LOW VOLTAGE ELECTRICAL DISTRIBUTION

Scope

New distribution systems shall be 480/277 volts AC, and/or 208/120 volts AC, three-phase, four-wire (w/ground), unless otherwise directed by University Design Manager (UDM).

The A/E shall perform a fault and coordination study to the depth needed to insure that the specified devices will properly and safely interrupt faults and overloads, and that the system can be coordinated properly.

All breakers, fuses and electrical distribution equipment shall have interrupting ratings of at least 1.2 times the available fault current as determined by a fault current analysis performed by an engineer.

All relays, breakers, fuses, and other overcurrent protective devices shall be coordinated in order to protect electrical equipment from damage and to isolate the fault to the smallest possible portion of the distribution system..

All fault current and coordination studies (not performed by the A/E) shall be approved by the A/E before equipment energization. The approved fault current and coordination studies shall be provided to the University Project Manager (UPM) before commissioning of the distribution system can proceed.

Switchboard and Panelboard Requirements

All switchboards and panelboard breakers shall have the appropriate short circuit interrupting rating as determined by the fault current analysis. All switchboards and panelboards shall be of the safety dead front type and ruggedly constructed of sheet steel. All switchboard and panelboard doors shall have latches in addition to locks and shall be master keyed alike. All switchboards and panelboards shall have an identity designation and shall include its source identification and location. All loads shall be identified by number and load (where applicable) and a typewritten load schedule shall be protected by clear plastic and placed in a frame mounted to the inside of the door.

All breakers requiring settings such as long time pick-up, instantaneous pick up, etc. shall be set according to a coordination study performed by an engineer. The coordination study shall be submitted and approved by the project A/E before any equipment energization. The approved settings shall be placed on the breakers and records of the approved settings and coordination study shall be provided to the UPM before job closeout/ commissioning.

At job closeout, all switchboards, and panelboards, shall have a minimum of 25 percent spare capacity - split equally between breakers spares and breaker spaces..

All current carrying parts shall be 98 percent conductivity copper and the phase buses shall be 100% rated throughout. Where a neutral bus is required (4-wire systems), it shall be 100% rated and isolated (unless it is required by the NEC to be bonded to ground, such as in the case of service equipment). The equipment ground bus shall be rated at a minimum of 50% of the phase bus capacity. Both the neutral and ground buses shall have sufficient terminals to accommodate the number of poles or devices that can be installed.

The main and feeder protective devices shall typically be bolted to the bus. Square-D, I-Line panels are an exception.

Indoor panelboards, switchboards, and safety switches, are to be NEMA 1. In areas where water spray or high humidity will be present (like a room needing occasional wash downs) use NEMA 4. Typical outdoor applications shall be NEMA 3R. In cooling towers, parking structures, or areas where water spray and/or high humidity will be present, use stainless steel NEMA 4. For other special locations, provide equipment that has NEMA type enclosures as required by the NEC.

Panelboards

Panelboards with mains (circuit breaker or fused switch) shall have these devices installed at the top or bottom of the bus. They shall not be mounted on the side like a feeder device.

In cases where significant neutral currents may be present due to non-linear loads, the panelboard shall be provided with a 200% rated neutral bus bar; the panelboard feeder neutral shall be sized at 200% and the source transformer shall be rated appropriately to serve non-linear loads (high harmonics) with a minimum K-rating of 4

For special systems, provide bus bars meeting those special system requirements.

Panelboards shall have wire gutters sized to accommodate the bending radius of all wires when fully equipped and shall not be less than 4 inches wide.

In general, panelboards in finished areas shall be flush mounted. Panelboards in electrical, mechanical and other service rooms and spaces may be surface mounted.

"Loadcenter" type panelboards are not acceptable unless specifically approved by the UDM for the specific and/or unusual application.

Switchboards

Wherever space permits, switchboards shall be of the fused switch type and equipped with peak current limiting fuses, (unless engineering requirements dictate other fuse types) so that fault current can be minimized. Where space is not available for the larger enclosures of fused switches, circuit breaker switchboards may be utilized.

Mount switchboards, whenever possible, in areas accessible only to qualified electricians. In those locations the switchboards do not need to have a door. In areas accessible to other than qualified electricians, provide a door.

In general, switchboards in finished areas' areas shall be flush mounted, in electrical, mechanical and other service rooms and spaces they may be surface mounted.

Safety Switches

Safety switches shall be fused or unfused as needed. Handles shall have provision for padlocking. In addition, safety switches shall include a maintenance bypass (open door while hot) provision.

