

## Division 26 | Electrical

Section includes various guidelines for the operation & maintenance of electrical systems, common work results, commissioning, medium-voltage & low-voltage distribution, and lighting. .

This design guideline is written to the designer of record (DOR). This guideline is written to document UA standards of work, assist the designers in ensuring UA standards are incorporated into the contract documents and provide a resource to facilitate the design process. It is the designer of record's responsibility to coordinate the criteria set forth in design guideline and in conjunction with the manufacturer requirements and use the most stringent standard.

### Section 26 05 01 – Electrical Materials and Methods

#### A. General

1. The following are UA preferences that need to be included in drawings and specifications. See additional requirements in other sections of this standard.
2. The installation of surface mounted raceway and equipment on the exterior of buildings shall be avoided.

#### B. Power and Communication Utility Poles

Aerial utilities and utility poles are not acceptable. Special circumstances must be approved in advance by UA Facilities Planning.

#### C. Underground Power Distribution

Refer to “Medium Voltage Distribution” section for underground infrastructure. Medium voltage underground ducts must be encased in red concrete with 48 inches of cover minimum.

#### D. Equipment Layout

1. Equipment shall be located and arranged to provide ready access for maintenance. It is especially important to coordinate equipment layout in spaces shared by other systems to insure that these systems do not block adequate working access and code required clearances.
2. In addition to NEC requirements, it is preferred that ALL electrical room doors swing out. Where electrical room doors swing in, electrical equipment (panelboards, contactors, etc.) shall not be mounted behind the door. Auxiliary equipment mounted behind such doors shall not restrict the door from opening to 90 degrees.
3. Floor-mounted equipment in electrical/mechanical rooms shall be installed on 4” high housekeeping pads with rounded edges.
4. The use of troughs for routing branch circuits out of panelboards shall be avoided. In all locations where troughs are utilized, NEC required derating of conductors shall be applied.
5. Transformer installations shall not infringe on access clearances to other electrical and mechanical equipment. The use of elbows on flexible raceway is recommended.
6. Design documents shall require the electrical contractor to submit scale shop drawings (1/4” = 1’ min) of electrical rooms indicating actual equipment sizes, locations and code-required



clearances. Components of other systems within 6' of electrical equipment shall be included in these drawings.

### E. Equipment Labeling

1. Provide engraved laminated plastic labels, black with white letters and attached with screws, for all major equipment, including switchboards, panelboards, transformers, disconnects, and control panels. Labels shall identify equipment per construction drawings, and shall indicate the source of power and Room Number. Labels on switchboards panelboards, and transformers shall also indicate voltage.
2. Provide typed schedules in all panelboards.
3. Install a label on the face of each receptacle coverplate and tags or wire markers inside the outlet box identifying the panelboard and circuit number from which the outlet is served. Use machine-printed, pressure-sensitive, abrasion-resistant label tape on face of coverplate - black print on clear tape on light colored or stainless steel plates and white print on clear tape on dark colored plates. Embossed tape labels will not be accepted. Install label on the bottom of the plate, centered beneath the receptacle. Use durable wire markers or tags within outlet boxes.
4. On concealed junction box covers, indicate with permanent marker the source panelboard and circuit numbers of circuits contained within the junction box. Where raceway is exposed in finished spaces, cover may be reversed to conceal marker annotation.
5. Underground Conduit Warning Tape Installation:  
  
Install continuously along length of pipe 12 to 18 inches above non-ferrous pipe, before final backfilling.
6. Fire Alarm Labeling:  
  
Paint Junction boxes red with stenciled white lettering "F.A.". All fire alarm conduits shall be red (continuous).

### F. Dry Type Transformers

1. Transformers shall be ventilated, class H insulation, 150°C. rise, meeting NEMA Standard TP-1 for energy efficiency.
2. Sound levels shall not exceed the following:

<u>KVA</u>	<u>Design Sound Level</u>
0-9	40 dB
10-50	45 dB
75-150	50 dB
225-300	55 dB
500	60 dB

3. Transformers 30 KVA and above shall have industry standard taps.
4. Transformers shall be provided with appropriate vibration isolation. Spring type isolators shall be provided for transformers 75 KVA and larger.

5. Dry type transformers for buildings shall not be installed outdoors. Transformers shall not be installed above suspended ceilings or in areas with restricted ventilation. Transformers installed on the floor shall be on 4" high concrete housekeeping pads.
6. Transformer installations shall not infringe on access clearances to other electrical and mechanical equipment.
7. All connections to transformers shall be made with flexible conduits, with elbows at the transformer.

