SECTION 16000 - Electrical

Part 1 - General:

1.1 Scope of Section

This section contains the requirements relating provision of electrical service, including utility infrastructure, distribution methods, materials and equipment, electrical energy management, emergency power requirements, circuit coordination, transformers, lightning protection systems, and lighting. Protection of existing electrical equipment, utilities procurement, utility disconnects and locates are included in Division 1- General Requirements.

1.2 Overview

A. Coordination Meeting: There shall be a utilities connection/coordination meeting during the Design Development process between Campus Utilities and the MEP/Civil Engineers. At the time of the meeting the design team should have documentation prepared to include the anticipated square footage of the facility, anticipated loads and a basic understanding of the existing utility infrastructure around the project location.

B. Connection to Existing Utilities: All utility work shall be coordinated with and approved by the Utilities Section through the construction Project Manager. Each drawing that shows a connection to existing utilities shall have a note stating the Contractor shall request permission for all outages a minimum of 5 working days in advance, unless an emergency arises. Explicit details shall be shown for all connections to existing utilities. The Utilities Section must approve both the location and the method of the proposed connection.

C. Electric Consumption During Construction: The Contractor, through the Project Manager, shall pay for all electric energy consumed during construction as part of the project General Conditions. The Contractor shall obtain the Utilities Procurement Procedures from the Project Manager. Requirements for establishing service are as detailed. Drawings shall clearly call for the Contractor to take such action.

D. Dedicated Electrical Rooms:

1. The project shall have dedicated electric rooms as required to accommodate all major electric equipment including main switchgear, panels, transformers, automatic transfer switch(es), and disconnect devices.
2. The Life Safety emergency switching equipment shall be in a separate room with outside accessibility.
3. No other type utilities that are not specific to the electric system shall be allowed to occupy any space (including ‘pass through’) in the electric rooms.

4. In multiple floor buildings where additional electrical rooms are required for each floor, the electrical rooms shall be 'stacked' to facilitate the installation of conduit and wire required to provide service to the floors.
5. A scaled drawing (minimum of ¼" = 1') of each electric room shall be available during design to insure the room is of adequate size to accommodate all electrical equipment (panels, transformers, switches) and provide NEC mandated clearances for all equipment.

E. Fault Current and Arc Flash Calculations, Phase Overcurrent Coordination Studies and Breaker Settings:

1. The Engineer of Record (EOR) is responsible for preparing fault current and Arc flash calculations, performing the coordination study and establishing settings for all adjustable circuit breakers.
2. Fault current and Arc fault calculations shall be included in the project specifications and submitted with the 100% construction documents. Construction documents will not be approved if the calculations are omitted.
3. The EOR is responsible for insuring the breaker settings are made prior to any equipment being energized. For projects that are renovations only, to the extent new electrical equipment is installed, the settings shall be made prior to energizing the new equipment.
4. **Remodeling:** For projects that are remodeling in nature and do not encompass the whole electric system, only the electric equipment involved in the remodeling will require circuit coordination settings.

F. Arc Flash Boundaries and PPE requirements:

1. Through a prior study, minimum ARC Flash boundaries and PPE requirements have been established as a standard for campus. The minimum ARC Flash boundary for any location on campus (except the Central Utility Plant and Satellite Utility Plants #1 & #2.) has been determined to be 4 feet. The minimum PPE required is Category 2.
2. If the EOR's calculations reveal any particular device(s) that exceed the above minimum requirements, all equipment exceeding the minimum shall be clearly marked with a warning sign as to the Flash Hazard Boundary, Flash Hazard, PPE Category, Shock Hazard, and all Approach Distances. The sign shall conform to the requirements of NFPA 70E 130.3(C).

G. As-Built Drawing Requirement: Record Drawings that accurately reflect the actual installed conditions shall be furnished at the end of the project. Consult with the Project Manager for details of this requirement.

H. Systems Observation/Training: An authorized representative(s) of the Owner shall witness an operational demonstration of completed systems. Representative(s) shall be completely instructed in the operation and

maintenance of installed equipment. Representative(s) shall sign and date a statement that confirms they have received proper, comprehensive training.

I. A manufacturer representative shall be required to provide necessary specified training on all equipment supplied by the manufacturer. Construction material described as 'general construction material' such as conduit and wire, shall not require specific training.

