

Louisiana State University Design Standards

DIVISION 26 - ELECTRICAL

1 ELECTRICAL REQUIREMENTS

- 1.1 Consultants shall explicitly follow all applicable criteria listed. Any variation from these criteria must be approved by the Office of Planning, Design and Construction (PDC).
- 1.2 For each project, provide electronic versions, pdf file format, of Operation and Maintenance manuals. Include submittal data on panel boards, switchboards, starters, transformers, meters, light fixtures, lighting controls, fire alarm system, sound systems, telecommunications equipment, etc.
- 1.3 All requests for power outages shall be coordinated with the Office of Facility Services, and shall be requested in writing at least two weeks prior to the outage. For each outage, the Contractor shall complete and submit a Facility Services Utility Shutdown Request form. The Contractor shall attend any pre- shutdown meetings required by the University to coordinate such outages. All work requiring a shutdown shall be scheduled after working hours or on weekends unless specifically allowed otherwise by LSU.
- 1.4 Verify with Mechanical that sufficient air conditioning is provided to all rooms with transformers, UPS's, Power Conditioners or other major heat generating electrical equipment.
- 1.5 All penetrations made in walls, floors or other building partitions for raceways, cables, equipment, etc. including penetrations in concealed areas (ceilings, chases, etc.) shall be either bore drilled or core drilled as required. Bust/poke-throughs with hand tools shall not be used to penetrate and will not be accepted. Any bust/poke through penetrations will be patched and redone with a drilled penetration by the contractor. All penetration work shall be neat and debris cleaned up after completion. Any walls or ceilings damaged due to penetration work shall be repaired. Any penetrations through walls or ceilings in visible finished areas shall be patched and painted, as required, to restore the finish around the penetration to its original condition. Where paint color/texture cannot be matched for an invisible transition from new to existing finish, the entire wall shall be repainted. The Contractor is to verify before starting any penetration work that the item to be penetrated has been checked by LSU and is free of asbestos. Roof penetrations shall be sealed by a licensed roofing contractor which maintains the existing roof warranty.
- 1.6 All wiring shall be run in conduit or other type raceways unless specifically noted or allowed otherwise by LSU. Horizontal runs of low voltage fire alarm, telephone, data, & controls may be run without a raceway in accessible ceiling spaces where allowed by code. Surveillance camera wiring shall be considered data wiring. Where run without raceways, cables shall be routed & grouped together utilizing UL approved J hooks by Caddy, Raco or approved equal attached to the building structure & spaced 4' - 0' maximum in a neat orderly arrangement. Ceilings considered accessible shall only be those with lay in panels on T-bar grids. Other types of ceilings may be considered accessible if specifically approved as such by LSU. Hangers used to support wiring run without raceways shall be Caddy CAT series or B-Line BCH series J- hooks or other hangers approved by LSU with mounting as appropriate to the location. Hangers shall be submitted for approval. Do not use wire wraps or tie straps to support cable. Provide attachment accessory suitable for the substrate the hanger is being attached to. Wiring run without raceways shall be bundled together with reusable Velcro wraps (not nylon tie wraps) at least once between each 4'-0' support. Wiring must be routed on the supports as high as possible, free and clear of mechanical equipment, lighting fixtures, piping, conduits, ductwork, building structural members and any other building equipment or items. Cables shall not rest on the ceiling support grid system or other building items. Each wiring system (fire alarm, telecom, etc.) shall be run separate with separate hangers. Do not support from ceiling system supports, HVAC ductwork, conduit, piping, etc. Where wiring run without raceways penetrates walls or ceilings a metal conduit sleeve with bushings at each end shall be provided for the penetration. Cables shall not be run through holes in walls or ceilings. Each cable shall be continuous, without splices or connections from the source to the connected device. Routing shall be parallel or perpendicular to building lines. Support arrangement and tension on cables shall be minimized to prevent exceeding the maximum cable bending radius. Where cables transition from sections run without a raceway into sections run with a raceway, a bushing shall be installed on the entrance to the raceway (conduit, wiremold, etc.). All fire alarm wiring shall have a red colored jacket.

- 1.7 All penetrations through floors, ceilings or other partitions shall be sealed using the design and materials of an Underwriters Laboratory (UL) listed method to maintain the fire resistance rating of the system. The contractor shall submit manufacturer's cut sheets of the product(s) to be used and the UL assembly method it will be used in before making the penetrations. This information shall also be provided at the end of the project at the time of the Fire Marshal inspection. For renovation projects, all existing walls and ceilings shall be considered to have a minimum 2 hour assembly rating.
- 1.8 Wiring run without raceways through ceilings or other spaces used for environmental air handling (ceiling spaces used for return air, etc.) shall be listed for the use (plenum rated) & comply with NEC Section 300-22.
- 1.9 For each new panelboard, provide a load schedule on the project drawings listing the load for each branch circuit and a breakdown of the connected load on the panel. Provide an electrical load summary for each project, as part of the final review set.
- 1.10 The fault rating of all new electrical distribution equipment shall be sufficient for the maximum available fault current. The fault rating for all new equipment shall be listed in the specifications or on the drawings. New circuit breakers added to existing panels are to meet or exceed the fault rating of the existing breakers in the panel.
- 1.11 Provide concrete housekeeping slabs under all floor mounted electrical equipment.
- 1.12 The exact location of starters, disconnect switches, control panels and similar type items shall be coordinated in the field with all other items being installed in the project and with any existing items, and adjusted as required to maintain all code required clearances.
- 1.13 Permanently label all electrical distribution and control equipment (panels, safety switches, starters, transformers, etc.) with etched laminated plastic nameplates, black letters on white background, 1/4" minimum size lettering.
- 1.14 Meter all electrical services for both energy usage and power demand.
- 1.15 For any existing systems (fire alarm, emergency lighting, access control, etc.) for which work is performed in a project, before starting work, the contractor is to document in writing to LSU any existing problems with the system (control panels in alarm condition, lights not operating, etc.). Any non-documented problems in these systems noted after the contractor starts work will be the responsibility of the contractor to correct at no increase in cost to LSU.
- 1.16 The contractor is responsible for providing temporary construction power to all construction sites from a source to be determined by LSU. All temporary construction power is to be provided with metering and charges for the power are to be paid for by the contractor.
- 1.17 Electrical equipment shall be contained in a dedicated electrical room with a minimum of one room on each floor.
- 1.18 For elevators, provide telephone service to the controller and generator emergency power circuit for elevator car lighting when the building has an emergency generator.
- 1.19 All mechanical piping and ductwork shall be routed such that they do not cross over electrical panels and switchboards or the working clearances of these items as per NEC.
- 1.20 Raceways shall be concealed in all finished areas unless required to be surface by existing conditions. Where raceways must be surface type in finished areas, they shall be decorative surface raceway, not exposed conduit. Surface raceways with power conductors (not tel/data) or combined power/tel/data raceways shall be metal type, not non-metallic type. Surface raceways for telephone, data shall be non-metallic type per LSU Information Technology Services standards. Surface power raceways shall consist of a system of U.L. approved, factory painted finish, surface metal raceway consisting of base and cover sections, wire retainers, corners, bends, junction boxes and all accessories required for a neat and complete installation. Boxes shall be sized to accommodate the wiring devices to be installed. Size of raceway shall be approved for number of conductors to be installed. Surface metal raceway shall be by Wiremold or approved equal with manufacturer's standard accessories (couplers, corners, right angles, entrance end fittings, tees, end caps, etc.) as required for a neat and complete installation. A factory supplied bushing shall be provided at the entrance to all surface metal raceways. Surface non-metallic raceway shall be surface mount constructed of high-impact, fire-resistant, UL Listed, PVC type compounds. All sizes and types of fittings including flat, inside

and outside elbows shall be EIA/TIA compliant with respect to Cat-6 bend radius requirements. Non-metallic raceway shall be provided complete with manufacturer's standard accessories (couplers, corners, right angles, entrance end fittings, tees, end caps, etc.) as required for a neat and complete installation. The color of all surface raceways and associated boxes, fittings, etc., shall be selected from the manufacturer's standard color selection to best match the finish color of the particular wall the box is to be installed on.

