2.9 Electrical Systems

2.9.1 General Considerations

General Guidelines

Intent
This section provides the primary considerations for electrical design, including codes and standards as well as regulatory agency requirements.

Resources
Campus Physical Plant and Facilities Planning and Construction professionals are available for consultation regarding policies, procedures, and normally accepted practices for electrical design work at the university.

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)

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.

Design Criteria
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.

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.

The designer must take 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.

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.

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. Specifications should be included on the drawings where possible to avoid the need for a separate document.

2.9.2 Campus Power Distribution

General Guidelines

Intent
This section describes the method and source of electrical power distribution to the Main Campus.

Design Criteria
The university Main Campus is supplied electrical power from Carolina Power and Light Company at one point of delivery. The university operates and maintains its own distribution system. It is installed primary in an underground conduit and manhole system. A diagram showing primary distribution design is available from Facilities Planning and Construction.

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, switchgear, lighting arrestors, terminations, 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.

2.9.3 Primary Distribution Systems

General Guidelines

Intent
This section describes the primary electrical power distribution systems For the campus.

Design Criteria
All operations of primary voltage switches on the existing campus electrical distribution system will be performed by the owner. Any requests for switching should be made to the university construction manager 48 hours in advance. Primary switch gear preferred manufacturer is S&C.

The contractor should 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 is being performed. The contractor should remove all locks, grounds, signs, and other safety equipment after work is completed on primary equipment. All new equipment should be operated by the contractor after system has been inspected by owner.

All transformers should be protected by an individual load-break switch device. 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 nearly as possible to 150% of transformer rating.

Primary transformers are normally three-phase, loop-feed-, dead front Y type, pad-mount design. Preferred manufacturer is General Electric. 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.

2.9.4 Secondary Distribution Systems

General Guidelines

Intent

This section describes the secondary electrical power distribution systems for the campus.

Design Criteria

The secondaries of transformers should be rated at 120/208 volts three phase, or 120/208 volts singe-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.

Larger mechanical loads and lighting loads will usually require a 277/480 volt system with subfeeders to dry-tape 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.

Free-standing 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.

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.

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. Mechanical and electrical equipment rooms shall also be separate from telecommunications closets and spaces. 3/4" conduit is required for all installations other than for short runs of flex or EMT runs to switches, fixtures, etc.

2.9.5 Emergency Generators and Lighting

General Guidelines

Intent
This section describes the emergency generator and lighting systems for the campus.

Resources
Designs for emergency generator and lighting systems shall comply with the latest edition of the following North Carolina Department of Insurance specifications:

Requirements for Battery Powered Emergency Lighting Units
Requirements for Battery Powered Emergency Exit Lights
Requirements for Standby Emergency Generators

Design Criteria
Emergency generator and lighting systems shall be provided to supply power requirements for critical life safety support equipment and emergency egress facilities. A portion (usually 10%) of the light fixtures in common areas (hallways, restrooms, lobbies, stairwells, entrances, exits, etc.) shall be served by the emergency power system through unswitched circuits.

All exit lights are to be LED type. Only one fixture per bathroom need be on the generator.

Research activities deemed "critical" may also be supported by emergency generators. Identification of these critical needs shall be made at the programming stage of the project.

All generators shall be powered by the campus natural gas system.

2.9.6 Interior Lighting

General Guidelines

Intent
This section will provide information on designing energy efficient lighting systems.

Resources
EPA GreenLights recommendations

Documentation
The designer is required to provide the owner with as built and maintenance information showing fixture manufacturers and model numbers and luminaire manufacturer and model numbers for maintenance purposes.

Design Criteria
Follow EPA GreenLights recommendations and IES recommended lighting levels.

Use highly efficient lighting systems that improve lighting and meet the needs of the residents.

For typical four-or eight-foot fluorescent fixtures, use electronic ballast and T-8 tubes.

Ballast General Specs
THD<10%
CCF<1.7
Power Factor>0.98
Operating Frequency>20kHz

Use Instant Start ballast in all common areas (hallways, stairwells, etc.) and where operation time is expected to be greater than or equal to 3 hours per start. Use Rapid Start ballast for other areas.

T-8 Lamps General Specs
32w
Rapid Start
3500K Color Temperature
minimum 75 CRI

Use parabolic louvers in areas where applicable to reduce glare.

Down lights should be compact fluorescent.

Install photocell controls on inside perimeter lighting.