## G. Electrical Raceways

1. All conduit raceways above grade shall be metallic. Exception: above-grade conduits containing ground electrode conductors are allowed to be schedule 80 PVC.
2. All conduits exposed in buildings shall be RGC or IMC to 10' AFF.
3. Conduits exposed outside of the building envelope, other than those routed in attics, crawl spaces, and electrical/mechanical rooms, shall be RGC or IMC, no exceptions.
4. Underground conduit raceways may be schedule 40 PVC but elbows and conduit risers up through slabs shall be RGC or IMC. Metal raceways installed below grade shall be PVC coated or protected with a double layer of corrosion protective tape (3M #52 or equal).
5. All raceway shall be ¾" minimum.
6. A continuous, stranded #10 THWN trace wire with purple insulation shall be routed with all non-metallic service or feeder conduits routed below grade outside of the building footprint. Where splicing of the trace wire is unavoidable, splices shall be made with waterproof wire nuts. The ends of the trace wire shall be turned up above grade and secured accessible and adjacent to panelboards or equipment.
7. Conduits shall be securely supported through the use of manufactured supports and/or hangers. Conduit shall not be supported directly from pipe, ductwork, or conduit of other systems. The use of non-metallic ties to support conduits is prohibited.
8. Junction boxes shall be supported independently of the conduit to the building structure.
9. Service and feeder conduits entering buildings below grade shall be externally sealed with removable, elastomeric, linked seal assemblies and internally sealed with water block foam sealant equal to Polywater FST. In no case shall below-grade conduits enter the building above or directly into electrical equipment.
10. All branch circuits entering buildings from the exterior shall pass through an exterior junction box. Typical junction box shall be in-ground composite concrete, traffic rated. Where building is subject to flooding through conduit, exterior junction boxes shall be above/below grade type equal to Pencil AG-1730. Circuits shall be gathered to pass through a common junction box where possible.
11. Surface mounted raceways ("Wiremold" or equal) shall be metallic. Non-metallic materials are prohibited.
12. Mogul type LB's shall be used in lieu of standard LB fittings on all raceways 2" and larger containing electrical power circuits.



13. The use of troughs for routing branch circuits out of panelboards shall be avoided. In all locations where troughs are utilized, NEC required de-rating of conductors shall be applied.
14. The use of MC cable shall be limited to lighting fixture whips. Exceptions may be made for non-academic projects on an individual basis with prior approval.

## H. Wiring Devices

1. Wiring devices shall be specification grade, and shall be rated at 20 amps or above.
2. Terminations to all devices that are circuited in series on a branch circuit must be made in such a way that removal of one device will not interrupt power to the downstream devices and will not disrupt the integrity of the grounding conductor.
3. The color of wiring device plates shall be coordinated with the color of plates of other systems.
4. Individual GFCI receptacles shall be used where required.
5. External "in use" receptacle outlets shall be metal construction. Cover of outlets shall be flush with exterior construction.
6. Controlled outlets required to meet ASHRAE 90.1 2013 shall not be split-wired. Each duplex outlet NEMA 5-20R outlet shall be either controlled or uncontrolled by the room receptacle controller.
7. For all equipment items pertaining to Audio/Visual, there shall be an uncontrolled outlet at that location for use by A/V. A/V shall never be forced into connection to a controlled outlet.
8. Controlled outlets shall be placed strategically so that computers or other equipment that needs to stay connected have an uncontrolled outlet for connection.
9. Devices shall be gray with stainless steel coverplate unless directed otherwise by UA.

## I. Underground Telecommunication Lines

Refer to "Telecommunications" section of this standard. Telecommunication main ducts shall be installed a minimum of 48" below grade. All other Telecommunications ducts shall be installed a minimum 30 inches below grade.

## J. Fire Alarm System

Refer to Section 28 46 00 - Fire Detection and Alarm for this standard.

## K. Lighting Protection System

1. Lightning protection systems shall be UL Master Label certified.
2. Downleaders shall be concealed, no exceptions. Provide sleeves where necessary.
3. Lightning protection system shall have its own driven ground rods and shall be bonded to the building electrical service ground electrode system (outside of the building, if possible). The lightning protection system shall not be grounded to the internal electrical grounding system



## L. Generators

1. New generators shall be manufactured by one of the following manufacturers:
  - a. Caterpillar
  - b. Cummins-Onan
  - c. Kohler
  - d. Generac
2. There shall be no other manufacturer offered as substitution unless approved by owner.
3. Generator fuel system shall be natural gas or bi-fuel (diesel/natural gas) as directed by owner.
4. Transfer switches shall be passive closed-transition type unless directed otherwise.

- End of Section 26 05 01 -

## Section 26 05 10 – Conductors and Cables

### A. General

1. This guideline covers the selection of installation of low voltage and medium voltage electrical conductors and cables.
2. Campus primary distribution is a 12.47 kV, solidly grounded medium voltage system.
3. Substation feeders are fused by 400 amp, standard speed fuses, S & C fuses.

### B. Medium Voltage Cables

1. Primary power distribution cable shall be single conductor stranded copper with ethylene propylene rubber (EPR) insulation rated 15kV, 105 degrees C, 133 percent insulation level. Cable shall have a 5 mil thick, minimum 12-1/2 percent overlap tape shield and a polyvinyl chloride (PVC) jacket.
2. The campus loop feeder cables shall consist of 500 kcmil phase conductors and a 600 volt, No. 4/0 AWG stranded copper common neutral grounded at all enclosures.
3. Service cables to transformers shall be No. 2/0 AWG phase conductors with a 600 volt, No. 2/0 AWG stranded copper grounding conductor fed from a fused pad-mounted switch.
4. Approved MV Cable Manufacturers:
  - A. Okonite
  - B. Kerite
  - C. Southwire
  - D. General Cable
  - E. Prysmian



### C. Low-Voltage Conductors (600 Volts and Below)

1. Power distribution conductors shall be a minimum size of No. 12 AWG copper.
2. Control wiring shall be a minimum size of No. 14 AWG copper.
3. Instrumentation and special systems wiring shall be in accordance with the manufacturer's recommendations and shall not be less than No. 18 AWG copper.