- 1.21 Wiring for transformers and bussing for panelboards, switchboards and bus ducts shall be copper.
- 1.22 Outdoor equipment (panelboards, safety switches, contactors, etc.) shall be stainless steel with external mounting tabs.
- 1.23 Conduit connections to outdoor enclosures shall be watertight with listed weatherproof hubs, not with only locknuts and shall be made on the bottom or sides of the enclosure (no top penetrations).
- 1.24 Do not run exposed conduit on exterior walls unless specifically allowed otherwise.
- 1.25 Under demolition, add the requirement that the contractor re-feed any items to remain presently fed through items to be removed in the project. Remove all accessible unused and abandoned wiring and conduit back to the source. This includes the conduit and abandoned wiring in accessible ceiling spaces. Electrical demolition is to include removal of all unused electrical items (conduit, boxes, wire, light fixtures, cables, supports, etc.) in the area being renovated. This includes any existing already un-energized abandoned electrical items as well items disconnected as part of this work.
- 1.26 For renovations, electrical work is to include re-supporting existing conduit, boxes, cables, etc. in ceiling not properly supported in accordance with requirements for new work in project.
- 1.27 The University has the right of salvage to any demolished equipment. For equipment to be removed, the Contractor is to confirm with the University whether or not the University desires to keep the respective piece of equipment. Equipment desired by the University shall be moved by the Contractor to a designated site on campus. Any equipment not desired by the University shall become the property of the Contractor and removed/disposed of by the Contractor.
- 1.28 For existing buildings being renovated, re-feed all exterior lighting circuits fed from the building which feed lights which are to remain (building mounted lights, street lights, etc.). Existing exterior lights shall be temporarily fed and controlled during construction to maintain security lighting around the building. Note the demolition of the existing exterior light fixtures and verify there is sufficient exterior security lighting to replace the coverage of the removed fixtures.
- 1.29 For maintenance considerations, unless specifically allowed otherwise by LSU PDC, ceilings shall be easily accessible with a simple method of tile removal so that electrical equipment may be more easily maintained and circuits may be added in the future. Hard ceilings shall only be used in areas where LSU specifically grants the designer permission to use non-accessible ceilings (plaster, gyp board, etc. or ceilings without a simple easy method of tile removal) generally restrooms or other high humidity areas. Where accessible ceilings are allowed by LSU, recessed light fixtures shall be capable of having the driver replaced from below the ceiling through the fixture opening and access panels shall be provided for items requiring access by code.
- 1.30 The electrical contractor is to submit a Facility Services Utility Locate Request form and have it approved before performing any digging or driving any object below grade.
- 1.31 For excavating in areas congested with existing underground utilities, the contractor is to use water excavation or hand dig in the vicinity of existing lines. Exact routing of all new underground ductbanks is to be adjusted in the field to avoid existing obstructions.
- 1.32 For any work requiring building electrical outages, develop and list in the bid documents a recommended sequence of work to accomplish the electrical work and verify all necessary outages are addressed and any special work or materials required to maintain power to critical loads is provided for as part of the project. Coordinate with the building users and if they cannot accommodate an outage of sufficient length to accomplish the work, then include the cost in the project to provide and connect a temporary generator to power any necessary building loads. The sequence of work associated with the electrical outage utility work is to be outlined and the allowable duration of the associated outages is to be clearly stipulated in bid documents. The sequence developed is to be approved by LSU before the project bids.

- 1.33 Include as part of the project for the contractor to provide an arc flash analysis and labeling service based on compliance with NFPA 70E, OSHA 1910 and IEEE 1584. All switchgear, switchboards, transformers and panelboards are to have arc flash labeling complying with the above standards including arc flash boundaries outlined, and required levels of personal protective equipment posted. Provide specifications for this work.

2 CONDUIT & BOXES

- 2.1 All wiring shall be run in conduit or other type raceway except where specifically allowed otherwise.
- 2.2 Galvanized rigid steel conduit w/ threaded fittings shall be used for all exterior conduit, conduit in damp locations, and conduit embedded in or run through concrete slabs.
- 2.3 Underground conduit runs shall be grey colored schedule 40 PVC type. Conduits for all underground medium voltage feeders shall be encased in 3" minimum of red concrete unless directionally bored. Conduit for directional bores shall be continuous Schedule 80 HDPE coiled in reels for direct burial service. There shall be no splices in directionally bored conduit.
- 2.4 Interior conduit in dry locations shall be EMT type with compression type fittings. Set screw fittings shall not be used.
- 2.5 Provide an insulated bushing on the ends of all conduits 1" size and larger.
- 2.6 Outlet boxes in concealed conduit systems shall be flush mounted, galvanized steel of sufficient size to accommodate the number of conductors and devices contained and be securely fastened to wall or ceiling framing for a rigid installation.
- 2.7 Outlet boxes for lighting fixtures shall be 4" octagon, galvanized steel, not less than 1-1/2" deep, with fixture stud fastened through from the back of the box.
- 2.8 Where outlet boxes are installed in a concrete slab, units designed and listed for this application shall be used.
- 2.9 Device boxes for receptacles, switches, data and communications outlets shall be deep type, not less than 4" square and 2-1/4" deep. Device boxes shall have box extension rings with the required number of gang openings and with a depth to match the wall finish material so that the face of the box extension is exactly flush with wall face.
- 2.10 Outlet boxes for switches and receptacles in exposed conduit systems shall be cast iron or aluminum, factory finished, Type FS or FD, with number of gangs as required.
- 2.11 Outlet boxes shall not be installed back to back in walls or floors.

3 POWER WIRING (600 VOLT AND BELOW)

- 3.1 All conductors shall be of soft drawn annealed copper having a conductivity of not less than 98% of that of pure copper. Conductors shall be standard code gauge in size, & shall have insulation rated for use at 600 volts.
- 3.2 All conductors shall be color-coded as follows

3Ph 480V System	3Ph 208 (or 240V) System	1Ph 240V System
Phase 1- Brown	Phase 1- Black	Line 1- Black
Phase 2- Orange	Phase 2- Red*	Line 2- Red
Phase 3- Yellow	Phase 3- Blue	Neutral-White
Neutral- Gray	Neutral-White	Ground- Green
Ground- Green	Ground- Green	(* Orange for wild leg)

- 3.3 Color coding shall be continuous the full length of wire No. 10 and smaller. On larger sizes, identification shall be by color-coded phasing tape at each box and connection. Surface printing at regular intervals on all conductors shall indicate manufacturer, size, Voltage and insulation type. White or gray colored insulation shall only be used for grounded (neutral) conductors. For multiple neutrals run in the same conduit, provide separate neutral conductors with a continuous, factory applied tracer stripe matching the color of the

respective phase conductor. Green colored insulation shall only be used for equipment grounding conductors. Insulation for isolated equipment grounding conductors shall be green with yellow tracers.

- 3.4 Except where specifically allowed, feeders shall be run their entire length without joints or splices. Splices in branch circuit wiring shall be made only at outlets or in accessible junction boxes. Splices in branch circuit wiring shall be listed for the quantity, types and sizes of the conductors connected. Splices shall be made with compression type solderless connectors or spring loaded, tapered, screw on type insulated units (wirenuts). Push-in, plastic body type connectors are not allowed. Do not use wirenuts on splices of solid wiring to stranded wiring. Terminations or splices for conductors No. 6 AWG and larger shall use compression type connecting lugs made with a hydraulic type compression tool approved by the manufacturer. All splices and terminations shall be insulated in an approved manner by an integral or separate cover or by taping to provide insulating value equal to that of the conductors being joined.
- 3.5 Branch circuit power conductors shall be a minimum No. 12 size except that conductors shall be minimum No. 10 size for 120V circuits with home runs over 75 feet long and for 277V circuits with home runs over 100 feet long.
- 3.6 Wire shall be copper, THHN/THWN insulation, #12 size minimum. Sizes #8 and larger shall be stranded. Wires #12 and #10 AWG may be stranded if terminated in devices which do not use screw type terminal connections and are UL listed for termination with stranded conductors (lug, pressure plate connectors, etc.). Wires #12 and #10 AWG shall be solid if terminated in devices which use screw type terminal connections or which are not UL listed for termination with stranded conductors.
- 3.7 For all conduit runs and raceways, provide a separate, green colored, insulated equipment grounding conductor, sized per the NEC, in addition to the conduit or raceway ground.
- 3.8 All emergency lighting shall be run in separate raceways from normal wiring, as per the NEC.
- 3.9 Each branch circuit shall have a dedicated neutral. Sharing a common neutral between multiple phases is not allowed.
- 3.10 For receptacles and switches which are not the end of the line, the equipment grounding conductor and neutral shall not route through the device per NEC 250.148(B). For such instances, splice from the incoming conductor in the box with one conductor going to the device and one continuing to the next device on the run, such that the device can be removed without losing the ground or neutral connection to the downstream devices.
- 3.11 For branch circuit wiring, there shall not be more than 8 current carrying conductors per raceway. Neutral conductors shall be considered current carrying. Apply derating factors as per NEC and increase size of conductors if necessary.
- 3.12 Each feeder shall be run in its own dedicated raceway.
- 3.13 For all 120 and 277 Volt branch circuits rated 30A or smaller serving above floor interior items requiring concealed wiring, the Electrical Contractor may use National Electrical Code (NEC) metal clad Type MC Cable in lieu of wiring in hard conduit. BX, AC, and NM type cables are not allowed. MC cable is to be run concealed except for equipment rooms where it can be exposed. All other wiring is to be in hard conduit as specified. The use of MC cable is not allowed for feeders. MC clad cable shall be a factory packaged, U.L. listed, NEC constructed assembly consisting of a flexible galvanized steel conduit system with pre-packaged insulated conductors with an integral insulated full size dedicated neutral (no multiwire branch circuits sharing a common neutral allowed) and a full size green grounding conductor. All conductors shall be rated 90°C. All circuits shown on the Drawings or called for with a separate normal and isolated grounding wire shall have a separate insulated ground wire in the cable, color coded green for the normal ground, and green with a yellow tracer stripe for the isolated ground. Color coding of the wiring shall comply with NEC and this Design Standard. Contractor MUST use different cables with different colors for each phase with the colors as noted above. The exterior of the MC cable shall be marked to indicate the color of the phase conductor(s) contained. The fittings used for MC cable shall be steel constructed and of the type specifically designed and listed for this use. Connections to boxes, panels or devices shall be made with steel straight squeeze connectors and secured with no play for a dependable ground. If required, provide oversized type fittings when attaching to a multiple size knockout to prevent the cable from opening the larger size knockout ring. Any loose connections shall be remade or replaced until acceptable to the Engineer. MC cable must be