Install motion controls for lighting in restrooms, classrooms, offices, auditoriums, and possibly hallways. Emergency egress must be maintained. System should be adjustable for minimum on time and range at least to 15 minutes.

Restrooms
Use ultrasonic or combination systems in restrooms or other areas where applicable. Do not have manual light switches in restrooms --system should be controlled entirely by automatic controls. Keep one fixture in restroom on emergency circuit.

Other Areas
Any manual switches must be in series with controls.

Daylight dimming controls should be considered and implemented where economically feasible.

Use dimming circuits for classrooms. Use fluorescent where possible. only use incandescent as last resort--then use halogen and 130V bulbs.

Maintain standard set of fixtures/tubes/components for facility. minimize variations.

All Exit Lights should be LED. Connect to emergency circuit.

All hardware to have one-year warranty period following project acceptance.

2.9.7 Fire Detection Systems

General Guidelines

Intent
The primary purpose of the fire detection system is to alert the Building occupants in the event of a fire. The design of the fire Detection system should be considered on a case-by-case basis Because the varied types of facilities and their use at the university.

Resources
Resources available to the designer include:

National Electric Code
NFPA-72
Requirements for Fire Detection and Alarm Systems published By the NC Department of Insurance

Documentation
Documentation shall include all details, drawings, and specifications Necessary for a complete and functional fire detection system installation.

Design Criteria
The fire detection system will feature all equipment necessary to meet All national, state, local, and university codes and requirements. The designer Will be responsible for the design of a fire detection system that is fully Serviceable by the university and can be U.L. certified as installed. The System design fully comply with the suggested DOI fire alarm standards (latest edition). All systems will be designed to be monitored by the University's off campus central monitoring station, HolmesElectric Inc., of Fayetteville, NC. All new systems require two phone lines coming into the dialer, and shall be included in the design work. Annunciation of all building alarms shall occur in one central location, such as central room, loading dock, or central entrance. Designers are required to take into account the schedule of building operations in preparation of design specifications. Contractors must work around the existing building operations schedule, unless otherwise agreed. All wiring shall be concealed, or if unable to be concealed, in painted wiremold. Standard shelf stock for devices shall be 10 percent of the total count.

2.9.8 Metering

General Guidelines

Intent
This section describes the requirements for metering system for the campus.

Design Criteria
All electrical installations are typically metered at the transformer for KWH/KWD for utilities billing purposes. First priority should be to meter from the switchgear. The contractor shall furnish and install all pad-mounted transformer metering equipment, including meter, meter base, current transformers, potential transformers, wiring, and terminations.

Metering should be accomplished on the secondary side of the building transformers. The meter should indicate a 15-minute integrated demand and re-set. Graphic or chart type meters are not acceptable. For free-standing switchgear, a test block should be included to enable the use of plug-in recording current and voltage equipment.

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 free standing switchgear, the meter should be factory wired and flush mounted with high interrupting fuse protection. potential tap points should be protected with HIC fuses.

Metering should be suitable for connection to the campus automation system.

2.9.9 Electrical Equipment Access and Vaults

General Guidelines

Intent
This section describes the requirements for electrical equipment access and vaults for the campus.

Design Criteria
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. locksets less cylinders should be furnished for indoor vaults. padlocks, cylinders, and cores will be furnished and installed by the owner.

All campus electrical distribution and telecommunication lines are in underground duct systems, with exception of scattered outlying areas. All new cable runs should be placed in 5" concrete-encased conduits as a minimum requirement. Duct runs should be drained to manholes, and manholes should be drained to the storm drainage system.

Where possible, duct runs should be placed in or alongside streets. size and location of manholes shall be coordinated through UNC-Pembroke Facilities Planning and Design. Handholes shall not be permitted,

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.

2.9.10 Campus Emergency Phones (Code Blue Lights)

General Guidelines

This section will provide guidance on the how emergency blue light phones are located and specified.

Each new exterior project shall consider the installation of additional blue light phones. Designers shall work with UNCP Police to site phones.

Locations should be easily accessible to pedestrians, and easily maintainable, and reviewed by Campus Police prior to finalizing design.

Design Criteria

Units shall be manufacturered by Code Blue,Inc., Base Model CB5, Phone Model CB3000. Designers shall specify the installation of phone and power conduit to the unit, along with locating the source for power and phone service. Both services shall be provided in the provided by the contractor , not handled as by the owner at a later date.