### D. Installation

1. All medium voltage and low voltage power conductors and cables shall be installed in raceways. Raceways include conduits, ducts, trays, surface raceways and wireways. The only exceptions include:
  - A. NEC Type MI cable.
  - B. Type MC cables serving as lighting fixture whips.
  - C. Type MC cables chased in existing hollow wall space with prior approval of UA Construction Administration.
  - D. Manufacturer prepared wiring systems which include corrugated metal covers.
    - 1) Wiring of different voltage levels shall be in segregated raceways. Exceptions include wiring to rooftop receptacles, rooftop motor controls and motor disconnect early-break auxiliary contracts may share raceways with motor power wiring.
    - 2) New feeder circuits shall not be spliced. Reworked existing 600 volt feeder circuits which must be spliced shall be spliced with solderless compression butt-splices or ring lugs and shall be terminated with solderless compression lugs. No splices shall be pulled into conduits.
    - 3) All circuits shall be analyzed for voltage drop.
    - 4) Branch circuit wiring, including power, lighting, controls and instrumentation may be spliced with wing-nut connectors. Wing-nuts without threaded metal inserts are not acceptable.
    - 5) Home runs of 20 amp branch circuits that exceed 150 feet shall be No. 10 AWG conductors.
    - 6) Neutrals on home runs of multi-wire branch circuits shall be upsized one wire size to allow for the increase in neutral current due to non-linear loads.
    - 7) Shield drain wires on controls and instrumentation cables shall be grounded on one end only. The shield and drain wires on the other end shall be cut back and taped to be isolated from ground.

- End of Section 26 05 10 -



## Section 26 05 26 – Grounding and Bonding for Electrical Systems

### A. General

1. Provide grounding and bonding in accordance with the requirements of the National Electrical Code and the local AHJ.
2. The "Electrical Service" for any facility is as it is defined by Article 230 in the NEC. Service drops or laterals to these service entrance conductors will be provided from distribution transformers served from the University's distribution system or the local electrical utility. Grounding and bonding conductors shall be sized in accordance with Article 250 of the NEC.

### B. Materials and Methods

1. Grounding mats and risers for buildings shall be minimum No. 4/0 AWG bare, stranded copper.
2. For low voltage system grounding systems, all connections of grounding conductors No. 8 AWG and larger and all connections to be placed underground or in concrete shall be made by Burndy Hyground connectors or by exothermic welding.
3. Exposed grounding conductors to be connected to equipment shall be made using copper compression grounding fittings or lugs bolted to the equipment.
4. Grounding of equipment rated greater than 600 volts or 600 amps shall be provided by two independent grounding conductors.
5. Grounding conductors shall be provided for all feeders and branch circuits. Conduits shall not be the only grounding path.
6. Provide protection for grounding conductors subject to physical damage. If a metallic conduit is to be used for protection, the conductors shall be bonded to the conduit at both ends.
7. The lightning protection system shall be bonded to the ground electrode system after the lightning protection system is completed and tested.
8. A copper ground reference bus with pre-drilled termination holes and mounted on insulating stand-offs shall be installed in the electrical room adjacent to the service entrance equipment and shall be bonded directly to the service entrance ground bus.

### C. Medium-Voltage Systems

1. A 4/0 THWN grounding conductor shall be run with all medium voltage circuits.
2. For medium voltage system grounding, all connections of grounding conductors to be placed underground or in concrete shall be made by exothermic welding.
3. Manholes shall be grounded with two 5/8" inch by 10 foot grounding rods located in opposite corners of the manhole. Provide a No. 4/0 AWG copper grounding loop around the manhole bonded to all the grounding rods. Pigtails shall be provided from this loop to all metallic devices located in the manhole including but not limited to cover frame, ladder, cable racks, concrete inserts, cable grounding conductors and cable shields that are spliced in the manhole.



4. Pad mounted switches shall be grounded with two 5/8" inch 10 foot grounding rods located on opposite corners of the switch and provided with a loop of No. 4/0 AWG bare copper wire.
5. The shields of medium voltage cables shall be grounded at both ends and at every location at which it is spliced.
6. The grounded conductor in each duct bank shall be bonded to ground at all equipment, manholes and enclosures through which it passes.

#### **D. Instrumentation and Controls**

1. Provide grounding to instrumentation, controls and electronic devices in accordance with the NEC or the manufacturer's recommendations, whichever is stricter.
2. Shielded instrumentation cables shall have their drain wires grounded at one end only. The shield and drain wires at the other end shall be cut back and taped to be isolated from ground.

#### **E. Testing**

1. Ground electrode systems shall be tested utilizing the Fall-of -Potential method as specified in ANSI/IEEE Standard 81 "Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of an Earth System".
2. Test results shall be in writing and shall indicate temperature and humidity at the time of testing. The ground resistance shall not exceed 15 ohms at 60 Hz. If any special equipment being installed requires a lower ground system resistance, that equipment manufacturer's maximum ground resistance shall apply.