secured and independently supported from the structure with a maximum spacing of 4-1/2 feet and with supports within 12 inches of every connection to a junction box or device. Use hangers similar to Caddy CC Series, 6M Series, WMX Series and RBMX Series. This cable must be neatly bundled together and routed to follow the building lines and not interfere with access to other equipment. Do not route diagonally. Do not lay over insulation, horizontal structural members, light fixtures, ductwork or HVAC equipment.

4 WIRING DEVICES

- 4.1 Wiring devices (receptacles and switches) shall be specification grade, 20A minimum rating, with nylon housing and metal mounting strap (devices with plastic mounting straps are not acceptable). Switches shall be silent actuating with 120V or 277V rating, as required by the circuit controlled. Receptacles may be back or side wired, but back wired receptacles shall utilize a pressure connection requiring the side screw to be tightened (wires held in with clip type mechanisms are not acceptable). Contractor shall tighten the screws on any unused receptacle terminations, to reduce the possibility of protruding screws shorting to the box.
- 4.2 Provide receptacles with integral ground fault protection for outdoor receptacles, receptacles in wet locations and receptacles where required to be ground fault type by code.
- 4.3 For any existing receptacles to remain in areas being renovated, the contractor is to check out the existing wiring and correct any problems (no power, open grounds, reversed polarity, etc.) and to repair and/or replace any inoperative or damaged receptacles.
- 4.4 For all new receptacles and light switches and for existing receptacles and existing light switches in renovated areas, and for all equipment connections made with disconnect switches, enclosed circuit breakers or a hard wired connection, provide a permanent label on the coverplate with the panel designation and circuit number of the circuit serving the device. Labeling shall use laminated, scratch resistant, 1/2" wide polyester adhesive backed tape, Panduit LS4M or Brother P-Touch labeling system or equal system approved by LSU Facility Services. Labels shall be black letters on clear background for light colored plates (ivory, white, etc.) and white letters on clear background for dark colored plates (black, brown, etc.). Lettering shall be 1/8" size.
- 4.5 Wiring devices shall mount securely to the device backboxes with no play (no gaps between mounting ears of the device and the box or trim ring).
- 4.6 Coverplates for interior wiring devices (receptacles, light switches, etc.) shall be flexible nylon type (not hard thermoplastic). Coverplates shall not be stainless steel unless specifically requested by LSU. Covers for exterior wiring devices shall be gasketed, non-metallic type with upward operating self-closing spring door. Weatherproof receptacles shall be flush mounted in exterior walls, unless required otherwise.
- 4.7 Provide red colored devices and cover plates for all receptacles and switches on emergency generator power.
- 4.8 For all receptacles securely attach the devices yoke to the back box or back box to wall structure such that there is minimal movement of the device when a plug is inserted or removed and the device is not dependent on the plate to keep it in position. For instances where the back box is loose, secure the back box to the wall structure. For instances where the mounting ears of the device do not touch the box ring due to improper extension ring depth and do not securely sit on the wall finish due incorrect wall opening size, where boxes are set back more than 1/4" from the face of the finished wall/ceiling provide an adjustable box extender ring (Bridgeport BXE series, RACO 976 series or approved equal). Where boxes are set back less than 1/4" from the face of the finished wall/ceiling provide a device leveler and retainer (Caddy RLC or approved equal). Provide any other work and accessories to provide a rigid, level installation of the device to the box.

5 SAFETY SWITCHES

- 5.1 Safety switches (disconnect switches) shall be UL listed, heavy duty type with ratings and features as required by the load served. Switches shall have visible blades, be padlock-able in the off (down) position, use positive quick made, quick break operating mechanisms, be horsepower rated for the motor served, have a NEMA 1 enclosure for dry indoor location and a NEMA 4X stainless steel enclosure for outdoor or wet locations. Safety switches shall have an isolated neutral bus for circuits with a neutral. All safety switches shall have listed ground lugs attached to the enclosure as required for terminating all equipment grounding conductors.
- 5.2 Safety switches shall be fused when required by code to provide overcurrent/short circuit protection or to comply with the nameplate data of the equipment served. Safety switches shall be non-fused when the

branch circuit protection device ahead of the switch provides the code required overcurrent/short circuit protection and the specific protection required by the equipment served as listed on the equipment nameplate.

- 5.3 For maintenance considerations, unless not possible by code or by requirements of the manufacturer of the item served, use enclosed circuit breakers instead of fused type safety switches to provide overcurrent/short circuit protection to equipment.
- 5.4 Galvanized angle, channel or other suitable supports shall be provided for switches that cannot be mounted on walls or other rigid surfaces. Switches shall not be supported by conduit alone. Switches shall not be mounted on equipment unless specifically allowed otherwise. When allowed, the location shall be coordinated with the equipment manufacturer, such that the switch does not damage any working components or block any unit access.

6 FUSES

- 6.1 Fuses protecting panelboards, switchboards and other distribution equipment shall be current limiting type RK1. All other fuses shall be current limiting type RK5. Provide one spare set of fuses (3 minimum) for each type and size fuse used on a project.

7 PANELBOARDS

- 7.1 Panel boards shall be circuit breaker type using quick-made, quick-break, trip free, bolt-on, molded case circuit breakers. Provide 25 % spare/spaces in each panel section (minimum of 4). Provide an additional section, if necessary, to meet this requirement. Panel board shall be dead front safety type with main breaker or main lugs, as required by code. Panel boards shall have single, feed through, or double lugs to accommodate feeder conductors. Panel boards with neutrals shall have a neutral buss and a neutral bar insulated from the enclosure for terminating feeder and branch circuit neutral conductors. Each panel board shall have an equipment grounding bar connected to the cabinet for terminating feeder and branch circuit ground conductors. All panel board bussing shall be copper. Load centers are not acceptable.
- 7.2 Doors shall be fitted with flush cylinder locks, keys to which shall all be alike: two keys shall be furnished for each lock. Provide a directory for each panel with typewritten identification of all circuits listing final approved room names, room numbers and item served.
- 7.3 Indoor panel boards shall be NEMA 1 and have door-in-door trim to allow hinged access to the interior panel wiring without removal of the panel door assembly (one lockable door over the interior and one which exposes the gutter).
- 7.4 Outdoor panel boards shall be NEMA 4X, stainless steel with external mounting tabs.
- 7.5 For recessed panel boards, provide a minimum of three 3/4" spare empty conduits from each panel section to the nearest accessible ceiling space.

8 SWITCHBOARDS

- 8.1 Switchboards shall be dead front with molded or insulated case circuit breaker mains and branches. Main circuit breaker shall have ground fault protection when required by code. Switchboards shall have an incoming solid state power meter recessed in the front of the enclosure to measure phase voltages (L-L and L-N), phase amps, KW, KVA, peak KW, peak KVA. CTs and PTs used in the metering shall provide minimum 2% accuracy.
- 8.2 Switchboard bussing shall be plated copper and be of sufficient cross sectional area to meet UL Standard #891 on temperature rise. The entire switchboard assembly (bussing, circuit breakers, etc.) shall have a fault rating as required to exceed the available fault current. All incomplete vertical sections shall have full length "space only" bussing such that it may accept future branch devices. This is to be in addition to the scheduled space or spare branches specified or scheduled. The continuous current rating of the vertical bussing shall be equal to or greater than the capacity of the available branches whether scheduled, supplied or not. Feeders shall enter and terminate in the same vertical section as per NEC 384-3 or interior wireways specifically for horizontal cable routing shall be provided. No cable is to route between or in physical contact with switchboard bussing. Horizontal bussing shall be full size, non-tapered with ampacities as required by the loads served plus minimum 25% extra for future and tapered for full size future extension.

