Purpose

The Electrical Safety program is designed to prevent electrically related injuries and property damage. This program also provides for proper training of maintenance employees to ensure they have the requisite knowledge and understanding of electrical work practices and procedures. Only employees qualified in this program may conduct adjustment, repair or replacement of electrical components or equipment. Electricity has long been recognized as a serious workplace hazard, exposing employees to such dangers as electric shock, electrocution, fires and explosions.

A written description of the program, including the specific procedures adopted by us, is available at all job sites for inspection and copying by OSHA and any affected employee.

Administrative Duties

The Operations Manager had been designated the competent person(s) to implement the program. The competent person(s) are responsible for developing and maintaining this written Electrical Safety Plan.

They are qualified, by appropriate training and experience that is commensurate with the complexity of the plan, to administer and oversee our electrical safety plan and conduct the required evaluations of plan effectiveness.

Equipment Grounding Conductor Program

This written plan is intended to establish and implement specific procedures for an equipment grounding conductor program covering:

- all cord sets,
- receptacles which are not a part of the building or structure, and
- equipment connected by cord and plug which are available for use or used by employees.

These requirements apply to all of Trinity Medical Management's (“Trinity”) construction job sites.

Equipment Grounding Conductor Inspection

Each cord set, attachment cap, plug and receptacle of cord sets, and any equipment connected by cord and plug, except cord sets and receptacles which are fixed and not exposed to damage, are visually inspected by Site Supervisor before each day's use for external defects, such as deformed or missing pins or insulation damage, and indications of possible internal damage.

Equipment found damaged or defective is not to be used until repaired, and is to be removed from service immediately by the person finding it and handed over to Site Supervisor.

Equipment Grounding Conductor Testing

The following tests are performed on all cord sets, receptacles which are not a part of the permanent wiring of the building or structure, and cord- and plug-connected equipment required to be grounded:

- All equipment grounding conductors are tested for continuity and are electrically continuous.
- Each receptacle and attachment cap or plug is tested by the electrician (PIC) for correct attachment of the equipment grounding conductor. The equipment grounding conductor is connected to its proper terminal.

All required tests are performed:

- Before first use.
- Before equipment is returned to service following any repairs.
- Before equipment is used after any incident which can be reasonably suspected to have caused damage (for example, when a cord set is run over).
- At intervals not to exceed 3 months, except that cord sets and receptacles which are fixed and not exposed to damage will be tested at intervals not exceeding 6 months.

Trinity does not provide or permit employees to use any equipment which has not met the requirements of this program.

Recordkeeping

Tests performed as required in this program are recorded. The test records identify each receptacle, cord set, and cord- and plug-connected equipment that passed the test, and indicate the last date it was tested or the interval for which it was tested.

The Training and Compliance Manager is responsible for maintaining these records.

This record is kept by means of an inspection log and is maintained until replaced by a more current record. The record is made available on the job site for inspection by OSHA and any affected employee.

Safe Work Practices

Safe work practices will be employed to prevent electric shock or other injuries resulting from either direct or indirect electrical contacts when work is performed near or on equipment or circuits which are or may be energized. These safe work practices are detailed throughout this program.

Working On Electric Circuit Parts or Equipment

Only qualified personnel are permitted to work on electric circuit parts or equipment that have not been de-energized. Qualified personnel will be made familiar with the use of special precautionary techniques, including but not limited to the following:

- Proper personal protective equipment.
- Insulating and shielding materials.
- The use of insulated tools to ensure safety.

Overhead Lines

If work is to be performed near overhead lines, the lines will be deenergized and grounded, or other protective measures will be provided before work is started. If the lines are to be deenergized, arrangements will be made with the person or organization that operates or controls the electric circuits involved to deenergize and ground them. If protective measures, such as guarding, isolating, or insulating, are provided, these precautions will prevent employees from contacting such lines directly with any part of their body or indirectly through conductive materials, tools, or equipment.

Qualified Persons

When a qualified person is working in the vicinity of overhead lines, whether in an elevated position or on the ground, the person may not approach or take any conductive object without an approved insulating handle closer to exposed energized parts than shown in Table S-5 unless:

- The person is insulated from the energized part (gloves, with sleeves if necessary, rated for the voltage involved are considered to be insulation of the person from the energized part on which work is performed), or
- The energized part is insulated both from all other conductive objects at a different potential and from the person, or
- The person is insulated from all conductive objects at a potential different from that of the energized part.