- End of Section 26 05 26 -

### **Section 26 05 44 – Medium-Voltage Ducts and Manholes**

#### **A. General**

1. The University of Alabama has its own 12,470 volt underground distribution system which serves most of the campus from four switchhouses, each adjacent to an Alabama Power Company substation. Many of the circuits through campus are looped and/or fed from two different substations for redundancy tie switches normally remain open, but can be fed concurrently from two substations to allow changing tie points without an outage. This must be scheduled in advance through the UA Electrical shop for coordination with Alabama Power Company.
2. Individual demand meters on each MV circuit are read each month.

#### **B. Modifications and Additions**

All proposed additions and modifications to the Medium voltage system shall be coordinated with the UA Project Manager, Electrical Engineer, and Electrical Shop Manager.

#### **C. Outages**

Due to the nature of University operations, electrical system outages typically require extensive planning. All outages must be coordinated well in advance through the UA Project Manager.





## D. Underground MV Distribution Ducts

1. All medium voltage underground power conductors shall be routed in 5" Schedule 40 PVC ducts fully encased in concrete, minimum 3" coverage all sides. Spacers shall be employed for required separation and coverage. Duct banks shall have 48" cover minimum.
2. A continuous #6 THWN trace wire shall be routed with each duct bank, near the top of the duct bank and fully and encased within the concrete (no conduit). Where splices are unavoidable, they shall be made with exothermic welds and insulated. Trace wires shall be marked with purple electrical tape on ends, and shall be solidly supported and readily accessible within equipment. At manholes, trace wire shall enter the manhole through a penetration at the top of the duct bank entry and shall be strapped on 12" centers and routed to just beneath the cast iron entry frame. Ends of trace wire shall be marked with purple tape.
3. Trenches shall be excavated to no more than the approximate width of the required duct. Excessive extent of concrete shall not be acceptable; contractors shall install forms in over-excavated areas.
4. Duct banks passing under drives and walks shall have longitudinal #4 steel reinforcement bars on 12" centers and #4 steel reinforcement hoops on 12" centers.
5. MV duct banks shall be colored red with red iron oxide concrete pigment, 8 lbs. per cubic yard of concrete.
6. All MV ducts terminations shall be fitted with bell end fittings.
7. A minimum of six 5" ducts shall be routed for each major branch.
8. A minimum of four 5" ducts shall be routed to each switch.
9. A minimum of two 5" ducts shall be routed to the transformer.
10. All duct banks shall contain spare duct(s).
11. All ducts shall be proofed by having a standard duct mandrel passed through them. Testing shall be witnessed by UA personnel.
12. Two 2" PVC conduits shall be routed on top of each duct bank for future auxiliary systems. These conduits shall be in addition to all other necessary raceways. The 2" conduits shall turn up into an 11" x 18" polymer concrete in-ground junction box at each end of the duct and at each manhole. Each junction box shall have "ELEC" cast into the lid. Where allowed by the scope of construction, two 2" shall be extended from the end junction box into an accessible location in the electrical room of buildings. All conduits shall be fitted with full-length polypropylene pull lines.

## E. Manholes

1. MV ducts shall have manholes adjacent to each switch, at maximum 500' intervals on long runs, and elsewhere as required by site conditions and to keep conductor pulling tension within acceptable limits. Pull or junction boxes for MV ducts are prohibited.
2. Manholes shall have the following features:
  - A. Heavy duty (H-20) rating.
  - B. Positive sealing elastomeric gasket between upper and lower sections.



- C. Cast iron grade ring and 36" cast iron lid with "ELECTRICAL" cast into the top.
  - D. Sump cast into the center of the floor of the manhole.
  - E. Duct terminations for duct entry cast into all sides.
  - F. Pulling irons opposite all duct entries.
  - G. Full height, non-metallic stanchions with 15" minimum non-metallic racks, equal to Underground Devices Inc. BNT-A3. Provide 3 racks minimum for each standard.
3. Manholes connecting duct banks 6 way and smaller shall be 8' x 8' octagonal.
  4. Manholes connecting duct banks larger than 6 way shall be 8' x 12' rectangular. Duct openings shall be offset from the center to allow easier routing of conductors.
  5. Each manhole shall be grounded with two 10' copper-clad steel rods driven through holes in the bottom (or low in the side if manhole is set in rock) with #2/0 bonding conductor thermowelded to rods.

**Note:** Refer to Section III of the Design Guidelines for 02 24 90 Trenching, Backfill, Compaction.

- End of Section 26 05 44 -

### Section 26 05 45 – Directional Boring – High Density Polyethylene (HDPE) Conduit

#### A. General

The use of directional boring shall be considered to avoid disturbing paved areas and to avoid damage to tree root systems.

#### B. Boring Requirements

1. Listed HDPE conduit shall be utilized.
2. Drilling fluids and additives shall be non-toxic.
3. A vacuum truck shall be employed for all bores. Drilling fluids shall not be allowed to collect on the ground.
4. Careful attention shall be given to the proposed phasing of bores and staging of equipment to avoid interference with trees and landscaping, and to minimize the disruption of vehicle and pedestrian traffic. Note that 25'-30' of staging area is needed at the end of the proposed bore for the boring rig.
5. Based on site conditions and routing of the bore, receiving pits shall typically be utilized. Pit sizes shall be kept to a minimum.
6. Length of all bores shall be limited to 300' where possible to avoid excessive pressures and thereby reduce the risk of uncontrolled broaching of drilling fluids to the surface. In-ground



composite concrete boxes shall be used at junction points of bores.