- 8.3 The switchboard shall have a ground bus extending through all sections. All equipment grounding conductor cables shall terminate at this ground bus with suitable lugs and not the metal switchboard frame. The ground bus shall be factory bonded to the switchboard frame.
- 8.4 Switchboards in non-secure areas shall have full length and width lockable, handle operated, hinged doors.

9 DRY TYPE TRANSFORMERS

- 9.1 Dry Type Transformers shall have two 2 ½ % primary taps above and below normal. Units are to have minimum 220° C insulation system with maximum 150° C temperature rise at 40° C ambient. Floor mounted units shall be provided with rubber vibration isolating pads (minimum ½" thick).
- 9.2 Dry type transformers shall have copper windings.
- 9.3 Sound levels shall not exceed 45 db for units 75 KVA and below, or 50 db for units above 75 KVA in an ambient of 24 db.
- 9.4 Dry type transformers shall be K rated as required when serving loads with significant levels of non-linear harmonic load currents.

10 LIGHTING

- 10.1 Design to Illuminating Engineering Society (IES) recommended levels for the use of the space or area.
- 10.2 Lighting shall be energy efficient, utilizing LED light sources. Color temperature of the LEDs shall be 3500K.
- 10.3 Incandescent, fluorescent and HID lamps are not to be used. Justification and approval from LSU for specialty use is required.
- 10.4 Each fixture shall be supported independently from the building structure.
- 10.5 Lenses for interior fixtures shall be injection molded UV stabilized acrylic (minimum 0.125" thick) or glass. Polycarbonate lens shall not be used unless specifically permitted by LSU.
- 10.6 Use occupancy sensors to control lighting in classrooms, conference rooms, restrooms, offices, storage rooms and similar spaces. Occupancy sensors shall have adjustable time delay 30 sec to 30 minutes and adjustable sensitivity. Rooms shall generally have a switch at the door to override the occupancy sensor to off if a wall type occupancy sensor with this capability is not used.
- 10.7 Lighting in areas where computer terminals are used shall be designed to minimize direct and indirect glare when viewing the terminal displays.
- 10.8 At the design development phase of a project, a lighting fixture schedule shall be provided listing at a minimum a description of each type fixture to be used and the proposed lumen output. In addition a cut sheet of each proposed fixture shall be provided.
- 10.9 Where existing fixtures are replaced with new fixtures, the connection shall include a #12 green equipment ground wire from the circuit equipment ground wire, if one is present, or from the metal box if a ground wire is not present.
- 10.10 Provide an HOA switch on all lighting contactors.
- 10.11 For recessed light fixtures, provide a maximum of 4 feet of steel constructed flexible metal conduit or MC cable between the last branch circuit wiring junction box and the fixture. Wiring in flexible conduit or MC cable shall be #12 size minimum with a green equipment ground wire. Flexible conduit to each fixture shall be from a hard conduit connected junction box to the fixture. Looping from fixture to fixture with flexible conduit or MC cable is not allowed.
- 10.12 Main corridor lighting shall be controlled by relays controlled through occupancy sensors. Selected minimal corridor lights shall be unswitched, connected to generator backed emergency lighting circuits with sufficient quantity and location to provide only the necessary code required emergency lighting and to allow the main corridor lights to be switched off during times of inactivity.
- 10.13 For emergency lighting, in all areas except for corridors and stairs, where lights are on an emergency lighting circuit, connect these fixtures to an emergency lighting circuit through an emergency lighting control unit (ECU) which normally controls the emergency fixture with the other normal fixtures in the room and automatically turns on the emergency fixture upon an outage of the normal lighting branch circuit. Do not use an emergency transfer device so that the fixture is never powered by the normal lighting circuit. For switched fixtures, the ECU shall be Wattstopper ELCU-200 Emergency Lighting Control Unit or approved

equal. For dimmed fixtures, the ECU shall be Iota ETS 20-DR or approved equal. Provide a nameplate in the fixture stating "EM FIXT W/ EM LTG CONT UNIT". Emergency lights in corridors and stairs are to be circuited as unswitched night lights and will not require an emergency control unit. Stairwell lights are to be provided with integral sensors to switch the fixture to reduced light output after no motion is detected after an adjustable time delay.

- 10.14 Lighting is to be installed such that there are no locations where the maintenance of light fixtures requires the use of greater than a 26 ft vertical scissor lift (30 ft maximum ceiling height) or would require scaffolding such as over a stair (no fixtures over stair risers), or other situations where the maintenance would be difficult or require specialized lifts.
- 10.15 All light fixtures shall have a minimum 5 year manufacturer's warranty.
- 10.16 All existing ballasts in ECM and renovation projects that do not carry the words "Non-PCB" shall be removed from existing fixtures, stored in the approved DOT/EPA specification drums (Provided by the contractor). These drums shall have a log of exact contents and date each article was in each drum. The drums shall be stored on pallets in a location suitable to the Owner. Disposal shall be the responsibility of the Contractor and shall be in accordance with all state and federal requirements. All PCB tracking documents from jobsite to destruction shall be delivered to the Owner via the Architect/Engineer prior to project close-out.

11 OUTDOOR LIGHTING

- 11.1 Outdoor site lighting shall provide adequate security lighting around buildings and on the sidewalks and drives. Lighting levels shall be in accordance with the latest IES recommendations. The light source should be energy efficient for low operating cost with a long lifetime for low maintenance. Fixtures shall utilize LED light sources. Color temperature of the LEDs for outdoor fixtures shall be 4000K.
- 11.2 Glare shall be minimized as much as possible with fixtures using cutoff type reflectors wherever possible. Open face "wall pack" type fixtures generally shall not be used except for equipment type areas not generally visible from public view.
- 11.3 Exterior light fixtures shall have a glass or acrylic lens to prevent lens yellowing. Polycarbonate lens are not allowed. Exterior fixtures not exposed to the weather shall be UL damp location listed and those exposed to the weather shall be UL wet location listed
- 11.4 Bollard fixtures are not generally desired and should only be used where specifically approved for use by LSU and where there is little chance of being struck by lawnmowers or vehicles. Ground mounted fixtures (ground mounted floodlights, etc.) shall only be used where specifically allowed by LSU and provided with a secure, strong mounting arrangement. Exterior fixtures supported only by the conduit connection are not allowed. In-grade mounted fixtures are not allowed.
- 11.5 Outdoor site lighting pole mounted fixtures shall utilize the LSU campus standard "Core/Historical" pole/fixture which shall consist of a traditional lantern type fixture on a decorative pole. Fixture and pole shall have a black finish. Fixture/pole shall consist of a cast aluminum fixture with a tapered six sided cage and top finial, minimum 126W LED light source, cutoff optics generally with a symmetrical reflector concealed in roof (with other type distribution where required), frosted chimney giving the appearance of the light source, clear seeded acrylic or clear seeded glass lenses, internal fusing in fixture or in-line fusing in pole base, 12 foot tall decorative cast alum pole. Fixture shall be Sternberg 6130C series with 4200 series pole, ANP LA844 series with 4F12.188-41 series pole or equal approved fixture/pole with similar photometrics, appearance and construction.
- 11.6 All pole/fixture assemblies shall have a minimum 100 mph wind load rating with a 1.3 gust factor.
- 11.7 Outdoor lights are to be controlled on at dusk and off at dawn either through a contactor(s) controlled by a master exterior photocell, or the fixtures themselves are to have individual built in photocells. Do not use a programmable lighting control panel (when one is present) to control outdoor lights. Provide an HOA switch on all lighting contactors with the "A" position having the contactor controlled by the photocell.
- 11.8 Pole foundations shall utilize double nutting as the means of mounting and leveling. Grout shall be installed between the pole base plate and the top of the foundation around the bottom leveling nuts. All poles shall have metal base covers. All metal poles shall have a ground rod with a connection to the pole ground lug located inside the pole and accessible through the base handhole.

