2.07 ELECTRICAL

GENERAL

It is expected that the electrical design professional will conform to accepted good engineering design practices. For this reason, most of the items covered in the electrical guidelines pertain to those items, which may be unique to the University of South Alabama, its electrical systems or preference or requirements mandated by the University. Any item not specifically outlined or commented upon in these guidelines is left to the judgment of the engineering design professional to use current accepted good engineering practice. The construction documents are subject to review and comment by the University Facilities Department at any time during the course of design or construction of the project.

SPECIFIC EXISTING UNIVERSITY CONDITIONS

APCO TRANSFORMER SPECIFICATIONS

The University of South Alabama receives electricity from APCO dedicated substation. The specifications on their transformer are:

- 25 MVA
- 115 KV Primary
- 12,470 Secondary
- 8.38% Z
- With built in voltage regulation

This unit was installed 2/6/99. It has built in voltage regulation that was set 2/19/99 @ 3 pm. With an operating voltage range of 121.5 to 124.5 volts measured at APCO point of metering on metering PT's.

During our heavy load periods we have approximately 14.5 MVA load. This sub is also served by two 115 KV feeders with the high side switch located on the northeast corner of University Blvd. at Old Shell Rd. These circuits are on 125 steel poles. Our reliability from APCO is extremely high, even during the last several hurricanes.

CAMPUS FEEDERS

The Campus High Power Distribution System consists of a dedicated substation and 8 radial circuits. There is a total of approximately 252,000 feet of cable underground. The Main Campus has a total of 74 unit sub transformers, more than 38 pad mounted switches, and 23 building generators on campus.

We have 8 radial circuits at 12,470 volts. Of these 8 circuits, 3 are 400 amp feeders, 4 are 250 amp feeders, and 1 is rated at 200 amps.

Two of the feeder circuits, #1005 and #1001, are dedicated for chillers at Central Plant. Circuit 1008 is dedicated to the new engineering and science building, while circuit #1007 is dedicated to the Allied Health School of Nursing building. All of the other circuits are for the remainder of campus buildings.

There is 215,541 feet of 4/0 15 Kv cable underground.

There is 36,705 feet of 500 Kcmil 15Kv cable underground.

UNIT SUB STATIONS

There are 74 unit sub transformers that serve dedicated loads of buildings, ball fields, street lights, parking lot lights, etc. They range in size of 15 Kva to 5,000 Kva. All of our buildings are served by 480/277 or 208/120 3 phase 4 wire wye systems. Seven of our chillers are 4160 volt. The other 2 are 480 volt.
PAD MOUNTED SWITCHES

There are more than 38 pad mounted switches on campus rated 15 Kv 600 amp. These switches provide fuse coordination of the various feeders and sectionalizing of loads across campus. Some have alternate feeder availability, and all have fault locators to help in identifying the direction of faults.

CAPACITOR BANK

We have a 12,470 volt 3600 Kvar capacitor bank that is fixed. It is connected at the APCO substation southeast corner of campus, and is connected on the APCO overhead buss. Out power factor during fall and winter is unity and during peak inductive loading is .9875 or better. There have been engineering design and drawings completed to add an additional 7900 Kvars in a 9 step capacitor bank, for the loads/buildings now under construction.

SYSTEM MAINTENANCE

We do maintenance on all 15Kv switches and transformers on campus. We do approximately 25% of campus each December before holiday break. It takes 4 years to complete this. The sub station switches and capacitor bank are done each year. The 5 Kv chiller starters at Central Plant are done yearly during winter months. We test all large breakers every 4 years with current injection and trip calibration and etc. This work is done under a maintenance contract with Holland Industrial Services of Bay Minette, AL.

GENERATORS

There are 23 building generators on campus ranging in size from 8 Kw to 1500 Kw. These generators supply limited, necessary load for various buildings across campus. There are three required by life safety code 101: Mitchell Center Arena, Library, and Performing Arts Center. These buildings also have fire pumps. All but two of these units are diesel. Two are natural gas. All of the generators have automatic transfer switches but two, they are manually transferred. Those that are manual are: Cafeteria, and Administration Building. The generators either have a belly tank or in-ground storage tanks with a minimum of 48 hours run time in fuel.