Part 2 – Materials:

2.1 General Material Requirements

A. All electrical materials and equipment shall be UL or ETL listed. CSA is not considered equivalent.
B. All materials and types of construction shall meet or exceed the requirements of UL, ANSI, NEMA, IEEE, and the NEC as well as conform to manufacturer's written recommendations.

2.2 Raceway

A. Exterior:
1. Raceway buried below grade shall be a minimum size of 1", unless otherwise noted, buried to a depth called for by the NEC.
2. Use of flames or hairdryers to fabricate bends of PVC conduit is unacceptable.
3. PVC shall be converted to rigid metallic conduit where the raceway transitions from below grade to above grade. Buried metallic raceway must have a minimum of two coats of bitumastic or have factory applied PVC coating.

B. Interior: All EMT connectors and couplings shall be steel, compression. No set-screw or zinc connectors or couplings shall be used.
C. Empty Conduit: All empty conduit shall have a 200-pound test pull cord installed.
D. Conduit shall be manufactured in the United States.

2.3 Wires and Cables

A. Conductors: All conductors shall be copper with insulation Type THHN/THWN.

B. Minimum power conductor size: #12AWG.
1. **Sizing:** Power conductors shall be sized for maximum 5% voltage drop from source to point of utilization.
2. **Wire Type:** In general, conductors #10 and smaller shall be solid, unless the application specifies stranded wire. Conductors larger than #10 shall be stranded.

3. **Neutral Conductors:** All 120 and 277 volt circuits shall have a dedicated neutral conductor. Multi-wire branch circuits, that share a neutral, shall NOT be allowed.

C. Control conductor sizes and color-coding shall be as governed by approved wiring diagrams or schematics.

2.4 Wire and Cable Connections

A. Wire and cable connected to main electric service equipment, utilizing factory or field installed bus bar, sizes 4/0 and larger shall employ copper to copper 2-hole, compression lugs (long barrel only) using ½" bolts, 2 flat washers, and 1 split lock washer. All bolts and hardware shall be grade 5 cadmium plated steel or bronze (equal to Burndy Durium style). Lugs shall be rated for copper only. Copper clad connectors will be acceptable. No all-aluminum connectors shall be used in any application.

B. Wire and cable may be spliced 'in line' to facilitate circuit extensions and/or new installations. Wire sizes 4/0 and larger shall employ in line compression sleeves with appropriate insulated covers. Cold shrink insulation sleeves may be used in lieu of 'heat shrink' insulation.

C. Connections made to breakers that are furnished with factory installed mechanical connectors will be allowed. For mechanical connectors, factory recommended installation procedures shall be employed (connector torque settings, the use of oxide inhibiting compound, etc).

2.5 MC Cable

A. All wire and cable shall be installed in conduit or where applicable, tray-rated cable in cable trays. In lieu of wire in conduit, MC cable may be used in areas allowed by the NEC, but only with the joint approval of the Engineer of Record, the FSU BCA, FSU Utilities Department, and FSU Plan Reviewers

B. In new and remodeling construction, MC cable shall not be used inside new walls.

Part 3 – Equipment:

3.1 Panelboards

A. Identification: Panelboards shall be identified using permanently attached machine engraved phenolic nameplates.
1. Standard color shall be white letters on black background.
2. Emergency panels shall have white letters on a red background.

B. Bussing: Panelboard bussing, including equipment ground bar, shall be copper.

C. Rating: Lighting and receptacle panelboard neutral bus shall be rated 100%.

D. Sizing: Panelboards shall be sized for minimum 25% spare above calculated diversified demand loads.

E. Breakers:

1. Circuit breakers shall be bolt-on construction.
2. Devices shall be rated for the calculated available bolted fault short circuit currents.
3. If breakers are to be used for switching, switching duty breakers shall be used.
4. Breaker handle ties shall not be employed.

F. Acceptable panel manufacturers: Square D, Siemens, and Cutler-Hammer

3.2 Surge Protective Device (SPD)

1. Main Distribution panels shall have metal oxide varistor type surge protection device (SPD). The MOV device shall have a short circuit current rating of 200 kA or greater.