11.9 See LSU Campus Site & Landscape Design Guidelines & Standards for additional exterior lighting information.

12 EMERGENCY POWER

- 12.1 The preferred method for emergency power for “Exit” signs and egress illumination shall be by a building emergency power generator. The code specified transfer and duration will be met. For small buildings and for renovations where emergency lighting systems do not exist in a building, individual battery powered units may be considered on a case by case basis, but must be approved by LSU.
- 12.2 Generators shall be natural gas fueled. For each project, the Designer shall obtain permission from the State Fire Marshall to allow natural gas as the fuel in lieu of an on-premises fuel supply as allowed by the exception listed in NEC 701.11,(B),(3). The wording of the request to the Fire Marshal shall be coordinated with LSU utilizing the same as used in past successful requests.
- 12.3 Generators shall have electronic isochronous governor, critical exhaust silencer, alternator and control panel space heaters, water jacket heater, output circuit breaker, max 130 deg C temp rise, automatic exerciser clock with selector for load or no load exercising, starting batteries and charger, lockable outdoor weatherproof enclosure.
- 12.4 The ATS for the generator shall be 3P, SN unless required otherwise and have time delay neutral position or in phase monitor. Each ATS shall have built in factory supplied metering that shall display at a minimum Amps, Volts, kW demand, and kVA demand.
- 12.5 Generator and ATS shall have a 5 year/1500 hour comprehensive warranty.
- 12.6 All aspects of the natural gas supply shall be in accordance with NFPA, 37, 54 and 110. Where the gas supply is connected to the building gas supply system, it shall be connected on the supply side of the building main gas shutoff valve and marked as supplying an emergency generator. The building’s main gas shutoff valve shall be marked to indicate the existence of the separate generator shutoff valve. Gas piping shall be Schedule 80, black steel, painted ANSI “Natural Gas” Yellow and installed by a licensed plumbing contractor. The connection at the generator is to be made with a flexible piping connection provided by the generator manufacturer. Gas trains shall include an equipment isolation valve at the generator, a manual shutoff valve in a remote location, a regulator and two automatic safety shutoff valves at the generator each with manual leak test valves. The automatic safety shutoff valves shall stop the flow of fuel in the event the engine stops for any cause. All gas piping shall be tested and purged in accordance with NFPA 54:8.
- 12.7 Provide a generator remote annunciator panel with emergency stop pushbutton in the building.
- 12.8 Provide a connection from the generator common alarm contact to the campus EMS system to monitor any generator alarm.
- 12.9 Generators shall be located a minimum of 5’-0” from buildings.
- 12.10 All telecom rooms shall be provided with emergency power. Coordinate exact requirements with LSU ITS.

13 FIRE ALARM SYSTEMS

- 13.1 Fire alarm systems shall be in accordance with NFPA 72, NFPA 101, ADA, and all other requirements of the Louisiana State Fire Marshall. All fire alarm system work shall be performed by a licensed fire alarm subcontractor in accordance with all requirements of the State Fire Marshall. Fire alarm system installer shall be an authorized vendor of the fire alarm panel manufacturer. The contractor shall be responsible for all Fire Marshall submittals and shall be responsible for any fees charged by the Fire Marshall for the reviews. For additions to existing systems, new fire alarm equipment shall be listed for use with the existing equipment.
- 13.2 The fire alarm system shall be non-coded, addressable, automatic and supervised. The fire alarm system shall be a Johnson Controls Metasys IFC 3030 system or Notifier NFS 3030 system. The fire alarm system shall be connected to and communicate on a point by point basis with the campus EMS system (Johnson Controls Metasys System) without using third party translators. The translation device shall be part of the control panel and UL listed for use with the fire alarm system control panel (the model number included on the UL listing sheet of compatible devices for the fire alarm control panel). Software programming of the Campus EMS system for this communication shall be done by the University. All other work and materials to accomplish this communication will be the responsibility of the fire alarm contractor. In addition to the point by point connection to Metasys, provide addressable relays on the data loop to tie into Metasys contacts for panel general trouble and alarm. In addition to this communication, the fire alarm system is to transmit

status (normal, alarm, or trouble) to the LSU Campus police through a Keltron Model RF750L subscriber unit transceiver. It shall convert control panel data to point-specific life safety event information (not just indicate trouble and alarm). Where existing systems are being replaced with new systems, the existing radio transmitter may be reused if one is present.

- 13.3 Provide a fire alarm remote annunciator at the location the fire department/police would use to enter the building when an alarm occurs.
- 13.4 The fire alarm control panel and any power extenders shall be powered from the existing generator backed up emergency system when one is present.
- 13.5 Pull stations shall be key resettable by a key provided by the system manufacturer (not an Allen head or other type screw arrangement). Over each pull station provide a clear, alarm deterrent cover with integral battery powered local alarm. Alarm deterrent covers shall be Americorp STI Stopper 2, STI-1100 series or Signal Communications Corp ST series.
- 13.6 Smoke detectors shall be photoelectric type, not ionization type.
- 13.7 Visual alarm appliances (strobes) shall be LED type.
- 13.8 Generally audible and visual alarm indicating appliances (horns, horn/strobes, speakers, speaker/strobes) shall be ceiling mounted wherever possible versus wall mounted.
- 13.9 Generally, all corridors and electrical and telecom equipment rooms shall be provided with smoke detection coverage per NFPA 72 whether required by code or not.
- 13.10 Shutdown of any air units shall be accomplished through a fire alarm addressable relay at the starter/drive for the air unit (not through the auxiliary contacts of the duct detector).
- 13.11 Provide isolation modules in the initiating wiring with no more than 25 addressable devices for each module.
- 13.12 The passwords for access to modifying the fire alarm system programming are to be left on the factory default settings and this password given to LSU at completion of the project.
- 13.13 A reduced copy of the as built fire alarm system shop drawings shall be included in the fire alarm system operations and maintenance manuals.
- 13.14 Fire alarm system control panel power supply and battery backup shall have 25% extra capacity to allow for additions to the system. Enclosures shall have 25% unoccupied extra physical space for future expansion capability.
- 13.15 Where existing fire alarm systems are replaced, remove all existing fire alarm items not reused including all wiring and exposed raceways after the new system is installed, operating and approved by the Fire Marshal.
- 13.16 Fire alarm system wiring shall be copper, 16 gauge minimum size. Fire alarm wiring shall be run in raceways except for sections in accessible ceilings for horizontal runs in equipment rooms which can be run without raceways supported and routed in accordance with LSU design standards. All fire alarm wiring shall have a red colored jacket and shall be installed separate from other building wiring systems. Fire alarm wiring between buildings shall be fiber optic cable where possible. Provide lightning/surge protectors at each end of fire alarm wiring serving items remote from the building. Wiring run underground shall be wet location listed.
- 13.17 For fire alarm control panels which are recessed in walls, provide three minimum 3/4" spare empty conduits from the panel to the nearest accessible ceiling space.
- 13.18 For all addressable fire alarm devices (smoke detectors, heat detectors, duct detectors, pull stations, etc.), provide a permanent label on the device base listing the device's complete address. Labeling shall use laminated, scratch resistant, 1/2" wide polyester adhesive backed tape, black letters on clear background, Panduit LS4M or Brother P-Touch labeling system or equal system approved by LSU Facility Services.
- 13.19 As part of the programming of the system, the contractor shall program Zone #50 to deactivate all outputs when this zone is disabled to allow the system initiating devices to be tested.
- 13.20 Where the building must remain in operation during construction, all outages of the existing system must be in accordance with the Fire Marshal requirements. The existing system shall be operational at the end of each work day unless specifically allowed otherwise by LSU. All work to disable/reconnect the existing fire alarm system items is to be done by the fire alarm system sub-contractor (not by LSU).
- 13.21 The contractor shall provide LSU a minimum of 2 days advance notice of the scheduling the Fire Marshall checkout of the system.

13.22 A copy of the final software programming shall be provided to LSU on flash drive at completion of the project as part of the operations and maintenance items.

14 SOUND SYSTEMS, SPEAKERS, SPEAKER INTERCOMS AND PAGING SYSTEMS

14.1 Specifications for these systems shall be developed as the specific need is determined and the scope as defined by the user agency.

14.2 Wiring for these systems shall be in appropriately sized conduit.

14.3 Electronic units used shall be solid state, easily serviced units.

15 CLOCK SYSTEMS

15.1 Specifications for clock systems shall be developed as the specific need is determined and the scope as defined by the user. In general, clocks are not to be provided in new buildings and existing clocks in renovated sections of existing buildings are to be removed as part of the renovation.

16 MEDIUM VOLTAGE WIRING (HIGH VOLTAGE SYSTEM)

16.1 For each project, provide a fault study and an overcurrent protective device coordination study. The coordination study shall cover from the utility system upstream substation main breaker down to the 480V branch circuit breakers in the building. The computer software program used to perform the studies shall be the ETAP program (latest version) and LSU shall be provided with all the data files for the fault study and coordination study at the completion of the project. Permanent electrical service to the building will not be provided until the coordination study curves and recommend protective device settings are submitted to and approved by LSU. All equipment shall be rated for the available fault current as determined in the study.

16.2 Verify all outages to accomplish the electrical utility work are addressed and any special work or materials required to maintain power to critical loads is provided for. Address the phasing and outages associated with the replacement of the high voltage feeders and equipment. In general, LSU cannot accommodate prolonged outages to accomplish high voltage utility work. The sequence of work associated with the electrical utility work is to be outlined and the allowable duration of the associated outages is to be clearly stipulated in bid documents. As much as possible, high voltage utility work is to be scheduled during the periods of low activity at the university such as between semesters and during the week between Christmas and New Year's when the University is closed. Portable backup generators shall be provided as part of the project (provided, installed, connected and fueled by the contractor) to power for any loads deemed critical by LSU and not capable of withstanding the outages necessary for the electrical utility work.