Provide ground connection point in all safety switches. Provide neutral bar where circuit is 4-wire.

Safety switches on load side of Variable Speed Drives shall have auxiliary contacts to de-energize VSD before opening safety switch (Form C). Certain applications may require more that one auxiliary contact.

All safety switches shall be "Heavy Duty" rated.

Distribution Transformers

Generally, building distribution transformers shall be of the 480-208Y/120 volt type. Transformers shall be of the dry type, with a 220 degrees C insulation system, and designed for a maximum temperature rise at full load of 115 degrees C above a 40 degrees C ambient.

Provide terminals compatible with copper terminations and having holes drilled to accept NEMA 2 or 4-hole terminals as is appropriate for the size of the transformer. Provide a ground connection bar (or device) to accommodate at least 4-NEMA 2-hole terminals.

Transformers shall have a sound rating 3 dB below NEMA standard (42 dB for 10-50 kVA, 47 dB for 51-150 kVA, 52 dB for 151-300 kVA and 57 dB for 301-500 kVA rated transformers). As a first preference, transformers should have 6 adjustment taps, two 2 ½ percent above and four 2 ½ percent below nominal voltage. If this setup is not readily available, four adjustment taps, two 2-1/2 percent above and two 2-1/2 percent below nominal shall be acceptable.

Where substantial non-linear loads are to be served, the appropriate K-rated (K-4 minimum) transformer shall be used.

Provide vibration pads for the transformer supports.

Distribution System Requirements

Substation secondary distribution breaker frame size shall be 800 A. The minimum sensor rating shall be 800 A, which can be set to 50 percent to produce a minimum 400 A breaker rating. Exemptions to these ratings will be permitted for feeds to emergency systems.

The first tier of distribution panels downstream of the substation shall be of the fused switch type and equipped with peak current limiting fuses, (unless engineering requirements dictate other fuse types) so that fault current can be minimized.

Provide required working space according to the NEC article 110 for motor disconnects and all other electrical equipment.

All outdoor disconnects and associated electrical equipment for cooling towers shall be stainless steel and NEMA 4 rated.

Provide NEMA Type 6-20R 250 volt, 2 pole, 3 wire, 20 amp receptacle outlets on a 208 volt, single phase circuit where required for large freezers or other large appliances. All wiring for these receptacles shall be No. 10 AWG minimum so that the circuits can be upgraded later to 30 amps if required.

Provide 120 volt duplex receptacle outlets on both side walls of corridors and hallways at intervals not exceeding 20 feet.

Provide a 120 volt duplex receptacle outlet at each stairwell floor landing.

Provide a minimum of one 120 volt duplex receptacle outlet per each 100 square feet, or any fraction thereof, in each mechanical, electrical and janitorial closet.

Provide ground fault circuit interrupter (GFCI) protection for all 120 volt receptacle outlets located outdoors, in toilet areas and within 6 feet of water sources. No receptacles shall be rendered GFCI by being fed from the load side of a GFCI. Water coolers do not require GFCI and shall be fed from a simplex receptacle.

Installation Requirements

The Contractor shall provide at least five working days notice and shall coordinate service interruptions with the University Project Manager. The University must approve each service interruption in writing.

Before closeout/commissioning the contractor shall:

- Comply with all applicable codes and standards.
- Install all wiring in approved raceway.
- Install a separate equipment grounding conductor with the phase conductors in the raceway.
- Provide exothermic welded connections or *Burndy High Ground* compression connection between the Grounding Electrode Conductor and any Grounding Electrode.
- Install all distribution equipment at a height that will not place the top unit operating handle more than 6 feet and 6 inches above the finished floor.
- Identify all receptacles with circuit number and source panel.
- Identify all installed switchboards and separately mounted circuit breakers, panelboards, motor starters, disconnect switches, relays, and all other equipment used

for the operation and control of electrical equipment by means of engraved laminated plastic (or equivalent) plates permanently affixed to the equipment. The information provided shall contain the identification number/label of the equipment and its power source identification and location.

- Identify all panelboard circuit breakers with permanently fixed numbers and a typewritten directory identifying the breaker loads mounted in a frame affixed to the interior of the door and protected by clear plastic.
- Perform testing in accordance with Section 16950 and provide the UPM with acceptable test reports.
- Provide all engineered coordination and short circuit studies to the UPM.
- Provide all one-lines, riser and as-built drawings to the UPM.