D. Voltage of the facility.

1. MOV(s) shall be installed in the first 'down line' panel and other locations deemed necessary by the Engineer of Record. This type MOV shall be sized as appropriate for the installation as determined by the Engineer of Record.

E. Acceptable SPD manufacturers: As specified by the Engineer of Record.

3.3 Switches and Receptacles

A. Switches and receptacles shall be specification grade and rated 20 amperes.

B. Color: Standard shall be ivory with stainless steel plates. Different color devices must be approved by the Engineer of Record and the Project Manager.

C. Emergency receptacles:

1. Devices assigned to the emergency system shall be distinctive in color: red is considered standard unless another color code has already been established in the facility.
2. Cover plates shall be engraved with panel name and circuit number.

D. Receptacle spacing:

1. Vending areas shall have GFI receptacles mounted no greater than 48" on center. Each receptacle shall be on a dedicated branch circuit.
2. Hallways shall have outlets mounted 50 feet on center, maximum.

E. Receptacle mounting height: Device mounting heights shall conform to the latest applicable edition of ADA standards.

1. Floor outlets shall be flush with finished floor or floor covering, as applicable.
2. When required for classrooms, receptacles for overhead LCD projector shall be mounted flush in finished ceiling.

F. Wet and Damp Locations: 20 Amp, 125 Volt and 250 Volt non-locking receptacles in wet or damp locations shall be 'Weather-Resistant', GFI receptacles with 'WR' clearly marked on face.

G. In Use Covers: 'In Use' covers employed on exterior receptacles shall be 'die-cast' construction. Plastic covers shall not be used.

H. Building Exterior: Outlets shall be provided on the exterior of facilities located so that their spacing does not exceed 100 feet on center. If the receptacle is not continually in use, a weather proof cover will be sufficient.

3.4 Motors, Disconnect Switches and Starters

A. Motors: Shall be high efficiency and have an operating power factor of 90% or greater. Provide reduced voltage starters or variable speed drives for all motors 15 horsepower, or larger.

1. Variable speed drives shall be connected to the campus-wide energy management/monitoring system. For detailed requirements for these connections, contact the FSU Utilities Section.
2. **Acceptable Manufacturers of VFDs and Soft Starts:**
    a. **VFDs:** AC Technologies; Yaskawa; ABB; Danfoss (under 125 HP); Trane.
    b. **Soft Starts:** SAF
3. **Acceptable manufacturers of disconnect switches:** Square D, Siemens, General Electric and Cutler Hammer (Eaton).

3.5 Dry Type Transformers:

A. Windings: Dry type transformers shall be constructed using aluminum windings.

B. Temperature Rise: Dry type transformers shall have 80 degree C temperature rise rating.

C. Acceptable Manufacturers: Square D, Siemens, General Electric, and Cutler-Hammer (Eaton).

3.6 Power Generation

A. Emergency Power Source: Where required for life safety per NFPA-101and/or for continuity of function in certain facilities, provide a standby rated emergency power engine generator set. The addition of battery-powered lighting, instead of providing a generator set, to meet NFPA-101 exit/egress requirements is highly discouraged.

B. Engine Generator Set: Shall be diesel fueled unless so small that diesel prime mover is not commercially available. Natural gas and LP fueled sets are unacceptable. 'Full tank' shall be defined as 7/8 tank capacity and shall provide 36 hours of continuous operation at full load. Larger tanks may be required to serve facilities where continuity of function is mandatory. The operation and fueling requirements for those types of facilities will be handled on a project-by-project basis as design criteria through the Project Manager.

1. **Acceptable Manufacturers:** Engine generator sets shall be Caterpillar, Cummins/Onan. All other manufacturers are unacceptable.

C. Generator Set Location:

1. There are numerous locations on campus where terrain or geometry of adjacent structures may require that the generator set be installed in a sound attenuating enclosure with a rated sound attenuating silencer. This requirement will need to be discussed during initial design meetings and the actual level of attenuation determined early in the design process.
2. Generator sets shall be installed on building exteriors except possibly for locations such as energy/utility plants.
3. The location of the generator set shall be coordinated with the relative location of the fresh air intake for the building to eliminate the intrusion of the generator's exhaust fumes into the building fresh air intake system.
4. Unit shall be located and physically protected in such a manner as to reduce the vulnerability to damage by vehicles, severe storms or hurricanes.