16.3 Medium voltage cable shall be UL listed, single conductor, 15kV rated, for use in solidly grounded wye circuits not exceeding 15kV phase to phase at conductor temperatures of 105 degrees C for continuous normal operation, 130 degrees C for emergency overload conditions, and 250 degrees C for short circuit conditions. Cable shall have stranded, concentric, round, compressed or compact, annealed copper conductor; extruded semi-conductor shield over the conductor; 220 mil Ethylene Propylene Rubber (EPR) insulation (133% insulation level); extruded semi-conductor shield over the insulation; minimum 3 mil thick helically applied minimum 25% overlapping solid copper tape shield; and black 80 mil PVC jacket imprinted with manufacturer, size, type insulation, insulation thickness, voltage rating, and UL designation. Cable shall be for use in general purpose applications in wet or dry locations including conduit, cable tray, direct burial and aerial installations. Cable shall be constructed in accordance with all applicable IPCEA standards. Cables shall be manufactured by General Cable, Okonite, Pirelli, Southwire, Superior Essex or approved equal.

16.4 The new medium voltage wiring and equipment shall connect to the existing solidly grounded 13.8KV or 4.16KV grounding system. Provide a green insulated equipment ground conductor run in each conduit containing a medium voltage feeder, minimum #3/0 size for the 13.8KV system and minimum #2 size for the 4.16KV system. Ground busses or conductors in existing manholes shall be extended full size to the new equipment and wiring. Cable shields shall be grounded at each termination and splice with an individual, (one per cable) minimum #6 size conductor to the ground system. Provide a minimum #12 size green ground from the tab on the elbow to the ground system. Provide a ground rod in each new manhole with a connection to the ground system. Cable shields for straight splices in manholes (except those made with elbow connectors) are not to be brought out and grounded.

16.5 Duct banks for medium voltage feeders shall have 25% spare conduits (minimum of one (1) each size).

- 16.6 The contractor shall be responsible for proper phasing of the system and shall demonstrate proper phasing for items fed by feeders affected by the work in this project. Coordinate phasing with Facility Services. The contractor shall be responsible for matching the phasing between the multiple feeders at HV switches and transformers and shall demonstrate proper phasing to LSU.
- 16.7 Provide new non-metallic cable racks in existing manholes when required for proper support of cables.
- 16.8 New cables shall make one complete loop in each manhole. Where multiple feeders are present in a manhole the conductors of the different feeders are to be kept apart from each other as much as possible to minimize the possibility of a fault on one feeder affecting the other feeder.
- 16.9 For splicing to existing medium voltage cables in manholes, verify that sufficient slack in cable lengths exist in the manhole to allow existing splices to be cut out and new splices to be made. If sufficient length does not exist, pull slack from adjacent manholes when possible or replace cables from adjacent manholes if it is not possible.
- 16.10 Where multiple medium voltage feeders are present in manholes, the contractor may be required to splice one feeder while other feeders in the manhole are energized. Contractor shall provide insulating blankets for added safety from energized cables and other safety items, necessary by manhole conditions.
- 16.11 New manholes for the medium voltage distribution systems shall be minimum 8' square, 6' tall, have 42" diameter traffic rated cover, non-metallic cable racks, as required, on all four sides with minimum of two racks for each side, 24" square sump for draining, 10' long ground rod and be adjusted so top is flush with finished grade or paving. All conduits to manholes are to terminate with end bells. Provide pulling eyes on all four sides and on the bottom of the manhole directly under the opening
- 16.12 Note that in areas congested with existing underground utilities, the contractor may be required to hand dig in the vicinity of existing lines. Exact routing of all new ductbanks is to be adjusted in the field to avoid existing obstructions.
- 16.13 Verify all outages to accomplish the work are addressed and any special work or materials required to maintain power to a particular load is provided for.
- 16.14 The contractor is to submit to the Architect/Engineer for review, the name and list of experience of the cable splicer to be used (actual person who will perform the work). Should the University deem that the cable splicer is not acceptable; the Contractor must submit information for a different cable splicer and repeat this process, until one is found with acceptable experience.
- 16.15 In each manhole, transformer and high voltage switch, etc. where work is to be performed in this project, the Contractor shall install on each medium voltage cable an etched laminated plastic nameplate (tag) identifying the feeder number/designation. On loop feeders, the tag wording shall also include the destination of the cable after it leaves the manhole or equipment. Note that for loop feeders in manholes, there will be a set of tags on both locations that the cable enters/exits the manhole designating at both ends where the cable goes to. Exact wording on cable tags shall be submitted by the contractor and approved by LSU. Tags shall be etched laminated plastic, white plate with black letters, with minimum 1/2" size lettering, attached with two nylon tie wraps, one at each end of the tag. The tags are to be positioned so that they can be viewed from the manhole or equipment opening. At each tag, and on both sides of every splice, the medium voltage cable shall also be color coded with electrical tape as to the phase connection (colors shall be same as presently in use on the system).
- 16.16 Underground splices in the 13.8KV or 4.16KV distribution systems are to be avoided as much as possible. Where splices must be made they are to be located above grade in sectionalizing cabinets with 600A deadbreak separable connector (elbow) type junctions inside. Sectionalizing cabinets shall be tamperproof; constructed with stainless steel enclosure, base, backpanel, hinge & hardware; Munsell green corrosion resistant finish; hinged padlockable cover with "Warning High Voltage" label and reflective sectionalizer designation label on outside; minimum 22" depth to allow back-to-back elbow connections; contain universal mounting plates with 600A junctions and parking stands. Sectionalizer cabinets shall be mounted on a minimum 6" thick, steel reinforced concrete pad with the top of the pad, 2" above grade. Provide an 18" deep, min 12" wide, below grade conduit window with concrete sides and open bottom to allow room for HV cables to turn before connecting to the unit. Conduits are to terminate 3" above the bottom of the window with bushings. Stainless steel base extenders may be utilized in lieu of a conduit window for sectionalizers

located in non-high visibility areas when approved by LSU. Sectionalizing cabinets shall be manufactured by Cooper Power Systems, Malton, CMC/BMC, Maysteel or approved equal. Protect with concrete filled, 6" round, yellow painted pipe bollards extending min 3 feet below grade with underground section surrounded by 12 inches of concrete.

- 16.17 Where underground splices in manholes cannot be avoided and above grade sectionalizers cannot be installed, splices shall be made using 600A deadbreak, separable connector (elbow) type junctions in the manhole unless the manhole containing the splice does not have sufficient space. Junctions shall be supported with J hooks from the manhole ceiling with the location coordinated with LSU to not obstruct access into the manhole. If there is insufficient space in the manhole for elbow type junctions, splice kits shall be used.
- 16.18 Medium voltage cable in-line straight splice kits where cable does not change size significantly at the splice shall be made utilizing pre-packaged, cold shrink or heat shrink type kits for shielded cable. Kits shall include compression connector, semi-conducting and insulating tapes, cold shrink or heat shrink insulation body and shield continuity assembly. Splice kits shall be rated for 15kV, 150kV BIL. Splice kits shall be 3M QS-III 5513A thru 5516A series, or Raychem CAS-15M or HVS-1520 series or approved equal.
- 16.19 Medium voltage cable tee splice kits shall be made with pre-packaged cold shrink or heat shrink type kits for shielded cable. Kits shall include connector, semi-conducting and insulating tapes, cold shrink or heat shrink insulation body and shield continuity assembly. Tee splice kits shall be 3M QS2001B or Raychem HVSY with appropriate cable reducing accessories as required.
- 16.20 For medium voltage cable X splices and for tee or straight in-line splices with a cable size change that cannot be accommodated by the kits specified above, and for instances where there is insufficient space to use the kits specified above, the splice shall be made with hand wrapped tape type splice kits containing the necessary compression connectors, semi-conducting and insulating tapes, and shield continuity assembly. Tape splice kits shall be rated for 15kV, 150kV BIL. Tape splice kits shall be 3M 5700 series or approved equal.
- 16.21 Medium Voltage cable terminations on equipment shall be dead front type wherever possible (SF6 switches, sectionalizing cabinets, pad mount transformers, etc.) made with separable (elbow) type connectors. Separable elbow connectors shall be minimum 15kV class suitable for 4-wire multi-grounded or 3-wire ungrounded systems. Connectors shall be 600A, deadbreak type. Connectors not located in manholes shall have a test point for the mounting of a fault indicator or for aid in testing of power available and phase sequencing. Connectors in manholes shall not have a test point. Each connector shall come with an insulated plug, cap, stud, lug, cable adapter and metallic tape shield adapter. Connectors shall be sized for the conductor installed on the project. Connectors shall be by Elastimold or Cooper Power Systems.
- 16.22 Where medium voltage cables must terminate in a live front connection (Metal Clad switchgear, live front equipment, etc.) the connection shall be made utilizing termination kits rated for IEEE Standard 48-1990 Class 1 termination. Terminations shall consist of high dielectric constant stress relief tube inside a molded silicon insulator mounted on a supported core. Terminations shall be rated 15 KV minimum and have a continuous operating temperature rating of 105 deg. C with an emergency overload rating of 130 deg. C. Terminators shall be constructed with insulators constructed of tracking resistant silicon rubber. Terminations for outdoor or inside outdoor pad-mounted gear shall be outdoor rated and shall be skirted. Terminations may be of a pre-stretched cold shrink design or heat shrink design. Termination kits shall include one piece silicone rubber termination with solderless mechanical ground assembly to accommodate tape shielded cables. The termination kits shall be utilized with listed copper compression lugs rated for 105 deg C continuous operation. Termination kits shall be properly selected for the conductor type and size involved. Field verify existing cable sizes. Termination kits shall be 3M QT-III series, Raychem TFT or HVT series or approved equal.
- 16.23 Each elbow connector at equipment connections (not in manholes) shall be provided with a single phase, test point mounted, fault indicator for mounting on the test point of the connector. Fault indicators shall have integral visual display, automatic reset upon restoration of system voltage (3 to 10 minutes), junction shield feature, and shall operate on a system voltage of 2.4 kV phase-to-ground. Nominal trip rating shall match the maximum ampacity of the cable served and shall be approved by the Engineer. Fault indicators shall be E. O. Schweitzer 1TPRI-J6 series or Hubbell Chance TJS series with junction shield feature or approved equal.