TABLE S-5 - APPROACH DISTANCES FOR QUALIFIED EMPLOYEES - ALTERNATING CURRENT

Voltage range (phase to phase)	***Minimum approach distance***
300V and less	Avoid Contact
> 300V, but < 750V	1 ft., 0 in. (30.5 cm)
> 750V, but < 2kV	1 ft., 6 in. (46 cm)
> 2kV, but < 15 kV	2 ft., 0 in. (61 cm)
> 15kV, but < 37 kV	3 ft., 0 in. (91 cm)
> 37kV, but < 87.5kV	3 ft., 6 in. (107 cm)
>87.5kV, but <121kV	4 ft., 0 in. (122 cm)
121kV, but <140kV	4 ft., 6 in. (137 cm)

Unqualified Persons

When an unqualified person is working in an elevated position near overhead lines, the location will be such that the person and the longest conductive object he or she may contact cannot come closer to any unguarded, energized overhead line than the following distances:

- For voltages to ground 50kV or below - 10 feet (305 cm);
- For voltages to ground over 50kV - 10 feet (305 cm) plus 4 inches (10 cm) for every 10kV over 50kV.

When an unqualified person is working on the ground in the vicinity of overhead lines, the person may not bring any conductive object closer to unguarded, energized overhead lines than the distances given in this program.

Note: For voltages normally encountered with overhead power line, objects which do not have an insulating rating for the voltage involved are considered to be conductive.

Warnings and Barricades

Warnings and barricades will be employed to alert unqualified Employees of the present danger related to exposed energized parts. The following rules apply:

- Safety signs, warning tags, etc., must be used to warn Unqualified Employees of the electrical hazards present, even temporarily, that may endanger them.
- Non-conductive barricades will be used with safety signs to prevent Unqualified Employees access to exposed energized parts or areas.
- Where barricades and warning signs do not provide adequate protection from electrical hazards, an Attendant will be stationed to warn and protect Employees.

Working Clearances: 600 Volts, Nominal or Less

Working Space about Electric Equipment

Sufficient access and working space will be provided and maintained about all electric equipment to permit ready and safe operation and maintenance of such equipment.

Working Clearances

Except as required or permitted elsewhere in this Chapter, the dimension of the working space in the direction of access to live parts operating at 600 volts or less and likely to require examination, adjustment, servicing, or maintenance while alive will not be less than indicated in Table 1.

In addition to the dimensions shown in Table 1, workspace will not be less than 30 inches (762 mm) wide in front of the electric equipment. Distances will be measured from the live parts if

they are exposed, or from the enclosure front or opening if the live parts are enclosed. Walls constructed of concrete, brick, or tile are considered to be grounded.

Working space is not required in back of assemblies such as dead-front switchboards or motor control centers where there are no renewable or adjustable parts such as fuses or switches on the back and where all connections are accessible from locations other than the back.

TABLE 1. WORKING CLEARANCES

Nominal voltage to ground	**Minimum clear distance for conditions [1]**		
	(a)	**(b)**	**(c)**
	Feet[2]	**Feet[2]**	**Feet [2]**
0 - 150	3	3	3
151 - 600	3	3 ½	4

[1] Conditions (a), (b), and (c) are as follows: (a) Exposed live parts on one side and no live or grounded parts on the other side of the working space, or exposed live parts on both sides effectively guarded by insulating material. Insulated wire or insulated busbars operating at not over 300 volts are not considered live parts. (b) Exposed live parts on one side and grounded parts on the other side. (c) Exposed live parts on both sides of the workspace (not guarded as provided in Condition (a)) with the operator between.

[2] **NOTE:** For International System of Units (SI): one foot = 0.3048 m.

Clear Spaces

Working space required will not be used for storage. When normally enclosed live parts are exposed for inspection or servicing, the working space, if in a passageway or general open space, will be guarded.

Access & Entrance to Working Space

At least one entrance will be provided to give access to the working space about electric equipment.

Front Working Space

Where there are live parts normally exposed on the front of switchboards or motor control centers, the working space in front of such equipment will not be less than 3 feet (914 mm).

Headroom

The minimum headroom of working spaces about service equipment, switchboards, panelboards, or motor control centers will be 6 feet 3 inches (1.91 m).