7. Efforts shall be made to maintain bores 5' minimum below grade beneath roads and trees.
8. Efforts shall be made to bring termination points up to approximately 3' below grade in locations where bored conduits is to be intercepted.
9. Transitions from HDPE to conduits of other materials shall be made using approved methods. Connections between HDPE and PVC conduit shall be made with BONDUIT adhesive or prior approved equal, installed per the manufacturer's instructions.
10. Refer to "Excavation and Backfill" section of these standards for all excavation. Unapproved excavation within the drip line of trees is prohibited.
11. The University shall be notified immediately of stuck pipe, fluid broaching, or other problems, and they shall be kept fully informed of all efforts to mitigate the effects of these situations.

- End of Section 26 05 45 -

## Section 26 12 19 – Pad-Mounted Medium-Voltage Transformers

### A. General

1. Each transformer shall be fed from a medium voltage load-interrupter switch connected to the campus distribution system.
2. Each transformer shall be served underground via two (2) 5" conduits (one spare) from a dedicated load-interrupter switch.

### B. Construction – Standard Features

1. Factory Mutual Approval
2. Aluminum windings.
3. Live front bushings.
4. Current limiting Bay-o-net fusing.
5. Gang operated load break switch.
6. Provide full capacity standard 2 ½% taps (2 above & 2 below nominal) with an external operator.
7. Distribution class surge arresters.
8. FR3 fluid.
9. Liquid level gauge.
10. Pressure/Vacuum gauge.
11. Pressure relief valve.



12. Fill plug and drain valve.
13. Provide meter base on secondary side if needed. See section on electrical metering.

### C. Preferred Manufacturers

1. Cooper
2. Square D
3. General Electric
4. ABB

### D. Installation

1. Install on reinforced concrete pad. Pad shall be 8" thick minimum and shall be bedded on 6" of compacted stone. Pad shall extend 6" beyond the outside dimensions of the transformer.
2. Pad to be poured with full "window" openings for primary and secondary conduits.

- End of Section 26 12 19 -

## Section 26 13 00 – Med-Voltage Switchgear

### A. General

1. Pad mounted medium voltage switches are used to switch power on the campus 12,470 volt medium voltage distribution system.
2. New switches shall be S&C Vista type switchgear. All gang operated switches and load-break interrupter switches shall be rated at 600 amps. Overcurrent settings shall be set as appropriate for the load served.
3. For replacement switches and legacy locations, install switches equal to S&C PMH style with SMC-20 fusing. Switches shall be set on 12" high spacer section. Fuses shall be sized as appropriate for the load served.

### B. Installation

1. Vista switches shall be mounted on concrete composite box pad designed for S&C Vista gear, equal to those manufactured by Concast or Quazite. Box pads shall be 36" high, and shall be installed with the top 6" above finished grade. Length and width of box pad shall be 12" greater than MV switch to provide 6" margin on all sides. Bottom of box pad excavation shall be covered with 8" of #57 stone, and ducts shall extend 6-12" above top of stone. Switches shall be solidly anchored to box pad per manufacturer's instructions.
2. Ducts shall be turned up into box pad aligned in a row immediately beneath the box pad slot.
3. Medium voltage cables connections to switches shall be made with 15 kV load break elbows equal to Tyco ELB T-body connectors with capacitive test point. Unused switch terminations shall be fitted with 15kV deadbreak insulating caps. Provide one spare set of three T-body connectors and



one spare set of three insulating caps with each switch, to be turned over to the UA Electrical Shop.

### C. Labeling

1. Switches shall be labeled per UA convention with 3" high adhesive labels as specified..
2. An as-built drawing in a vinyl sleeve shall be installed in each switch indicating duct layout, duct terminations, spare ducts turned out of switch and capped, and circuit size, routing, and year installed.

- End of Section 26 13 00 -

## Section 26 24 00 – Switchboards and Panelboards

### A. General

1. This guideline covers the selection and installation of electrical panelboards in campus buildings and at other locations on campus.
2. "Loadcenter" type panelboards are not acceptable unless approved by the University's Facilities Planning Department for a particular application.
3. Lighting panelboard sections shall not exceed 54 spaces unless approved by the University Facilities Planning Department for a particular application.
4. Multiple section panelboards are acceptable, provided sections are the same physical size. Sections shall be connected through the use of sub-feed lugs laid out such that sections can be connected top to top or bottom to bottom, without passing through the vertical gutter space.
5. Panelboard bus bracing shall be fully rated; do not provide series rated panelboards.

### B. Construction

1. Bussing shall be tin-plated copper of 98% conductivity.
2. Phase bussing shall be rated 100%.
3. Neutral bussing shall generally be rated 100%. Neutral bus in panelboards serving multiple non-linear loads shall be rated 200%.
4. Grounding bussing shall be rated a minimum of 50%.
5. Distribution type panelboards shall be fully bussed.
6. Main Circuit Breakers shall be bolted to the top or bottom of the bus (no back-fed mains).
7. All spaces shall be permanently numbered sequentially, beginning on the left side and continuing down the right side.
8. Lighting type panelboards shall be provided with a minimum of 50% spare breaker spaces, of which 25% shall be spare breakers.