D. Fuel tank location/Platform: Fuel tank shall be above ground and approved by EPA. If fuel tank is of such dimension that the top of the mounting skid is 24" or greater AFG, then a substantial maintenance platform shall be constructed that allows for adequate access to both sides and generator controls (if controls are mounted on the end of the generator). Platform shall be in full accordance with all applicable OSHA safety standards for handrails, etc.

E. Generator Start: Generator set shall be started electrically using its own properly rated and sized batteries. Air start is unacceptable.

F. Connection to Building Power Distribution: Engine generator set shall connect to building power distribution system through coil and contactor operated automatic transfer switch(s) (ATS). "Walking Beam" switches are unacceptable.

G. Automatic Transfer Switch:

1. Transfer switch shall have an integral, field adjustable automatic exerciser clock.
2. If a four pole ATS is employed, the neutral switching operation shall be a 'make before break' on transfer to emergency power and re-transfer to normal power.
3. Acceptable manufacturer: Emerson Network Power ASCO 7000 Series or ASCO 4000 Series

H. Number of Automatic Transfer Switches:
When 'Standby Emergency' power is required, there shall be a minimum of two Automatic Transfer Switches installed. The switches and associated panels shall be labeled and identified as 'Life Safety' (LS) and 'Optional Standby Emergency' (OS). In a facility where a legally required standby system is required then there shall be a minimum of three Automatic Transfer Switches installed. The switch and associated panels for the legally required system shall be labeled and indentified as 'Required Standby Emergency' (RS).

I. Minimum Emergency Services: In addition to other requirements, the generator set shall have the capacity to serve, as a minimum, one elevator, building access control panels, all building data gathering panels used for HVAC control and management systems, steam condensate return pumps, and sump pumps.

J. Generator Sizing: Shall be for minimum 25% spare above calculated diversified demand loads. Greater than 25% spare capacity may be required. Consult with FSU Project Manager for percentage spare capacity.

K. Reference Standard: Generator shall conform to ISO-9001; have Class H insulation, and permanent magnet excitation for production of 300% of rated full load current for ten seconds.

L. Generator Cooling: Generator set shall be cooled with self-contained coolant and radiator system. Remote coolers are unacceptable.

M. Load Bank Testing: Generator set on-site acceptance testing shall be performed in accordance with NFPA-110 at 80% and 100% power factors.
1. The acceptance test shall be a minimum of 4 hours at 80% PF utilizing a resistor/reactive load bank device.
2. Generator Shop Supervisor shall be notified of the test schedule a minimum of 72 hours in advance so that they may attend.

N. Acceptance Testing and Code Conformance: On site testing of the entire emergency power supply system shall be witnessed by the Engineer of Record and a Representative from EH&S for the test to be valid. It is the contractor's responsibility to make arrangements for the test procedure and witnesses. This testing shall include all control systems incorporated in the particular generator/motor installation. A manufacturer's representative shall be available to demonstrate the system's control functions.

O. Fuel: The contractor shall furnish a full tank of fuel at the completion of all testing. Full tank shall be defined as 7/8 tank capacity.

P. Maintenance Manuals: Equipment supplier shall supply two operation and maintenance manuals. Deliver one to the Project Manager and one directly to the Generator Shop Supervisor.

Q. Warranty: All systems shall have a minimum five-year warranty. Additional warranty may be required on a project-by-project basis.

3.7 Service and Distribution

A. Electric Service:

1. **Source:** Electric service to buildings and facilities on campus will normally be served from FSU's 15 KV (12,470V) medium voltage distribution system. If a building is not served from an existing sectionalizing device, a new SF6 gas insulated vacuum fault interrupter device shall be installed. Interrupters shall have 600-ampere separable quick change bushings. G & W is the only acceptable manufacturer. A 35 lb bottle of SF6 gas shall be supplied with all new sectionalizing switch installations.
2. **Demand Capacity:** Service to buildings shall be supplied from pad-mounted transformers as described below. The transformers, service entrance conductors or bus, and main electrical panel or equipment shall be of adequate size for the demand expected in the facility and to allow for future growth of 25% based on calculated diversified demand.
3. **Transformer Location:** Transformers shall be located as close as possible to the main electric service room. Future servicing or replacement of transformers shall be a consideration when selecting a location. The transformer shall be protected from vehicular and pedestrian traffic.
4. **Connections:** Refer to Paragraph 2.4 (A) Wire and Cable Connections to Main Electric Service for allowable types of connections.
5. **Aesthetics:** The location of the building electric service apparatus shall be incorporated in the landscaping as much as possible.