Guarding of Live Parts

Except as required or permitted elsewhere, live parts of electric equipment operating at 50 volts or more will be guarded against accidental contact by cabinets or other forms of enclosures, or by any of the following means:

- By location in a room, vault, or similar enclosure that is accessible only to qualified persons.
- By partitions or screens so arranged that only qualified persons will have access to the space within reach of the live parts. Any openings in such partitions or screens will be so sized and located that persons are not likely to come into accidental contact with the live parts or to bring conducting objects into contact with them.
- By location on a balcony, gallery, or platform so elevated and arranged as to exclude unqualified persons.
- By elevation of 8 feet (2.44 m) or more above the floor or other working surface and so installed as to exclude unqualified persons.
- In locations where electric equipment would be exposed to physical damage, enclosures or guards will be so arranged and of such strength as to prevent such damage.
- Entrances to rooms and other guarded locations containing exposed live parts will be marked with conspicuous warning signs forbidding unqualified persons to enter.

Additional State Requirements - Low-Voltage Electrical Installations and Equipment (<600 volts)

- Suitable insulated gloves must be worn for voltages in excess of 300 volts, nominal.
- Suitable accident prevention tags must be used to control a specific hazard. Such tags must provide the reason for placing tag, the name of person placing the tag and how that person may be contacted, and the date the tag was placed.
- No electrical power source, permanent or temporary, may be connected to a premises wiring system, or parts of such a system, unless positive means are used to prevent the transmission of electricity beyond the premises wiring system, or beyond any intentionally segregated parts of such system.
- Equipment intended to break current at fault levels must have an interrupting rating sufficient for the system voltage and the current, which is available at the line terminals of the equipment. Equipment intended to break current at other than fault levels must have an interrupting rating at system voltage sufficient for the current that must be interrupted.
- Attics, furred ceilings, and underfloor spaces must have minimum unobstructed access openings of 22 inches by 30 inches.
- Each motor controller must be legibly marked to indicate the motor it controls, and each motor must have the same marking unless located and arranged so that the control point is evident.
- When a circuit is abandoned or discontinued, its conductors must be removed from the raceways, or be maintained as if in use.

- Open wiring and cables must be 16 feet above areas (other than thoroughfares) where it is possible to drive vehicles, and 12 feet above areas accessible to pedestrians only.
- Conductors run above the top level of a window may be less than 3 feet above the window provided that they are at the maximum practical distance and that in no case are they less than 1 foot above the window.
- Under the following conditions, the frame of a portable or a vehicle-mounted generator need not be grounded and will be permitted to serve as the grounding electrode for a system supplied by the generator:
  - the noncurrent-carrying metal parts of equipment located on the vehicle and the equipment grounding conductor terminals of the receptacles are bonded to the generator or vehicle frame; and
  - the generator supplies only equipment located on the vehicle or the generator and/or cord- and plug-connected equipment through receptacles mounted on the vehicle or on the generator; and
  - the frame of a vehicle-mounted generator is bonded to the vehicle frame; or
  - the generator is single-phase, portable or vehicle-mounted, rated not more than 5 KW, and the circuit conductors of the generator are insulated from the generator frame and all other grounded surfaces.
  - Circuits for electric cranes operating over combustible fibers in Class III locations must not be grounded.
- Exposed, noncurrent-carrying metal parts of the following kinds of equipment, regardless of voltage, must be grounded:
  - switchboard frames and structures supporting switching equipment (except frames of DC, single-polarity switchboards where effectively insulated, and marked "Switchboard Frame Not Grounded," or equivalent wording);
  - generator and motor frames in an electrically operated organ (except where the generator is effectively insulated from ground and from the motor driving it, and marked "Generator Frame Not Grounded," or equivalent wording);
  - motor frames;
  - enclosures for motor controllers, except lined covers of snap switches;
  - electric equipment for elevators and cranes;
  - electric equipment in garages, theaters, and motion picture studios;
  - electric signs and associated equipment, except where insulated from ground and from other conductive objects and accessible only to qualified persons;
  - motion picture projection equipment;
  - equipment supplied by Class 1, 2, and 3 remote-control and signaling circuits; and
  - lighting fixtures.
- The path to ground from circuits, equipment, and conductor enclosures must have ample carrying capacity to conduct safely any currents liable to be imposed on it, and have impedance sufficiently low to limit the potential above ground and to facilitate the operation of the overcurrent devices in the circuit.
- Where an AC system is connected to a grounding electrode in or at a building, the same electrode must be used to ground conductor enclosures and equipment in or on

that building. Two or more electrodes that are effectively bonded together will be considered as a single electrode in this sense.