CAMPUS FIRE ALARM SYSTEM

The University of South Alabama has seventy two fire alarm systems on main campus. Fire alarm systems consist of the following manufactures: Simplex, Notifier, Edwards, F.C.I., Harrington and Fire Lite.

The University of South Alabama is required by N.F.P.A. code to have all fire alarm systems tested on an annual basis. A complete N.F.P.A. test and inspection form must be kept on file for a period of two years. Sensitivity tests are also required to be performed on a semiannual basis on all smoke detectors in each location.

ELECTRICAL DESIGN

Electrical equipment shall be selected based on the life cycle cost. Alternatives may be chosen with the approval of the University Project Manager and Superintendent of the University's Electrical Distribution System.

Each building on the main campus will be served from the University 12.47 KV distribution system. It will be served by a pad-mounted transformer(s) which is served by a 12.47 KV S&C, pad-mounted loop switch with enclosure.

Primary and secondary cables shall be installed in concrete encased, re-bar reinforced PVC duct bank with dyed red concrete. Limit the ductbank pour to that required for the encasement. It is unacceptable to dump excess left over concrete in the excavated area. All ductbank is to be doweled into wall of manholes.

The primary cables shall receive power from a re-connectable Elastimold splice in the closest manhole. The primary cable shall have a fault detector installed around the outer jacket of the cable. (Do not cut the jacket or tape shield to install this.) The secondary cable in concrete encased duct shall enter underground and terminate in either insulated case or metal clad switchgear. On the secondary only use PVC elbows to turn up into the transformer compartment.

On the primary only use Galvanized Rigid Elbows to turn up into the transformer compartment. Engineer shall review the secondary service entrance routing method with the University Central Utilities department. If the switchgear is below grade do not come in the top.
On buildings where ground fault is required on the main breaker there shall also be ground fault on all feeder breakers in that gear. The transformer shall be furnished with a Square D Powerlogic meter and ct's installed with shunt blocks.

The meter shall be capable of being read remotely. Landscaping shall be placed around the pad-mounted transformers and loop switches but shall not interfere or be placed within 10 feet in front of doors or within 4 feet in front of the meter. The design for each new building must include the design of the above requirements.

The pad-mounted transformer shall be installed at least 10 feet from the building. There shall be at least ten feet clear space in front of the doors of each transformer and loop switch. In large research buildings where feasible, provide two pad-mounted transformers with double-ended switchgear with a secondary tie-breaker to ensure continuity of service. Vault transformers and indoor substation transformers are unacceptable, but may be considered on an individual basis.

Pre approval is required for the use of specific qualified cable splicer's and terminations. See the University Project Manager for approval. The University also requires independent testing of high voltage cable after installation and before energization by the University's contractor, H.I.S. Inc.

Separate outdoor power circuits from those intended for indoors.

**DESIGN CONDITIONS**

The University of South Alabama Campus Distribution System is a 19.8 kV [19,800 Volts], 3 phase, 4 wire, solidly grounded wye connected system with source fault capacity of 350 MVA. Insulation level shall be not less than 125 kV BIL. Fault capacity shall be APCO's available fault at the sub.

**TELECOMMUNICATIONS AND DATA SYSTEMS**

The design for Telecommunications and Data Systems shall be coordinated with those respective departments. There are very specific requirements on space and equipment. This section is also a part of this design guide that links to the Netcom standards.

**BUILDING DISTRIBUTION**

Building distribution shall be planned on a project basis based on the specific needs and requirements of that building. Usually distribution will be 480/ 277, 3 phase, 4 wire switchgear with main breaker with bus risers with dry type transformer(s) installed at each floor. The riser requirement will change frequently based on job circumstances.

On most University buildings (all but very small buildings) panelboards at both ends of the building or in the building center are preferable.