B. Metering: A watt-hour meter with a demand register shall be provided for each building. This shall be coordinated through the University Project Manager with the Campus Utilities.

1. **Meter Location:**
   - **a.** For buildings being served by a pad mounted transformer, the meter location shall be on the transformer. Metering current transformers shall be installed in the secondary compartment of the transformer. A 1" conduit shall be installed from the pad to the nearest Building Automation System (BAS) control panel for connection by others to the campus monitoring system. Approved metering for building service is Siemen's DEM series 2000 meters.
   - **b.** All metering installed on or in switchgear, panels, or transformers shall be interface compatible with the campus BAS. Provide an empty 1" conduit with pull string from the metering location to the nearest BAS control panel.

C. Grounding

1. **Required Resistance:** All grounding for building services, standby generators, and transformers shall achieve a maximum 10-ohms or less as required by specific project criteria, using the three-point test method. Drive multiple rods as necessary to achieve the desired ground resistance.

2. **Connectors:** All grounds shall be connected with a properly sized copper conductor. All grounding electrode conductors shall be connected to ground rods by either (1) an approved exothermic welding process as manufactured by Erico or (2) a compression system as manufactured by Burndy known as 'Hyground'.
3. **Ground Rods:** Each ground installation shall be tested in the presence of the University's representative. A written record of the test results shall be prepared and signed by the contractor and University's representative. This record shall be submitted to the Architect/Engineer and supplied to the University with the "Record Drawings" and reports upon the completion of the project.

D. 15kV Circuit Coordination: It is the responsibility of the Engineer to insure the proper electric circuit coordination.

1. All new circuit and transformer installations shall be properly coordinated with the existing electric distribution on campus. The Engineer shall furnish circuit coordination parameters including relay/fuse settings, time-current characteristic curve plots, and verification that all settings have been made.
2. Existing substation breaker settings and available fault current data (at FSU's substation) will be made available, upon request, from FSU's Utility Department.
3. The Engineer must produce coordinated time current curve characteristic plots of his proposed settings for review and approval by FSU Utilities Section prior to energizing.

E. Pad-Mounted Transformers:

1. **Base Capacity Rating:** In order to provide better circuit coordination in the University's electrical system, a service transformer's base rating shall not exceed 2000 KVA. If additional capacity is required the design professional must consider either multiple transformers or specifying units that are dual temperature rated and equipped with forced air-cooling.
2. The phase overcurrent device simulated in the SF6 switch must be compatible with the campus system's feeder breakers in order to achieve proper circuit coordination. If requested, a copy of the feeder breaker time-current characteristic curves will be furnished by FSU for use by the design professional prior to the time required for the incoming service to be energized.
3. **Basic description, features, accessories:**
    a. **Insulating fluid** – Envirotemp FR3
    b. **Winding Material** – Copper or Aluminum
    c. **Primary Voltage**, 12470 delta – 95 KV BIL
    d. **Taps** – 2 @ 2 ½ % above and 2 @ 2 ½ % below normal
    e. **Configuration** – Dead front, radial feed
    f. **Primary Bushings** – Three Wells, 15 KV, 200-amp
    g. **Inserts** – Feed through
    h. **Secondary Bushings** – Spade Terminals
    i. **Fusing** – Bay-O-Net oil immersed in series with ELS-P

j. Impedance – NEMA Standard with standard tolerances
k. Color – Bell Green
l. Standard Features:
i. MOV arrestors
ii. Provisions for bushing mounted CT's
iii. Stainless steel grounding pads in HV and LV compartments
iv. Removable neutral ground strap
m. Standard Accessories:
i. 1" fill plug
ii. 1" drain valve and sampling device in HV compartment
iii. Dial type thermometer.
iv. Liquid level gauge
v. Pressure vacuum gauge
vi. Pressure relief valve.