- For the grounding of noncurrent-carrying metal parts of equipment, raceways, and other enclosures, the following requirements apply:
  - Individually covered or insulated grounding conductors must have a continuous outer finish that is either green, or green with one or more yellow stripes.
  - An insulated conductor larger than No. 6, and (where the conditions of maintenance and supervision assure that only qualified persons will service the installation) an insulated conductor in a multiconductor cable may, at the time of installation, be permitted to be permanently identified as a grounding conductor at each end and at every point where the conductor is accessible. Identification must be accomplished by stripping the insulation from the entire exposed length, coloring the exposed insulation green, or marking the exposed insulation with green colored tape or green colored adhesive labels.
  - Bare, covered, or insulated equipment grounding conductors are permitted.
- Noncurrent-carrying metal parts of cord- and plug-connected equipment, where required to be grounded, must be grounded by means of:
  - the metal enclosure of the conductors supplying such equipment, if a grounding-type attachment plug with one fixed grounding contact is used for grounding the metal enclosure, and if the metal enclosure of the conductors is secured to the attachment plug and to equipment by connectors approved for the purpose;
  - a grounding conductor run with the power supply conductors in a cable assembly or flexible cord properly terminated in a grounding-type attachment plug with one fixed grounding contact; or
  - a separate flexible wire or strap, insulated or bare, protected as well as practicable against physical damage, where part of approved portable equipment.
- The metal noncurrent-carrying parts of the following equipment must be effectively bonded together:
  - service raceways, cable trays, or service cable armor or sheath;
  - all service equipment enclosures containing service-entrance conductors, including meter fittings, boxes, or the like, interposed in the service raceway or armor; and
  - any metallic raceway or armor enclosing a grounding electrode conductor.
- An equipment bonding jumper must be used to connect the grounding terminal of a grounding-type receptacle to a grounded box, with certain exceptions.
- Equipment bonding jumpers must be of copper or other corrosion-resistant material, and may be installed inside or outside of a raceway or enclosure. Where installed on the outside, the length of the equipment bonding jumper must not exceed 6 feet and must be routed with the raceway or enclosure.
- Where available on the premises, a metal underground water pipe must always be used as the grounding electrode, regardless of its length and whether supplied by a community or a local underground water piping system or by a well on the premises. Where the buried portion of the water pipe (including any metal well casing effectively bonded to the pipe) is less than 10 feet long or where the water pipe is or is likely to be isolated by insulated sections or joints so that the effectively grounded portion is

less than 10 feet long, it must be supplemented by the use of an additional electrode. The interior metal cold water piping system must always be bonded to the service-equipment enclosure, the grounded conductor at the service, the grounding electrode conductor where of sufficient size, or to the one or more grounding electrodes used. Where a water system is not available, the grounding connection must be made to:
  - the metal frame of the building, where effectively grounded;
  - an electrode encased by at least 2 inches of concrete, located within and near the bottom of a concrete foundation or footing that is in direct contact with the earth, consisting of at least 20 feet of one or more steel reinforcing bars or rods of not less that 1/2-inch diameter, or consisting of at least 20 feet of bare copper conductor not smaller than No. 4 AWG;
  - an electrically continuous metal underground gas piping system that is uninterrupted with insulating sections or joints and without an outer nonconductive coating (if acceptable to the gas supplier and the authority having jurisdiction); or
  - other local metal underground systems or structures, such as piping systems and underground tanks.
- Where none of the electrodes specified above is available, one of the following must be used:
  - rod and pipe electrodes at least 8 feet long, or
  - plate electrodes that expose at least 2 square feet of surface to exterior soil. A single electrode consisting of a rod, pipe, or plate, which does not have a resistance to ground of 25 ohms or less, must be augmented by one additional electrode.
- Connection devices or fittings that depend on solder must not be used.
- Where more than one equipment grounding conductor of a branch circuit enters a box, all such conductors must be in good electrical contact with each other and the arrangement must be such that the disconnection or removal of a receptacle, fixture, or other device fed from the box will not interfere with or interrupt the grounding continuity.
- A connection must be made between the one or more equipment grounding conductors and a metal box by means of a grounding screw, which must be used for no other purpose, or an approved grounding device. One or more equipment grounding conductors brought into a nonmetallic outlet box must be so arranged that a connection can be made to any fitting or device in that box requiring grounding.
- For temporary wiring, multi-conductor cords and cables must be hard service type or equivalent, with multi-conductor fittings, and open wire taps, not exceeding 6 inches in length, may be made from permanent wiring outlet boxes to supply approved lampholders.
- The minimum size of a temporary wood pole must be 6 inches by 6 inches (nominal) if square, or have a top diameter of at least 5 inches if round, and be of sufficient length to maintain all required overhead clearances, but at least 20 feet long. The lower end must be embedded at least 4 feet in the ground.
- Open exposed wiring must not be installed in any building or portion of a building, except in substations, transformer vaults, transformer enclosures, on the supply side of electric furnace electrodes, or in tunnels or similar locations, where such spaces

