Design Standard

Electrical Safety

This document defines the UES electrical safety design standards in order to provide the safest, most efficient and reliable electrical equipment installations to Texas A&M University.

This document covers employee safety-related design concepts for electrical equipment and installations in workplaces related to or derived from NFPA 70E -2018. This document specifies design considerations that have impact on the application of the safety-related work practices only.

PART 1 - GENERAL

1.01 General Contractors, subcontractors or other contracted parties working for or on Texas A&M projects who have responsibility for facilities and installations having electrical energy as a potential hazard to employees and other personnel shall ensure that electrical hazard risk assessments are performed during the installations. The design A/E for all new building projects and renovation projects that involve electrical upgrades shall do breaker coordination to ensure that a fault within the building doesn't trip gear upstream. The design engineer shall also complete an arc flash study and provide appropriate arc flash labels for building electrical equipment. TAMU Utilities and Energy Services will provide the design engineer with max and min fault current values to use in the calculations. ETAP is the TAMU standard and shall be used for all calculations. Equipment shall be labelled with this information as specified by NFPA 70E before being accepted by Texas A&M University. Labels shall be applied adjacent to the on/off switches or disconnects for devices or at the point of maintenance access. **See label template on next page as an example.** Any deviations from this basic format must be approved by TAMU UES.

WARNING

Arc Flash and Shock Hazard Present
Appropriate PPE Required

Arc Flash Protection		**Shock Protection**	
Working Distance	**XX in**	Nominal System Voltage	**XXX VAC**
Incident Energy	**XX.X cal/cm²**	Limited Approach Boundary	**X.X ft**
Arc Flash Boundary	**XX ft**	Restricted Approach Boundary	**X.X ft**

Changes to equipment or system configuration will invalidate the calculated values and associated PPE requirements. Values shall be re-evaluated as necessary and within 5 years of the Evaluation Date.

Performed by:
Burns & McDonnell

Equipment: **XX/XX**

Evaluation Date: **XX/XX**

Note: the word "WARNING" shall be printed in black bold letters on an orange background

1.02 Design option decisions shall facilitate the ability to eliminate hazards or reduce risk by doing the following:

A. Reducing the likelihood of exposure.

B. Reducing the magnitude or severity of exposure.

C. Enabling achievement of an electrically safe work condition.

1.03 INCIDENT ENERGY REDUCTION METHODS

A. The following methods have proved to be effective in reducing incident energy and shall be included as appropriate in final equipment and installation design:

1. Zone-selective interlocking. This is a method that allows two or more circuit breakers to communicate with each other so that a short circuit or ground fault will be cleared by the breaker closest to the fault with no intentional delay. Clearing the fault in the shortest time aids in reducing the incident energy.

2. Differential relaying. The concept of this protection method is that current flowing into protected equipment must equal the current out of the equipment. If these two currents are not equal, a fault must exist within the equipment, and the relaying can be set to operate for a fast interruption. Differential relaying uses current transformers located on the line and load sides of the protected equipment and a fast acting relay.
3. Energy-reducing maintenance switching with a local status indicator. An energy-reducing maintenance switch allows a worker to set a circuit breaker trip unit to operate faster while the worker is working within an arc flash boundary, as defined in NFPA-7OE, and then to set the circuit breaker back to a normal setting after the work is complete.
4. Energy-reducing active arc flash mitigation system. This system can reduce the arcing duration by creating a low impedance current path, located within a controlled compartment, to cause the arcing fault to transfer to the new current path, while the upstream breaker clears the circuit. The system works without compromising existing selective coordination in the electrical distribution system.
5. Arc flash relay. An arc flash relay typically uses light sensors to detect the light produced by an arc flash event. Once a certain level of light is detected, the relay will issue a trip signal to an upstream overcurrent device.
6. High-resistance grounding. A great majority of electrical faults are of the phase-to-ground type. High-resistance grounding will insert an impedance in the ground return path and will typically limit the fault current to 1O amperes and below (at 5 kV nominal or below), leaving insufficient fault energy and thereby helping reduce the arc flash hazard level. High-resistance grounding will not affect arc flash energy for line-to-line or line-to-line-to-line arcs.
7. Current-limiting devices. Current-limiting protective devices reduce incident energy by clearing the fault faster and by reducing the current seen at the arc source. The energy reduction becomes effective for current above the current-limiting threshold of the current-limiting fuse or current limiting circuit breaker.
8. Shunt-trip. Adding a shunt-trip that is signaled to open from an open-fuse relay to switches 8OO amperes and greater reduces incident energy by opening the switch immediately when the first fuse opens. The reduced clearing time reduces incident energy. This is especially helpful for arcing currents that are not within the current-limiting threshold of the three current-limiting fuses.

1.04 ADDITIONAL SAFETY-BY-DESIGN METHODS

A. The following methods have proven to be effective in reducing risk associated with an arc flash or shock hazard and shall be included as appropriate in final equipment and installation design:

1. Installing finger-safe components, covers, and insulating barriers reduces exposure to energized parts.
2. Installing disconnects within sight of each motor or driven machine increases the likelihood that the equipment will be put into an electrically safe work condition before work has begun.
3. Installing current limiting cable limiters can help reduce incident energy. Additionally, cable limiters can be used to provide short-circuit protection (and therefore incident energy reduction) for feeder tap conductors that are protected at up to 1O times their ampacity, a situation where the tap conductor can easily vaporize.
4. Installing inspection windows for noncontact inspection reduces the need to open doors or remove covers.
5. Installing a single service fused disconnect switch or circuit breaker provides protection for buses that would be unprotected if six disconnect switches are used.
6. Installing metering to provide remote monitoring of voltage and current levels reduces exposure to electrical hazards by placing the worker farther away from the hazard.
7. Installing Type 2 “no damage” current limiting protection to motor controllers reduces incident energy whenever the arcing current is within the current limiting threshold of the current-limiting fuse or current-limiting circuit breaker.
8. Installing adjustable instantaneous trip protective devices and lowering the trip settings can reduce the incident energy.
9. Installing arc-resistant equipment, designed to divert hot gases, plasma, and other products of an arc-flash out of the enclosure so that a worker is not exposed when standing in front of the equipment with all doors and covers closed and latched, reduces the risk of arc flash exposure.
10. Installing provisions that provide remote racking of equipment, such as remote-controlled motorized remote racking of a circuit breaker or an MCC bucket, allows the worker to be located outside the arc-flash boundary. An extended length hand-operated racking tool also adds distance between the worker and the equipment, reducing the workers exposure.
11. Installing provisions that provide remote opening and closing of circuit breakers and switches could permit workers to operate the equipment from a safe distance, outside the arc flash boundary.
12. Class C, D, and E special purpose ground fault circuit interrupters exist for circuits operating at voltages outside the range for Class A GFCI protection. See UL 943C for additional information.