4. **Conductor Connections:** All conductor connections to padmounted transformers shall be installed using 2-hole compression lugs, ½" bolts, (2) flat washers and (1) lock washer for wire size 4/0 and larger. All connection hardware shall be grade 5 cadmium plated steel or bronze equal to Burndy Durium type. Lugs shall be rated for copper only.
5. **Acceptable Manufacturers**: Cooper – Waukesha, Wisconsin; Howard– Laurel, Mississippi; or General Electric – Shreveport, Louisiana.

F. Medium Voltage Cable

1. **Specification:** Medium voltage cable shall be copper, 105 degrees C rated, EPR with 133% insulation.
2. **Size**:
a. Feeders: Cable size shall be 350 KCMIL for feeders.
b. Transformers: Transformer feeder cable, from switch to transformer, shall be 2/0, 1/0 or #2 (minimum).
3. **Acceptable Manufacturers**: Cable shall be manufactured by The Okonite Company or The Kerite Company.
4. **Proof-testing:** All new 15KV cable shall be proof tested according to manufacturer's recommendations prior to being energized.

G. Duct Bank Systems: All 15 KV cable shall be installed in duct bank system as follows:

1. All ducts shall be encased in at least 3" concrete on all sides, top and bottom.
2. Ducts may be EB-35, or schedule 40 PVC conduit. Conduit shall be parallel and separated by appropriate spacers. Conduit shall be sized as required for the project but not less than 4".
3. Duct banks shall have sufficient number of conduit for the project plus a minimum of two spares. Conduits from 15 KV switches to transformers will require only one spare. If future use may require additional circuit installation, then more spare ways may need to be installed.
4. Duct banks shall be a minimum depth of 36" to the top of concrete. Where duct banks are less that 36" or in locations that require protection, a layer of 'flowable fill' with red dye shall be installed over the duct bank. The

flowable fill layer shall come to within one foot of finished grade or, if under a paved area, to the bottom of the asphalt base or concrete pavement.

5. A #4 Rebar shall be installed in the duct bank on each corner of the flowable fill for all 2-duct wide banks. If deemed necessary by the engineer of record, on wider duct banks, more #4 Rebar shall be installed in the middle of the top and bottom of the duct banks.
6. A 4/0 copper ground loop conductor shall be installed with all duct banks, regardless of number of ways. The ground loop conductor shall be located in the center of the top of the concrete encasement.
7. All duct bank installations shall be inspected by the Engineer of Record, FSU's BCA, and FSU's Utility Department Representative prior to encasing in concrete.
8. If a duct bank is within 8' laterally or crosses a steam line, coordinate with FSU's Utility Department to insure sufficient additional heat barrier insulation is installed to prevent damage to the duct bank and electric cables.

H. Manholes

1. **Characteristics:** Manholes shall have the following basic physical description:
   - **a.** Inside dimensions of 8'-0" octagonal made from minimum 2500 PSI concrete.
   - **b.** Duct entrances supplied with end bells.
   - **c.** Minimum clearance from centerline of lowest duct entrance shall be 2'-0"to floor.
   - **d.** Minimum 8" thick walls, minimum 6" thick floor for sump.
   - **e.** Duct face at corners a minimum of 18" wide.
2. **Cabling Supports:** Cable racks shall be heavy duty, galvanized, with porcelain cable saddles. Pulling irons fabricated from hot-dipped galvanized steel bars shall be provided in walls opposite duct entrances. Cables shall loop manhole prior to exiting on through-pulls and shall pass by two adjacent complete faces, as a minimum, on angle pulls.
3. **Covers:** Conform to Specification RR-F-621 with vent holes and, minimum, two pick holes. Pick holes shall be minimum ¾" diameter. Cover shall be approximately 32-½" diameter. Manufactured by U.S. Foundry, or equal.
4. **Ground Loop Cabling:** Each manhole shall contain a 4/0 ground loop, mounted 18" above the floor, bonded to a ground rod that measures 10 ohms to ground or less. Ground loop shall bond all non-current carrying conductors in each manhole and shall be bonded to the ground loop conductor routed with the duct bank systems. Bond shall be by exothermic means or compression using a Burndy "Hyground" system. No other compression system is acceptable.