Electrical rooms must be stacked to utilize vertical chase arrangements, etc. It is unacceptable to feed an entire floor from only one end of a large building. All corridors that are adjacent to these electrical rooms (sources of power) must have accessible lay in ceilings. It is unacceptable to place an electrical room behind a lobby area which contains a hard or inaccessible ceiling unless spare conduits with a number and size as determined in consultation with Emory’s Electrical Engineer are installed to bridge this space. The spare conduits allow for future circuits to be run across the hard ceiling. A typical requirement is for 10 each ¾ inch and 1 each 3 inch EMT conduits across each hard ceiling space.

All electrical rooms must have at least 25% usable spare wall space after all equipment is installed including miscellaneous control systems, Access Control Panel, Fire Alarm, etc. They must be at least 6 feet wide by 8 feet deep with only electrical equipment installed there. Careful attention must be given to NEC Code Clearances. No laundry sinks, storage provisions, etc. shall be permitted in these electrical rooms. Utilities that do not serve this room shall not be routed through it. At least one 120 volt duplex receptacle shall be installed in each electrical room. An emergency light of some type must be installed in every electrical room and in every mechanical room in the building. In addition a battery pack with two self contained heads must be installed in the main switch room. A copy of the building riser or single line shall be mounted on the wall in the main switch room in a frame behind a clear plastic covering.
On all new buildings, the Electrical Engineer shall do a thorough analysis of the nature of building layout and load requirements and determine if more than one electrical room is required per floor.

**OTHER BUILDING CONSIDERATIONS**

All corridors must contain receptacles on a dedicated circuit spaced no more than 25 feet apart for operating cleaning equipment, etc. All storage rooms, small storage closets, custodial closets, etc. shall contain at least one receptacle. Larger storage rooms shall have receptacles on minimum 12 foot centers. For all indoor lighting applications where possible use 4 foot long, T8, 3000 degree Kelvin lamps with electronic ballasts in all areas where possible. Minimize the use of incandescent lamps. The University Project Manager must approve the use of incandescent lamps.

No electrical feeder conduits or service entrance conduits shall be run in the concrete floor slab. Feeder circuits are defined by the NEC and include but are not limited to circuits which serve panelboards, switchgear, dry type transformers, etc. All feeders shall be run above ceilings through spaces after the slabs are poured. Individual branch circuit conduits shall be allowed to be poured in the slab as long as one of the following is adhered to. The conduit shall be ¾ inch EMT conduit or less. No PVC or electrical flexible non metallic tubing shall be used in either case.

Branch circuits 3/4 inch or less shall be permitted to be installed in the slab in a star pattern spreading out from the panels if the following painting guidelines at the time of installation is followed. The top of the bottom form which supports the poured slab must have a release agent on it. The conduit path shall be sprayed with orange paint onto the top of the form under each branch circuit conduit after installing conduit so that the paint outlines the conduit location and hence routing path against the form. In most cases concrete is actually poured the following day after this paint stripe has dried. When the slab is poured and the form is removed the conduit route will then be painted on the bottom surface of the slab by virtue of the wet concrete contact with the painted stripe. The paint will adhere to the surface of the concrete and mark the routing of the conduit. This process is successful even though the paint is dry when the concrete is poured.

In lieu of the above painting scheme, it is acceptable to run the branch circuit conduits down corridors and along walls when poured in the slab. It is also acceptable to run branch circuits in EMT conduit exposed in ceilings. Provide maintenance duplex receptacles to support maintenance functions around cooling towers, chiller coils and sufficient outlets in all mechanical areas. Outlets shall be of the type approved for the particular location and the environment. Use ground fault outlets in all locations required by the latest NEC. Provide as built drawings of the electrical systems in all elevator systems to the University Project Manager.

The A/E shall in every case provide for access to lighting. If manlifts are required, they shall be provided as collateral building equipment. Storage space for this equipment shall be provided in a logical place within this building.

**INDOOR LIGHTING**

Ceiling lighting higher than 30 feet is unacceptable. In stairwells lighting shall be installed so that it is mounted underneath the landing above or on the wall. In either case the fixture shall be mounted no more than 16 feet above the landing. For fixture mounted higher than this above stairs a winch system must be provided to raise and lower fixtures. All lighting must be controlled automatically as required per the latest Energy Codes and ASHRAE Standards. This shall normally be accomplished by using motion sensors in every space. If there is a special purpose space, which the consultant thinks that a lighting relay system must be used, the University Electrical Engineer must approve this.