- 16.24 Each elbow connector at equipment connections (not in manholes) shall be provided with a single phase hot line indicator for mounting in place of the rubber cap on the connector. Hot line indicators shall be line powered, have flashing neon lamp, be hotstick installable and operate from 2 - 35 kV phase-to-ground. Hot line indicators shall be E. O. Schweitzer VIN600 series, Hubbell/Chance VI600F or approved equal.
- 16.25 Splicing and termination kits and elbow connectors shall be properly selected for the conductor type and size involved. The contractor is to field verify the existing cable size and insulation type/thickness before starting work.
- 16.26 For all HV terminations (switches, sectionalizers, transformers, etc.) provide an 18" deep, min 12" wide, below grade conduit window with concrete sides and open bottom to allow room for HV cables to turn before connecting to the unit. Conduits are to terminate 3" above the bottom of the window with bushings.
- 16.27 Seal all underground conduits at manholes and HV equipment to prevent water from draining from the equipment to manholes or buildings.
- 16.28 At the completion of work in power manholes and transformer vaults, the Contractor shall remove all debris, dirt and any other trash already present or created by the construction.
- 16.29 All medium voltage cables must be tested. The cable is to be tested on the reel by the manufacturer at time of construction, as per all applicable IPCEA standards. Each reel is to be tested individually. Copies of these tests shall be provided to LSU. The installing contractor shall also hire a testing contractor to test the cable after it is installed in conduits, but before connection to existing cables, equipment or transformers. Cables shall again be tested after all terminations, stress cones and splices have been completed, but prior to connections to any equipment and energization. When new cables are spliced on to existing cables, the cables shall be tested prior to making the splice. On completion of the splice, the entire run of new and existing cable, shall be tested as a unit. The maximum voltage on DC high potential tests is to be per the cable manufacturer's recommendation for new cable and not over the rating of the cable for existing cable. Each time the cable is tested, the following tests shall be made:
- 16.29.1 Shield Continuity Test
 - 16.29.2 Insulation and Dielectrics Absorption Test
 - 16.29.3 Direct Current (DC) High Potential Test
- 16.30 For each existing medium voltage oil switch removed in this project, the contractor shall take an oil sample from the switch and have the sample tested for PCB content. For switches with a separate oil reservoir for each phase, the oil from only one reservoir will need to be tested. For any switches which test above 50 PPM PCB content, the university will drain the oil from the switch, after which the switch would be classified as non-hazardous. After the testing and, if necessary, the draining of the switches, all switches will become the property of the contractor and are to be removed from the campus by him. All testing procedures shall be coordinated with and performed in accordance with the LSU Occupational and Environmental Safety Department requirements. A copy of the test report for each switch shall be provided to the university. The lab performing the testing of samples shall be EPA certified and accredited by the AIHA. (ENTEK and Gulf Coast Analytical are two of several local labs that can perform this work.) Samples shall be tested as required by EPA per TSCA Part 761 (PCBs) using one of the following testing methods:
- 16.30.1 ASTM D 923-86 (PCB specific)
 - 16.30.2 ASTM D 923-89 (PCB specific)
 - 16.30.3 EPA Method 8270 (PCB must be specified)

17 MEDIUM VOLTAGE SWITCHGEAR

- 17.1 Medium Voltage switchgear shall be SF6 type pad mounted switchgear. The switchgear shall be dead front, load break, three phase, 15KV, minimum 600A continuous current. The switchgear assembly (all switches and interrupters) shall have a minimum fault rating of 25KA symmetrical, 40kA asymmetrical. The switchgear shall generally consist of two non-interlocked, incoming feeder switches without overcurrent protection to select between two medium voltage feeders powering the switchgear. It shall also contain outgoing switches each with automatic load interrupters for each load fed by the switchgear. Provide a minimum of one spare outgoing switch/load interrupter. The quantity of outgoing switch/load interrupters shall be as required by the project. Each load interrupter shall have adjustable, electronic overcurrent trip control to automatically

protect for overcurrent and fault conditions. Incoming switches and outgoing load interrupter switches shall be 3 position type (open, closed, ground). The switches and load interrupters shall operate in an insulating medium of SF6 gas contained in a type 304 stainless steel tank. Switches and load interrupters shall operate all three phases together. Each switch and interrupter way shall be provided with a large viewing window at least 6 inches by 8 inches to allow positive verification of the switch operating condition.

- 17.2 The switchgear shall be housed in a minimum 14 ga, tamper resistant, steel enclosure with Munsell green finish, access covers and hinged doors with recessed handles containing a pentahead bolt and provisions for pad locking. The enclosure shall be independent of the switchgear, bolt to the concrete pad and be easily removable for replacement. Provide a ground rod inside the switchgear enclosure. The enclosure and switchgear, ground rod, and system grounds shall be bonded together with a minimum #3/0 ground bonding jumper. Both the switchgear and the enclosure shall have lifting provisions.
- 17.3 Feeder connections shall be made with 600A, dead-break separable elbow connectors with test points. Elbow mounted fault indicators and hot line indicators shall be provided on each elbow connector. The switch enclosure shall be extended to allow for back-to-back elbow connections taking into consideration hot line indicators installed on the back of the outer elbows. Cable connections shall be on the opposite side of the unit from the switch and interrupter operating handles. Provide a minimum 18" deep concrete lined window for the conduit entries to allow space for the cables to be routed to the termination points without exceeding the cable bending radius and putting excessive stress on the elbow connectors.
- 17.4 Each switch/interrupter shall be provided with a factory supplied Voltage indicator to indicate the energization status of each phase of the switch respective switch. The indicator shall be visible from the operating side of the switchgear.
- 17.5 Each switch/interrupter shall be provided with factory supplied low voltage phase verification pins (one pin per phase) to allow verification of phasing between switches using a low voltage multimeter between the corresponding phase pins of each switch.
- 17.6 Medium Voltage switchgear shall be S&C Vista series or G&W Padmount series.
- 17.7 Medium Voltage switchgear must be submitted to LSU PDC for approval before ordering.

18 LIQUID FILLED PAD MOUNT DISTRIBUTION TRANSFORMERS

- 18.1 Transformer shall be liquid filled pad mounted transformer with the following ratings: 3 phase, 60 HZ, 13.8KV or 4.16KV Delta connected primary, 95KV BIL, 480 WYE/277 volts or 208 WYE/120 volts secondary, 30 KV BIL. The transformer temperature rise shall not exceed 65 degree C above a 40 degree C ambient. Transformers shall be liquid filled with a 10 C insulating liquid. The transformer shall comply with the latest applicable standards of the American National Standards Institute (ANSI) and be provided with a test report as per ANSI Standards.
- 18.2 Transformers shall be compartment type, self-cooled, tamper proof and weatherproof for mounting on a pad. There shall be a transformer tank, high voltage compartment and low voltage compartment assembled as an integral unit. There shall be no exposed screws, bolts or other fastening devices which are externally removable. Transformers in the vicinity of cooling towers shall have stainless steel enclosures, bases, radiators and hardware.
- 18.3 Transformers shall be of the sealed tank construction of sufficient strength to withstand normal internal working pressures without permanent distortion. The cover shall be welded with a tamper proof bolted and gasketed handhole.
- 18.4 Cooling panels will be provided on the back and sides of the tank. Lifting eyes and jacking pads will be provided.
- 18.5 The core and coil assembly shall be wound core type with copper windings. A tap changing mechanism shall be provided for accurate voltage adjustment without opening the transformer tank and shall have two 2½% voltage taps above and below the primary voltage. The tap changing mechanism shall be externally operated and shall be for de-energized operation only. Cores shall be high quality silicon steel.
- 18.6 The high and low voltage compartments shall be located side-by-side separated by a steel barrier. Terminal compartments shall be full height, air filled with individual doors. The high voltage door fastenings shall not be accessible until the low voltage door has been opened. The low voltage door shall have a 3-point latching

mechanism with vault type handle having provisions for a single padlock. The doors shall be equipped with lift-off type stainless steel hinges and door stops to hold the doors open when working in the compartments. ANSI tank grounding provisions shall be furnished in each compartment.