are restricted to electrical use and are accessible to qualified and authorized persons only.

- All manually operated switches must be of an approved externally operable type, unless operating at 50 volts or less, and must be enclosed in boxes or cabinets.
- Grounding conductors must be continuously marked with a green color or a green color with one or more yellow stripes, and must not be used for anything other than grounding purposes. The identifying color(s) must be on the insulation or on a braid.
- Lampholders, fixtures, or standard receptacles rated 15 amperes or less must not be supplied by voltages exceeding 150 volts to ground, with some exceptions.
- Attachment plugs or other connectors supplying equipment at more than 300 volts must be of the skirted type, unless designed so that the arc will be confined within the body or case of the device.
- All new or replacement 15- and 20-ampere attachment plugs must be of dead-front construction such that there are no exposed current-carrying metal parts except the prongs, blades, or pins.
- Grounding-type receptacles, cord connectors, and attachment plugs must be provided with one fixed grounding pole in addition to the circuit poles. Grounding-type receptacles, adapters, cord connectors, and attachment plugs must be grounded.
- All smoothing irons and portable electrically heated appliances that are rated at more than 50 watts and produce temperatures in excess of 250°F on surfaces with which the cord is likely to be in contact must be provided with approved heater cords.
- Portable immersion-type electric heaters must be constructed and installed so that current-carrying parts are effectively insulated from electrical contact with the substance in which they are immersed.
- Each electrically heated appliance that is intended by size, weight, and service to be located in a fixed position must be so placed as to provide ample protection between the appliance and adjacent combustible material.
- Each smoothing iron and other portable electrically heated appliance intended to be applied to combustible material must be equipped with an approved stand, either as a separate piece of equipment or a part of the appliance.
- Electrically heated appliances intended to be applied to combustible material must be provided with a signal, unless provided with an integral temperature-limiting device.
- Infrared heating lamps rated at 300 watts or less are permitted with lampholders of the medium-base, unswitched porcelain type or other types approved for the purpose. Screw shell lampholders must not be used with infrared lamps over 300 watts rating.
- A separable connector or a plug and receptacle combination in the supply line to an oven or cooking unit used only for ease in servicing or for installation must not be installed as the disconnecting means, and must be approved for the temperature of the space in which it is located.
- All heating elements that are rated over one ampere, replaceable in the field, and a part of an appliance must be legibly marked with the ratings in volts and amperes, or in volts and watts, or with the manufacturer's part number.
- If an appliance is to be used on a specific frequency or frequencies, or when motor overload protection external to the appliance is required, it must be so marked. The

marking on an appliance consisting of a motor with other load(s) or motors with or without other load(s) must specify the minimum circuit size and the maximum rating of the circuit overcurrent protective device (with some exceptions).