9. Distribution type panelboards shall be provided with a minimum of two spare breakers of nominal feeder or load size and two provisional spaces.
10. Circuit breaker arrangement shall be the same as indicated on the panelboard schedules in the design documents.

### **C. Enclosure**

1. Enclosures shall be galvanized steel of the appropriate NEMA type.
2. Covers in electrical and mechanical rooms or any unfinished areas shall be surface mount type.
3. Covers in finished areas shall be flush mount type.
4. All sections of multiple section panelboards shall be the same height.
5. Provide all panelboards with door-in-door or hinged front trim covers.
6. Door shall include a welded metal frame for a directory.
7. Door shall have a key operated lock.

### **D. Mechanical and Electrical Labeling**

All panel boards, disconnects, motor controllers, etc. shall have laminated plastic or non-ferrous metal nameplates held in place with a minimum of two screws. Name-plates shall have black letters on a white background.

### **E. Preferred Manufacturers**

1. Square D
2. General Electric
3. Siemens
4. Cutler Hammer

### **F. Installation**

1. Surface mount panelboards in electrical rooms, mechanical rooms and unfinished spaces.
2. Flush mount panelboards in finished areas.
3. Flush mounted panelboards shall be provided with six (6) 1" conduits from the panelboard up to an accessible ceiling space.
4. Panelboards shall be provided with a black plastic laminated nameplate with white text indicating the panelboard identification as noted on the drawings, the voltage rating, the amp rating, and the name of the panelboard feeding the panelboard.
5. Directories shall be typewritten and shall be sized to be fully legible without removing from frame.

- End of Section 26 24 00 -



**Section 26 24 19 – Motor Controllers****A. General**

Provide motor controllers per NEC requirements and as indicated below.

**B. Requirements**

1. Controllers to be NEMA rated only. Do not include IEC rated controllers in the specification.
2. Motors 50 HP and larger shall be provided with reduced voltage starters
3. Controllers to have over-load relays size to the motor's nameplate current.
4. Doors on Magnetic Controllers should include a "Hand-Off-Auto" switch.
5. Controller doors should include a transformer type indicator light indicating that the motor is in operation.
6. Short circuit protection for each motor and motor controller should be provided by a Motor Circuit Protector.
7. Each controller shall include a voltage monitoring relay to provide protection from the following:
  - a. Phase loss
  - b. Under- and overvoltage
  - c. Phase imbalance
  - d. Phase reversal
8. Each controller should include a control circuit transformer providing 120 VAC control power.
9. Each controller should include a minimum of two auxiliary contacts.

**C. Preferred Manufacturers**

1. Allen Bradley
2. General Electric
3. Square D
4. Siemens
5. Cutler Hammer

- End of Section 26 24 19 -



## Section 26 27 13 – Electrical Metering

### A. General

1. Metering of Services: The U of A wishes to meter all permanent and long-term electrical services fed directly from distribution transformers, including the following:
  - A. All buildings
  - B. Parking Decks
  - C. Parking Lots
  - D. Area Lighting
  - E. Portable buildings serving construction
  - F. Temporary construction power
2. Sensus meters shall be provided by the UA for all metered locations. All other materials required for installation, and all labor for each location, shall be provided by the contractor.
3. Sub-metering will be required for food service venues within buildings of different type or revenue source.
4. All meters and instrument transformers used for metering of building services shall be revenue class equipment.

### B. Electric Meters

1. All Meters shall be polyphase, form 9S, CL20, 120-480V, Elster A3RL with integrated Sensus FlexNet module. Battery and MeterCat program must be loaded at the factory. Meters shall be provided by the UA. Contact by email Fred Johnson in UA Energy Management [fjohnson@fa.ua.edu](mailto:fjohnson@fa.ua.edu). The following information must be provided with each email request:
  - a. UA project name & number
  - b. Contact information of requestor (name and email)
  - c. CT Ratio
2. Five business days advance notice will be required to schedule meter installation.

### C. Meter Bases

Meter bases shall be NEMA 3R with two piece cover and test switch provisions. The meter base is to be mounted on the outside of the secondary compartment of the building's transformer. Locate meter base against front top edge of secondary compartment such that a second, future meter base can be added beneath it.





## D. Instrument Transformers

1. Instrument transformers are to be located in the transformer's secondary compartment. Potential transformers (PT's) are normally not required. Current transformers (CT's) should be mounted on the secondary bushings.
2. CT's should have a factory standard ratio with the primary sized at  $\frac{1}{2}$  to  $\frac{3}{4}$  of the service entrance capacity.
3. Wiring between the instrument transformers and the meter shall be color-coded so that leads can be easily differentiated. Wiring shall be neatly bundled and supported.
4. Potential leads shall include a fuse block, mounted toward the front right edge of the secondary compartment for accessibility.

## E. Temporary Construction Meters

1. Construction power meters shall be the same Sensus meter installation as described above (though only two CT's required if single phase).
2. The meter base may be mounted (1) on the permanent padmount transformer if it is installed and there is available space, or (2) adjacent to the temporary service disconnects. In this case a CT enclosure will be required.

