explain electrical designs to the extent required to avoid problems, conflicts, and questions during construction. The documents should also be prepared for use by operating and design personnel for reference to as-built conditions following completion of construction.

2.03 Safety, reliability, and energy conservation should be the designer's prime considerations in the design and specification of all electrical equipment and wiring on the campus.

2.04 The designer must make every effort to consolidate mechanical and electrical equipment on the building site. Consideration must be given to organizing the equipment so that it is easily accessible to service areas and service vehicle parking. The equipment should be treated architecturally such that it does not detract from the appearance of the building or the landscape. Schematic and design development drawings must clearly show how this will be accomplished.

2.05 The designer must make every effort to protect the university landscape and avoid disturbance of any area within the drip line of trees when routing underground lines. Detailed landscape specifications and guidelines are included within this document for reference.

2.06 Electrical designs should include detailed information such as panel schedules, circuit designations, conduit routing, wire types and sizes, conduit types and sizes, enclosure and equipment classifications, switch and receptacle grades, and circuit breaker types. Equipment should be specified to avoid substitution with unsuitable or substandard items.

2.07 Drawings should include single-line diagrams, riser diagrams, plan and elevation views, wiring diagrams, and details as appropriate to convey the design information. Plan drawings should be supplemented with elevations and details as required to avoid confusion and conflicts during construction.

2.08 MAIN CAMPUS MEDIUM VOLTAGE DISTRIBUTION - The University Main Campus (North, Central, and part of South campus) is supplied electrical power from Carolina Power and Light Company at one point of delivery from the Sullivan Site Substation. The university operates and maintains the 12,470/7,200-volt, grounded-Y medium voltage distribution system. It is installed primarily in an underground conduit and manhole system.

2.09 COLLEGE OF VETERINARY MEDICINE MEDIUM VOLTAGE DISTRIBUTION - The CVM Campus is supplied electrical power from Carolina Power and Light Company at one point of delivery from the CVM Substation. The university operates and maintains the 12,470/7,200-volt, grounded-Y medium voltage distribution system. It is installed primarily in an underground conduit and manhole system.

The CVM campus is beginning a phased transition from a 12,470/ 7,200 volt system to a 23,900/13,800 volt system. All new facilities should be planned for 23kv. Any work involving the existing 12kv system should be closely coordinated with the University. If feasible, any additions or modifications to the existing system should be constructed to 23kv standards and with the use of dual primary voltage transformers until the transition is complete.

2.10 CENTENNIAL CAMPUS MEDIUM VOLTAGE DISTRIBUTION - The Centennial Campus is supplied electrical power from Carolina Power and Light Company at one point of delivery from the Centennial Substation. The university operates and maintains the 23,900/13,800-volt, grounded-Y medium voltage distribution system. It is installed primarily in an underground conduit and manhole system.

2.11 All new facilities, facility additions, and facility modifications requiring new or modified primary electric system service are served by the underground duct bank and manhole system. All electric facilities associated with a project, such as duct banks, manholes, cable, transformers, sectionalizing switches and associated materials, are to be included in the project budget. Adequate provisions must also be made for the installation of metering and current transformers. The capacity of service conductors from the transformer should provide for the full connected load plus 25% additional load capacity for future growth.

2.12 University personnel will perform the operation of all primary voltage switches on the campus electrical distribution systems. Any requests for switching should be made to the University Construction Manager a minimum of 10 working days in advance.

2.13 The contractor should be prepared to provide all grounding locks, signs, and other safety equipment that may be required. The contractor must solidly ground all high-voltage circuit conductors before starting work and the grounding must remain on circuit conductors while work is being performed. The contractor should remove all locks, grounds, signs, and other safety equipment after work is completed on primary voltage equipment. The contractor should operate all new equipment after owner has inspected system.

2.14 The university delivers primary power to various campus loads through totally enclosed metal-clad switchgear. Feeder loops are protected by removable air insulated circuit breaker units. Over-current and fault protection for each feeder consists of induction disk relays, one in each phase and one for ground fault protection. Sectionalizing load-break switches connect individually fused high-voltage building laterals into the looped circuits. Air-insulated sectionalizing switches are preferred. Gas insulated (SF6) switches may be

considered under certain conditions. University representatives should be consulted for location and information regarding connections.

2.15 Individually fused load-break switch devices should protect all transformers. Three-phase switch operation is preferred with current-limiting fuses. Pad-mounted transformers should have distribution-type lightning arrestors and should include suitable barriers to separate high- and low-voltage compartments. All transformers should be fused as closely as possible to 150% of transformer rating.

2.16 Primary transformers are normally three-phase, loop-feed, dead-front, pad-mounted designs. Transformers should be located at an acceptable site outside of the building at a sufficient distance from any building opening. Transformers must be accessible to maintenance personnel and truck-mounted cranes. At least 10 feet of clearance is necessary in front of the transformer for hot-stick operation of the terminations and cables. Metering is typically mounted on the outside of the transformer secondary compartment. Transformer pads, compartment sizes, and conduit arrangements shall be designed to accommodate the transformers adequately. All transformer installations shall comply with the National Electrical Code, Article 450, latest edition.

Part 3: Design Guidelines - Secondary Voltage Distribution Systems

3.01 The secondary voltage ratings of transformers should be 120/208 volts three-phase, 120/240 volts single-phase, or 277/480 volts three-phase, or 277 volts single-phase (for banking at 277/480 volts), depending upon the type of load served. Some high load situations may necessitate a 4,160 volt, 3 phase secondary.

3.02 Larger mechanical loads and lighting loads will usually require a 277/480 volt system with sub-feeders to dry-type transformers serving 120/208 volt receptacle and small motor loads.

Consideration should be given to a two-voltage system for loads 500 kva and larger.

3.03 Freestanding switchgear will be required to accommodate building service-entrance power requirements in most cases. The disconnecting means for service-entrance conductors should consist of either an air circuit breaker or molded case circuit breaker. Minimum requirements for ground-fault circuit protection should be as specified in the latest edition of the *National Electrical Code.*

3.04 All bus-bar structures should be braced to withstand the mechanical forces associated with a bolted fault current available at the terminals of the switchgear. All circuit breakers should have an interrupting capability equal to or greater than the fault currents available at the terminals of the circuit breaker. Fault currents should be calculated by the designer based upon unlimited short circuit kva available from the primary system, and limited only by the self-impedance of the service-entrance conductors. Air breakers may be installed in accordance with the principles of cascading. However, cascade operation of molded case breakers is not acceptable.

3.05 Secondary power distribution load centers should be equipped with main circuit breakers. Power and lighting panels should be located in protected rooms designated for the purpose of facilities support equipment. Panels shall not be located in janitorial closets, storage rooms, or in open or unprotected areas. Mechanical and electrical equipment rooms shall be separate from telecommunications closets and spaces. A minimum conduit size of 3/4” is required for all installations other than for short runs of flex or EMT runs to switches, fixtures, etc.

3.06 Neutral conductors shall be oversized on Y-grounded systems subject to harmonic loads.