- Means must be provided to disconnect the heater, controller(s), and overcurrent protective device(s) of all fixed electric space heating equipment from all ungrounded conductors. Switches and circuit breakers used as disconnecting means must be of the indicating type. Duct heater controller equipment must be accessible with the disconnecting means installed at or within sight from the controller, unless the disconnecting means is arranged to be locked in the "open" position.
- All fixed outdoor electric de-icing and snow melting equipment must be provided with a means for disconnection from all ungrounded conductors. Where readily accessible to the user of the equipment, the branch circuit switch or circuit breaker may serve as the disconnecting means. Switches used as disconnecting means must be of the indicating type.
- The presence of electric pipeline and vessel heating equipment must be evident by the posting of appropriate signs or other markings at frequent intervals in the area involved. Means must be provided to disconnect all fixed electric pipeline or vessel heating equipment from all ungrounded conductors. The branch circuit switch or circuit breaker, where readily accessible to the user of the equipment, may serve as the disconnecting means. Switches used as disconnecting means must be of the indicating type, and must be provided with a positive lockout in the "off" position. The factory-installed attachment plug of cord-connected equipment, rated 20 amperes or less and 150 volts or less to ground is an acceptable means of disconnection.
- A motor-running overload device that can restart a motor automatically after overload tripping must not be installed unless approved for use with the motor it protects. A motor that can restart automatically after shutdown may not be installed if its automatic restarting can result in injury to persons.
- Where a transformer or other device is used to obtain a reduced voltage for the control circuit and is located in the controller, the transformer or other device must be connected to the load side of the disconnecting means for the control circuit.
- Each motor controller must be capable of starting and stopping the motor it controls, and must be capable of interrupting the stalled-rotor current of the motor. An autotransformer starter must provide an off position, a running position, and at least one starting position. It must be so designed that it cannot rest in the starting position or in any position that will render the overload device in the circuit inoperative. Motor-starting rheostats must be so designed that the contact arm cannot be left on intermediate segments. The point or plate on which the arm rests when in the starting position must have no electrical connection with the resistor. Motor-starting rheostats for direct current motors operated from a constant voltage supply must be equipped with automatic devices that will interrupt the supply before the speed of the motor has fallen to less than 1/3 its normal value.
- The controller must have a horsepower rating not lower than the horsepower rating of the motor, with certain exceptions. The controller does not have to open all conductors to the motor.

- Capacitors containing more than 3 gallons of flammable liquid must be enclosed in vaults or outdoor fenced enclosures. Capacitors must be enclosed, located, or guarded so that persons cannot come into accidental contact or bring conducting materials into accidental contact with exposed energized parts, terminals, or buses associated with them.
- The residual voltage of a capacitor must be reduced to 50 volts or less within one minute after the capacitor is disconnected from the source of supply. The discharge circuit must be either permanently connected to the terminals of the capacitor or capacitor bank, or provided with automatic means of connecting it to the terminals of the capacitor bank on removal of voltage from the line. Manual means of switching or connecting the discharge circuit must not be used.
- A disconnecting means must be provided in each ungrounded conductor for each capacitor bank, unless a capacitor is connected on the load side of a motor-running overcurrent device. The disconnecting means is not required to open all ungrounded conductors simultaneously, and may disconnect the capacitor from the line as a regular operating procedure. The rating of the disconnecting means must not be less than 135 percent of the rated current of the capacitor.
- Some states have classified and adopted special precautions for vehicle service and repair operations, aircraft hangars, gasoline dispensing and service stations, bulk storage plants, finishing area (locations where paints, lacquers, or other flammable finishes are applied), wastewater wells, and oil and gas wells.
- Some states have adopted a variety of specific electrical requirements for the following:
  - places of assembly;
  - theaters;
  - motion-picture studios;
  - motion-picture projectors; and
  - sound recording equipment.
- The bottom of sign and outline lighting enclosures must be at least 16 feet above areas accessible to vehicles, unless protected from physical damage. Other specific clearances for signs and outline lighting systems must be followed.
- For cranes and hoists, the following requirements apply:
  - Where a crane or hoist operates over readily combustible material, the resistors must be placed in a well ventilated cabinet composed of noncombustible material so constructed that it will not emit flames or molten metal.
  - On floor operated overhead cranes a suitable work platform with means of access must be provided, attached to the building structure, or on the overhead crane bridge, giving ready and safe access to electrical control cabinets for service, maintenance, or repair.
  - On every new installation, major replacement, modification, or repair made after 3/15/72, the dimension of the working space in the direction of access to energized parts which are likely to require examination, adjustment, service, or maintenance while energized must be in accordance with §2340.16.

- All cranes using a lifting magnet must have a magnet circuit switch of the enclosed type with provision for locking in the "open" position. A separate means for discharging the inductive load of the magnet must be provided.
- Conductors must be enclosed in a raceway or must be Type MC or MI cable, with certain exceptions.
- Some states have adopted numerous requirements for crane and hoist controls.