- End of Section 26 27 13 -

## Section 26 51 00 – Lighting

### A. General

1. This guideline covers the selection and installation of interior and exterior lighting of campus and campus buildings. The following should be used in conjunction with the Alabama Building Energy Conservation Code for the selection and installation of lighting equipment.
2. Lighting design for all areas, interior and exterior, should meet recommended standards of the Illuminating Engineering Society of North America. Submission of schematic design documents need to include illumination levels for interior and exterior areas. Typical areas to be included are: offices, classrooms, corridors, walkways, and parking lots.

### B. Interior Lighting

1. Fixtures
  - a. Fixtures should be specification grade minimum.
  - b. LED fixtures should be used for all new construction and renovation work unless otherwise directed. Where fluorescent lamps are used (renovations), they shall match existing.
  - c. Lenses on troffers should have a 1/8" cross section minimum.



- d. Pendant fixtures should not be used in classrooms or audio visual rooms as they will restrict the location of video projectors. It is preferred that lighting fixtures be recessed or flush with the ceiling.

## 2. Lamps

- a. Fluorescent lamps should be low mercury type.
- b. Fluorescent lamp ballasts should be electronic with less than 10% THD.
- c. LED fixtures shall meet LM-79 and LM-80 testing standards.
- d. LED fixtures shall yield an LM-80 result of a minimum of 70% of original light output at 50,000 hours operation.
- e. LED drivers shall have 150,000 hours mean time between failures.
- f. Incandescent lamps should not be used without approval of The University. If their use is required, they should be rated for 130 volts.
- g. All LED recessed troffers shall be L70@50,000hrs and have a minimum 3 SDCM.
- h. All down light LED luminaires shall be min L90@55,000 hrs and have a 2- 1/2 SDCM or less.
- i. Interior Fixture Color Temperature: Generally, 3500K fixtures are appropriate throughout campus for academic, classroom, corridor, office, residential, athletic, etc. spaces. However, every project should be considered relative to color temperature. For spaces such as dining areas, public food prep areas, hospitality, theatrical, etc., warmer color temperatures may be preferred and necessary. For every project, desired color temperature is to be discussed and approved during design between the Designer of Record and the University Design Group, including Architect, Electrical Engineer and Interior Designer. If multiple color temperatures are used in the same facility, attention is to be paid to confirm that significant changes in temperature do not occur between spaces that will adversely impact the aesthetic.
- j. Light fixture selection – The Designer of Record is to consider aesthetics, maintenance and first costs in selecting fixtures. Generally, buildings have primary, secondary and tertiary fixtures in terms of aesthetic and cost impacts. For the majority of fixtures, it is desirable for the fixture to not make a dramatic design statement or draw attention to the fixture, rather be complimentary and subtle to the overall design. The DOR is to review fixture type cut sheets with UA Design Staff during design to develop the strategy for desired aesthetic & cost profiles.
- k. Fixture scheduling – The DOR is to specify three manufacturers/model numbers for each fixture type specified. Listing a Basis of Design fixture or a single fixture with the phrase 'or approved equal' is not allowed

## 3. Emergency and Exit Lighting

- a. Include battery back-up in fixtures for emergency lighting where no generator is used for life safety purposes.
- b. Include battery back-up in all exit lights.



4. Preferred Manufacturers
  - a. Lithonia
  - b. Metalux
  - c. Columbia
  - d. Williams
  - e. Philips

## C. Exterior Lighting

1. Fixtures
  - A. Minimize the use of wall mounted fixtures. Pole mounted fixtures are preferred over “Wallpacks”.
  - B. Refractors and lenses should be glass.
  - C. Minimize light pollution by the use of cut-off fixtures and faceted reflectors.

2. Lamps

Lamps should be LED, 4100K.

3. Preferred Manufacturers
  - A. General Electric
  - B. Gardco
  - C. Kim
  - D. Lithonia
  - E. Hubbell

4. Location of Pole Mounted Fixtures

Coordinate the installation of pole mounted fixtures with the landscape plantings to ensure future growth of the plantings do not block the projection of light

## D. Campus Standard Lighting Fixtures and Poles

1. Area and Walkway Lighting
  - a. Acorn luminaire on 13ft pole is used for exterior walkway and area lighting. Approved luminaire: Smart City Management (Division of Global Green) LED post top with 140W LED, Type V distribution, with 7-pin NEMA photocell socket, ready to adapt to the Sensus Wireless Lighting Controller. #LPT-140W-2G-7P6.0-2C-5.0-15.4L-1x150-1.3A-BK
  - b. Approved pole - Antique Street Lamps, Capital Series PI-C24-13-L-8079B cast iron pole.



## 2. Street and Sidewalk Lighting

- a. The following information is for reference, these fixtures are owner furnished, contractor installed:
- b. Teardrop luminaire on 31 ft. pole is used for street illumination.
- c. Teardrop luminaire on backside of pole is used for sidewalk illumination.
- d. Approved luminaire and Pole (Street Only) - Holophane Esplanade, Series ESU on Millerbernd cast iron pole on cutsheets shown in this standard.
- e. Approve luminaire and Pole (Street and Sidewalk) - Holophane Esplanade, Series ESU & ESP on Millerbernd cast iron pole on cutsheets shown in this standard.

## 3. Traffic Control

- a. Teardrop luminaire on 31 ft. pole is used for intersection illumination. Luminaire matches the luminaire on the street lighting poles indicated above. Traffic control lighting and lighting controls must meet Alabama Department of Transportation specifications.
- b. Approved luminaire and Pole - Holophane Esplanade, Series ESU on Millerbernd cast iron pole on cutsheets shown in this standard. Arm length and attachments will vary.