Part 4 – Lighting Systems:

4.1 <u>Requirements for Sit Down Review</u>

FSU is evaluating the present lighting guidelines. The revision will not be completed in time for the present edition of the Design Guidelines. Design professionals shall confer with FSU officials prior to doing any design on proposed lighting systems for any new construction.

4.2 Emergency Lighting

A. Shall be provided at all exits and in all stairways, hallways, mechanical rooms and elevators as required by NFPA-101.

B. Power Source: Building emergency generator system.
1. Battery powered emergency lighting shall not be used unless there is no emergency generator associated with the project.
2. Where emergency lights are required in classrooms, a bypass switch shall be installed to permit the light to be switched off during special presentations. During actual power failures, the bypass shall be rendered inoperative.

C. Exit lights: Shall be of the Light Emitting Diode (LED) type. If appropriate to the specific use, LEED compliant fixtures employing sustainable power sources may be considered. Approval by the Project Manager must be obtained prior to inclusion in the project.

4.3 Interior Lighting

A. General: Comply with the current edition of the Illuminating Engineers Society (IES) standard, except where specifically directed for different foot candle levels.

B. Standard: The standard lighting system shall utilize fluorescent T8 or T5 lamps with instant start electronic ballasts having a total harmonic distortion (THD) of less than 10%.
1. **Non-dimming Systems:** Interior systems shall employ 25W lamps where ambient temperatures and other conditions are suitable for their application.
2. **Dimmable Systems:** Use 25W lamps. Wherever possible, four-foot lamps are to be used. T5HO lamps may be used when required by project design.
   - **a. Approved dimming system manufacturers**:
     - **i.** Lutron 'Hi-lume' system
     - **ii.** Lutron Eco-10 system with Hi-lume 3D ballast where 1% dimming is required.
     - **iii.** Crestron
   - **b.** Scene Switching: All dimming systems shall employ switching scenes that will return emergency lights to full brightness upon loss of normal electric power.

C. Fixture Whips: All fixture whips shall have #12 wire minimum.

D. Automatic light controls shall comply with "Chapter 13, Energy Efficiency", of the Florida Building Code.

E. Stairway Lighting: Shall be above the landings and not above the steps.

F. Re-lamping: No lights shall be installed that require scaffolding for re-lamping. Exceptions include high ceiling auditoriums and gymnasiums.

G. Building Lighting Level requirements: The following recommended maximum lighting levels shall be used as a general guide*:

a.	Hallways, Restrooms	20 Foot Candles (FC)
b.	Classrooms	50 FC
c.	Offices	40 FC
d.	Laboratory	As required
e.	Mechanical/Electrical Rooms	30 FC
f.	All other areas	As required.

*Approval from FSU's Utility Department and Project Manager is required for variations from the above foot candle levels.

H. Classroom Lighting: Classroom lighting shall comply with DOE requirements. Lighting in classrooms and lecture halls with seating capacity greater than 25 people shall be equipped fluorescent dimming systems. For detail requirements for dimming and occupancy sensor systems refer to Appendix E, Design Criteria and Requirements for Classrooms at Florida State University.

4.4 Exterior Lighting

A. General: Outdoor lighting on the FSU campus shall be attractive and in keeping with the standards set forth in this section. The lighting plan shall be energy efficient while maintaining appropriate light level(s) as prescribed in the latest edition of the NFPA codes and IES handbook for high activity facilities. When outdoor lighting is associated with a building project, security lighting and parking lot lighting shall be included in the building design.

B. Lamp Access: No lights are to be installed that require scaffolding for re-lamping. Pole mounted parking lot and walkway lights shall be bucket truck accessible.

C. Lighting Control: Walkway and exterior security lighting shall be controlled by a photoelectric cell and contactor, with a manual override for maintenance.

D. Security of all areas shall be carefully considered when locating outside lights on buildings or on poles.

E. Aesthetics: Outdoor lighting shall be period style fixtures, pole mounted where possible. Poles and fixtures shall be:

F. Fixtures: All fixtures shall use high-pressure sodium lamps.

1. **Ballasts:** All ballasts shall be multi-voltage capable (120, 208, 240, and 277-volt). Tapped ballasts or 'voltage ranged' ballasts are acceptable.
2. **Globes/diffusers** shall be glass. Plastic is unacceptable. Precision injection-molded, UV stabilized; acrylic lens is acceptable for parking deck fixtures.