- 18.7 The high voltage terminations and equipment shall be dead front and conform to ANSI C57.12.26 requirements with the number of terminators required for the connection configuration (single radial, dual radial, loop, etc.). Each bushing well shall be suitable for accepting 15KV 600A separable (elbow) connectors. Provide accessory mounting brackets for use with test/grounding bushings or parking bushings adjacent to each bushing well.
- 18.8 The primary shall have an oil immersed switch to match the connection configuration and shall contain drywell cartridge current limiting fuses (McGraw Edison Type NX) or oil immersed Bay-O-Net type current limiting fuses. Fuses shall be externally replaceable with distribution hot stick without opening the transformer tank and shall be sized in accordance with the transformer rating to protect against transformer overloads. Fuses shall contain current limiting elements to provide the transformer with a 50,000 AIC symmetrical fault rating. Provide one set of spare fuses.
- 18.9 Padmount transformers shall have a recessed, stainless steel, captive, pentahead security bolt with 0.560" sides.
- 18.10 Furnish the following accessories
 - 18.10.1 Nameplate in low voltage compartment.
 - 18.10.2 One-inch drain plug.
 - 18.10.3 One-inch upper filter press and filling plug.
 - 18.10.4 Liquid level gauge.
 - 18.10.5 Pressure relief device (self resealing with indicator).
 - 18.10.6 Pressure vacuum gauge
 - 18.10.7 Temperature gauge
- 18.11 Transformers shall be by General Electric, Van Tran, Cooper, ABB, Schneider, Eaton or approved equal.
- 18.12 Provide a permanent sign on the outside of each transformer door stating "Warning High Voltage".
- 18.13 Each transformer is to be provided with meter consisting of current and potential transformers as required mounted in the secondary compartment with a watt hour meter and meter pan mounted on the outside transformer housing. The Contractor is to provide all necessary wiring and connections to connect the meter including fusing for the power connections. The meter is record kWH and kW demand. CT's and PT's for metering shall have 1% accuracy or better. Meter shall be a Byram Labs, p/n1C6907 - Fm9S, AA, Node, A3TL, Byram LAN 069, CL20, 3P4W, 120-480 volts auto ranging, kwh demand & TOU and load profile registers, LAN ID 069, Form 9S meter. Meter shall be Form 4S for single phase applications.
- 18.14 Before shipment the actual transformer shall be factory tested in accordance with the provisions of ANSI C57.12.90 and shall include as a minimum the following tests:
 - 18.14.1 RatioPolarity
 - 18.14.2 Phase Rotation
 - 18.14.3 No-Load Loss
 - 18.14.4 Excitation Current
 - 18.14.5 Impedance Voltage
- 18.15 A copy of the completed test report indicating passing for each test shall be provided.
- 18.16 Transformers must be submitted to LSU PDC for approval before ordering.

19 TELECOMMUNICATIONS

- 19.1 Telecommunications shall be in accordance with the LSU Information Technology Services (ITS) requirements available from the LSU ITS website found at <https://www.lsu.edu/its/units/uni/construction-requirements.php>

- 19.2 LSU utilizes a Panduit-General Cable solution for all cabling across campus in order to standardize the network. All cabling, jacks, faceplates, patch panels, etc. shall conform to the Pan-Gen solution. These requirements are addressed in more detail on the ITS website.
- 19.3 LSU requires that any low-voltage contractor shall be PCI (Panduit Certified Installer) certified in addition to having an RCDD on staff. These requirements are addressed in more detail on the ITS website.
- 19.4 Standards for General Purpose Multimedia Classrooms are addressed on the ITS website.

20 SURVEILLANCE CAMERAS

- 20.1 For all projects, surveillance cameras on the campus surveillance camera system shall be provided. Cameras will be IP devices connected to the campus surveillance camera system through the LSU network. Cameras shall be provided and installed by LSU.
- 20.2 The exact location of cameras shall be provided to the designer by LSU. Camera locations shall be as required to view the following
 - 20.2.1 Each building entry (from inside)
 - 20.2.2 Main lobbies, gathering areas and high use areas.
 - 20.2.3 Stairs
 - 20.2.4 Exterior areas around the building particularly high traffic areas (exterior camera).
 - 20.2.5 Point of Sale areas
 - 20.2.6 High security areas
 - 20.2.7 ATM locations
 - 20.2.8 Elevator cars or elevator lobbies.
- 20.3 Additional cameras may be required due to special situations and additional cameras may potentially be required. The purpose of this standard is to set the minimum requirements.
- 20.4 Unless noted otherwise, for each camera the contractor is to provide a Cat 6A network data wiring drop from the nearest LSU network data rack to the camera location. Data wiring shall be in accordance with LSU ITS standards, terminated at each end and tested per ITS requirements. Terminate the cable at the camera end with an RJ45 female connector. Rough-in provisions for the specific types of camera locations shall be as follows.
 - 20.4.1 Cameras in Accessible Ceilings: Leave camera end of data drop coiled in ceiling space above camera location with 10' of slack and terminated with Panduit CBX1WH-A surface mount box. Provide minimum 5' long Cat 6A jumper from data drop end for connection to the camera. The jumper shall be terminated at the camera end with an RJ45 male connector. For all data cable termination points in accessible ceilings, provide a label on the ceiling with 1/8" size lettering listing the camera number.
 - 20.4.2 Cameras on Non-accessible Ceilings (Hard Ceilings) and Walls: At the camera location provide a recessed rough-in J box with single gang opening. Provide a 3/4" conduit from the J box to nearest accessible ceiling in the direction of the nearest data rack. Leave the camera end of the data drop coiled in the accessible ceiling space at the end of conduit with minimum 10 ft of slack and terminate with Panduit CBX1WH-A surface mount box. Provide and install a Cat 6A data cable jumper from the connector on the end of the data drop in the accessible ceiling through the conduit to the camera J box leaving as much slack as will fit in the box. The jumper shall be terminated at the camera end with an RJ45 male connector. Connect the jumper to the data drop connector in the accessible ceiling space. The installation of the connector on the camera end of the jumper will be by the camera installer. Provide a blank coverplate over the box for the camera in case a camera is not installed with the initial construction.
 - 20.4.3 Exterior Cameras: Provide a 1/2" sleeved conduit from the camera to the nearest accessible ceiling space. Terminate the conduit end at the camera with a sleeved and sealed exterior wall penetration as close to the camera as possible in the least visible location. Provide a grommeted opening on both ends of the conduit to protect cable from snagging. Provide and install outdoor-rated section of Cat 6A data cable jumper from the connector on the end of the data drop in the accessible ceiling through the conduit to the camera leaving 10' of unterminated slack at the accessible ceiling end.

The jumper shall be terminated at the camera end with an RJ45 male connector. Connect the jumper to the data drop connector in the accessible ceiling space. Protect the exterior exposed end of the cable from the weather. Installation of the connector on the exterior end of the jumper will be by the camera installer.

20.4.4 Cameras in Elevator Cabs: The data drop for an elevator cab camera shall be provided in the elevator shaft with 10 ft of slack coiled at the top of the shaft. On top of the elevator car, the electrical contractor shall provide a quad receptacle connected to the elevator 120V power.

20.4.5 Cameras on Exterior Poles: Provide & install a 16"x14"x8" NEMA 4X non-metallic, padlockable, box with galvanized backplate at base of pole to house camera and radio equipment. Bottom of box shall be approximately 24" above grade and shall not obstruct handhole. For round poles, mount the box to the pole using a U-bolt arrangement wrapped around the pole connecting to two minimum horizontal unistrut supports on the back of the box. Paint the box and all associated mounting hardware to match the pole color. Provide an unswitched 120V power circuit to a fourplex receptacle in a separate device box within the overall box. Provide two stacked 1/2" bushed nipples through the back of the box into the pole (bottom for power, top for data). Power conductors are to go directly into the receptacle device box and are not to be exposed inside the overall box. Provide a new ground rod at the pole with a solid #6 connection from it to the receptacle equipment grounding conductor. Install 2 black exterior-rated Cat6A data cables from the box thru the pole to a 1/2" grommeted opening made near the top of the pole. Data cables will be terminated by others. Seal all openings for a watertight installation. Camera and radio equipment are to be provided by LSU.

20.5 The contractor shall coordinate the exact rough-in requirements for all cameras with LSU PDC and provide all work and materials required.