## 4. Lighting Pole Base

The diameter of pole foundation is to be 4" greater than the pole base to provide a 2" reveal around the base. The top of the foundation is to be 6" above grade and have a 1" chamfer along the edge.

## E. Lighting Controls

### 1. Occupancy (Vacancy) and Dimming Sensors

Wattstopper, nLight (Acuity), Crestron, Hubbell and Lutron are the preferred manufacturers.

### 2. Lighting Control Panels

- A. Lighting Control Panels shall have remote access capability without the need for an onsite network-connected server. Built-in web server required in Lighting Control Panels, with user interface.
- B. Low-voltage ethernet cables used for lighting controls shall have green jacket.

### 3. Lighting Control Methods

- A. Dimming of LED fixtures is preferred in classrooms, conference rooms and A/V rooms. May be required in other rooms due to ASHRAE 90.1-2013.
- B. Individually controlled fixtures shall be used only where required (daylighting applications, certain A/V applications, etc). Otherwise, separate controller above ceiling shall operate groups of fixtures. Use only vacancy sensors and low voltage override switches whenever possible (corridors, closets, offices with no A/V or daylighting, etc....i.e. no connection to lighting



- control panel) to reduce cost and eliminate CAT 5 where unnecessary, all while complying with ASHRAE 90.1-2013. Balance needs with cost and practicality.
- C. “Dim to off” shall be used only where required (A/V, theatrical, auditoriums, x-ray labs, film rooms, etc). Otherwise, dim to 1% method shall be standard.
  - D. In classrooms and auditoriums where Crestron A/V controls are provided by owner, room lighting controller shall have interface capability to dim zones for preset scenes from input at the Crestron controller. Coordinate Crestron model number with UA A/V personnel at design review meetings.

- End of Section 26 51 00 -

## Section 26 60 61 – Food Service Electrical Installations

### A. General

1. “Washdown Areas” referenced herein shall include all cooking, food prep, serving, and dishwashing areas.
2. All exposed conduit exposed in washdown areas shall be galvanized rigid conduit (GRC).
3. Conduits serving food service equipment shall be one size larger than required by the original conductors (does not apply to flexible equipment connection).
4. Surface mounted or exposed boxes in washdown areas shall be die cast weatherproof with gasketed stainless steel “In-Use” covers.
5. All exposed electrical raceway, enclosures, and equipment in washdown areas shall be installed with ½” minimum standoff, mounted with all stainless steel supports, strut, and hardware. Do not use stacked washers.
6. Panelboards for food service equipment shall be located within the food service occupancy, but shall not be located within washdown areas. Panelboards shall not be located on the back side of walls surrounding food prep areas unless installed in 12” CMU wall. Where panelboards must be located in washdown areas, stainless steel covers shall be specified. In no case shall surface mounted panelboards be installed in washdown areas.
7. For equipment with hardwired connections, install circuit breakers in the panelboard with integral locking hasps; do not install disconnects at equipment connections. NEC 422.34 provision for Unit Switch as a disconnecting means shall not be acceptable. Where circumstances dictate that a disconnect is required at the equipment, a stainless steel enclosure shall be specified.
8. Convenience receptacles shall be located above work surfaces on maximum 4’ centers. No more than two convenience outlets shall be on a 20/1 circuit.
9. Each piece of food service equipment shall be served by a dedicated circuit sized per the equipment nameplate and/or manufacturer’s recommendations.



10. All equipment connections up to and including 60 amps shall be made with straight blade receptacle devices. Equipment 30 amps and above shall be provided with a nominal 6' long SOOW cord with right angle plug.
11. At hardwired equipment outlets, utilize cast covers with threaded openings and waterproof metallic flexible conduit. Note that covers are a long lead time item; proceed accordingly.
12. Drop cords through ceilings shall be SOOW with Kellums strain relief. Conduit shall be extended through ceiling, terminated with an insulated bushing.
13. Route two spare 1" conduits to all islands from the nearest electrical panelboard.
14. Floor outlets for cash register and equipment islands shall be mounted in horizontal cast boxes on a rigid conduit stem at least 1" above the floor. Flush floor boxes shall not be installed in any area subject to wash down areas.
15. Outlets shall be GFCI protected per NEC. GFCI protected wall outlets may be utilized only where the outlet is readily accessible for reset without moving equipment, covers, etc. Where outlets will not be accessible, standard wall outlets shall be utilized and protected by GFCI circuit breakers in the panel. Outlets protected by GFCI circuit breakers shall homerun in separate conduits to the panel.
16. Lighting fixtures shall be rated for "Damp" or "Wet" locations as required. "Damp" location fixtures shall be installed in food prep and serving areas. "Wet" location rated fixtures shall be utilized in dishwashing and can wash areas. Surface or stem mounted fixtures shall be installed in accordance with the manufacturer's instructions utilizing appropriate hardware to maintain "Damp" or "Wet" ratings of the installation. Lighting fixtures installed in lay-in ceilings shall be equipped with sealed and gasketed aluminum doors with prismatic lenses installed smooth side down.

- End of Section 26 60 61 -