G. Walkway and roadway type fixtures:

1. **Acceptable Manufacturers:**
   - **a.** Holophane - Utility Series Granville with black finial or
   - **b.** Sternberg - Hometown Series with acorn glass globe.
   - **c.** Fixture trim shall be black.

H. Parking Lot Fixtures:

1. **Acceptable Manufacturers**:
   - **a.** Gardco - Gullwing Series (G18 series) or
   - **b.** Lithonia Lighting – Aeris AS2 Series w/decorative curved arm
   - **c.** Fixtures shall be black.
2. **Poles:**
   - **a. Streets/Walkways:** Poles shall be 12' Holophane Mount Vernon series or Sternberg Somerset (2700-FP) series flute aluminum for streets and walkways.
   - **b. Parking Lot Poles** shall be square aluminum of appropriate height.
   - **c. Pole Color:** All street and walkway poles shall be black. Parking lot poles shall be bronze.
   - **d. Pole Mounts:** Poles shall be mounted on poured concrete bases. Bases shall be installed at grade level on asphalt, concrete or brick paving; at 6" A.F.G. along walkways and streets; at 30" A.F.G. in parking lots.
   - **e.** Light fixtures and poles shall be separate items (no combination units).
   - **f.** All lighting circuits shall employ an appropriate sized Quazite junction box at each pole location. Conduit shall not be run directly from pole to pole.
   - **g.** A minimum size of 1" buried to a depth called for by the NEC. A Quazite junction box shall be installed near a pole location. A ¾" conduit may be used from the junction box to the pole.

4.5 Parking Deck Lighting

A. The consultant shall evaluate the feasibility of installing lighting control systems that monitor and control the "interior" and "exterior" lighting zones according to available ambient levels. The control systems shall be field adjustable to owner's specifications.

B. A control system recommendation shall be presented to the Project Manager no later than the 50% plans submittal.

C. Acceptable Manufacturers:

1. Lithonia – PGR Series with 100-watt HPS lamps. Fixtures shall be dark bronze with offset junction box mounting feature. (QRS is a quartz restrike option where such is desired)
2. Gardco – Quadra Series fixture with 100-watt HPS lamps. Fixtures shall be dark bronze with offset junction box mounting feature. (QRS is a quartz restrike option where such is desired).

D. Due to the ever changing technology in lighting systems, different systems may be employed in new parking garage projects. Any new system design must be evaluated by the design professional (economically and shown to conform to lighting design criteria) and have approval of FSU's Engineering Services.

Part 5 – Miscellaneous Systems

5.1 Lightning Protection Systems

A. New Construction: All buildings/structures shall have appropriate lightning protection systems designed and installed in accordance with NFPA-780.

B. Existing Construction: Expansions and renovations of existing facilities shall upgrade the existing lightning protection system as required to obtain or maintain a Master Label for the envelope.

C. Certifications: Installer shall be LPI certified. Installed system shall bear a Master Label.

5.2 Blue Light Emergency Call Station Poles and Fixtures

A. Blue Light Stations (BLS) manufacturers: Approved vendors: Talk-A-Phone. Design specifications for the BLS are available from the project manager. The design professional shall be responsible for insuring the BL specifications are current with FSU's standards.

B. Campus Police Coordination: Blue Light Station locations shall be coordinated with the FSU Campus Police Department representative. Design professional shall confer with the representative during the design phase of the project.

C. Blue Light Installation:

1. BL stations shall be ADA accessible including wheel chair access. If required install a concrete apron for wheel chair access.
2. The pole foundation shall provide adequate support for the installation. A copy of the foundation detail is available through the Project Manager.
3. When the pole is installed on the foundation, allow a 1/2" air gap between the bottom of the pole and the foundation.

4. Wall mounted units shall be 48" to the red activation button for ADA compliance.
5. **Electrical:** A dedicated emergency circuit (on Life Safety emergency system) shall be installed from the emergency panel to the BLS. The circuit panel and number shall be indicated in the BLS access panel.
6. **Communication:** A 1" conduit (with pull string) shall be installed from the BLS to the communication room specified for each project.

END OF SECTION