**OUTDOOR LIGHTING**

For outdoor lighting emphasis will placed on night time security lighting and limiting light pollution. Campus lighting should provide an environment of safety and accessibility for all pedestrians on campus at all times of day and night. Fixture design should minimize ‘up light’ and eliminate lighting trespass to the neighborhoods surrounding the campus. Avoid using light fixtures which are pointed so that the lighting is directed upward.

Step lights, wall packs, and recessed ground mounted fixtures are unacceptable. Fixtures in handrails and fixtures in trees are unacceptable.

**ENERGY CONSERVATION**

The Consultants shall design electrical systems to meet the University energy conservation goals. Energy efficient lighting systems are required. Generally, fluorescent fixtures shall be used in most spaces; however, use of HID
lighting fixtures is recommended where appropriate. The Consultants shall use electronic ballasts and T8 lamps in fluorescent light fixtures.

Automatic shut-off controls shall be provided for lighting, such as motion or infrared detectors, time clocks, or photocells. For spaces that are intermittently occupied occupancy sensors shall be provided.

Incandescent lamps, because of their poor efficiency, shall be used only where compact fluorescent lamps are not suitable. Compact fluorescent lamps are available in ever increasing configurations and can provide an option to incandescent lamps. If selected, fixtures are preferable to screw in lamps since they cannot be replaced with incandescent lamps later on.

Premium efficiency motors shall be specified for fans and pumps.

Variable frequency, AC adjustable-speed drives shall be specified for motors 5 HP and up when appropriate for system operation.

LIGHTING GUIDELINES

Lighting fixtures should use only electronic ballasts for fluorescent lighting. No hybrid or cathode-disconnect ballasts or electromagnetic ballasts shall be used. In facilities with a high proportion of nonlinear or electronic loads, ballasts with low harmonic distortion shall be specified. Rapid start ballasts shall be selected for fixtures that are frequently switched or are controlled by occupancy sensors. Instant start shall be selected for fixtures with long burn times.

Incandescent lighting shall not be used except when used for dimming applications, emergency backup of HID or low-duty cycle applications.

Mercury vapor lighting shall not be used unless for landscaping applications, where mercury may be used for color considerations.

At high bay applications for ceiling heights less than 18'-20, use high output 8' T8 lamps with electronic ballasts shall be specified. For ceiling heights greater than 18'-20,' HID shall be specified.

Outdoor lighting shall be controlled by a north facing photocell or other automatic system. Exterior areas not required to have continuous night time illumination may be controlled by time clocks.

Exit signs shall be 2 watts or less under normal conditions. Exit signs must provide high visibility in a smoke filled environment. LED type shall be used unless other type is approved for specific locations. Exit signs shall be selected that carry the Energy Star logo indicating low energy consumption and high visibility.

Occupancy sensors are recommended for Offices, conference rooms, restrooms, and enclosed areas with switched loads greater than 250 Watts. Mechanical timer switches shall be considered for smaller storage areas and closets.

Dual-level switching shall be used for areas using three or four lamp luminaries and with multiple types of work functions within an area including high density of computer monitors or lighting circuits running parallel to a glass wall or other areas with significant ambient light

Where possible use natural daylight to reduce electrical lighting load. Daylighting zones shall be provided with bilevel switching, dimming, light level control, occupancy sensors, independent switches, etc. For vertical glazing, daylighting zone includes luminaires located within a zone that is 15 feet inward and 2 feet to either side of vertical glazing. For horizontal glazing (skylights), daylighting zone includes luminaires located within a zone that is the overhead glazing area projected to the floor plus the floor to ceiling height in all directions.

Where possible provide tandem wiring of one-lamp and two-lamp fixtures located in continuous rows or within 10 feet of each other in a recessed ceiling be designed for tandem wiring. Single ballast may be used to power two luminaires.

SUSTAINABILITY

In general, all University Buildings must be designed and constructed in accordance with LEED (Leadership in Engineering and Environmental Design) Requirements. A LEED Consultant will be hired for planning and evaluating buildings for LEED Compliance.