- Each welder must have overcurrent protection rated or set at not more than 200 percent of the rated primary current of the welder.
- For data processing systems, the following requirements apply:
  - The branch-circuit conductors to which one or more units of a data processing system are connected to a source of supply must have an ampacity not less than 125 percent of the total connected load.
  - The data processing system may be connected by means of computer or data processing cable or flexible cord and an attachment plug cap or cord-set assembly specifically approved as a part of the data processing system. Separate units may be interconnected by means of flexible cords and cables specifically approved as part of the data processing system. When run on the surface of the floor, they must be protected against physical damage.
  - Power cables, communications cables, and interconnecting cables associated with the data processing equipment are permitted under a raised floor provided the raised floor is of suitable construction, and the branch-circuit supply conductors to receptacles are in rigid metal conduit, intermediate metal conduit, electrical metallic tubing, metal wireway, metal surface raceway with metal cover, flexible metal conduit, liquid-tight flexible metal conduit, mineral-insulated, metal-sheathed cable, metal-clad cable, or Type AC cable, and ventilation in the underfloor area is used for the data processing equipment and data processing area only.
- For electrically driven or controlled irrigation machines. The following requirements apply:
  - Irrigation cable must be secured by approved straps, hangers, or similar fittings so designed and installed as not to injure the cable. Cable must be supported at intervals not exceeding 4 feet.
  - Fittings must be used at all points where irrigation cable terminates. The fittings must be designed for use with the cable and suitable for the conditions of service.
  - All electrical equipment on the irrigation machine, all electrical equipment associated with the irrigation machine, metallic junction boxes and enclosures, and control panels or control equipment that supply or control electrical equipment to the irrigation machine must be grounded. Grounding is not required on machines where the machine is electrically controlled but not electrically driven, the control voltage is 30 volts or less, and the control or signal circuits are current limited.
  - A cord-connected swimming pool filter pump must incorporate an approved system of double insulation or its equivalent, and must be provided with means of grounding only the internal and nonaccessible noncurrent-carrying metal parts of the appliance. The means for grounding must be an equipment grounding conductor run with the power-supply conductors in the flexible cord that is properly

terminated in a grounding-type attachment plug having a fixed grounding contact member.
    - All electric equipment, including power-supply cords, used with storable swimming pools must be protected by ground-fault circuit interrupters.
- Circuits, systems, and equipment intended to supply power for illumination and special loads, in the event of failure of the normal supply, must be tested periodically on an approved schedule to assure their maintenance in proper operating condition. Where battery systems or unit equipments are involved, including batteries used for starting or ignition in auxiliary engines, the authority having jurisdiction will require periodic maintenance. A written record must be kept of such tests and maintenance. Means for testing all emergency lighting and power systems during maximum anticipated load conditions must be provided. Where emergency lighting is necessary, the system must be so arranged that the failure of any individual lighting element, such as the burning out of a light bulb, cannot leave any space in total darkness. All manual switches for controlling emergency circuits must be in convenient locations. In places of assembly, such as theaters, a switch for controlling emergency lighting systems must be located in the lobby or at a place conveniently accessible thereto, never in a motion picture projection booth or on a stage. The branch circuit overcurrent devices in emergency circuits must be accessible to authorized persons only.
- In electroplating and electrostripping processes, when access to the process while energized is necessary, the entrance door guarding the electrolytic process must be electrically interlocked so that access by employees will be prevented when the voltage exceeds 50 volts DC.

Over 600 Volts, Nominal

Conductors and equipment used on circuits exceeding 600 volts, nominal, will comply with all applicable provisions of the OSHA standard.

Enclosure for Electrical Installations

Electrical installations in a vault, room, closet or in an area surrounded by a wall, screen, or fence, access to which is controlled by lock and key or other equivalent means, are considered to be accessible to qualified persons only. A wall, screen, or fence less than 8 feet (2.44 m) in height is not considered adequate to prevent access unless it has other features that provide a degree of isolation equivalent to an 8-foot (2.44-m) fence. The entrances to all buildings, rooms or enclosures containing exposed live parts or exposed conductors operating at over 600 volts, nominal, will be kept locked or will be under the observation of a qualified person at all times.

Installations Accessible to Qualified Persons Only

Electrical installations having exposed live parts will be accessible to qualified persons only and will comply with the applicable provisions of the OSHA standard.

Installations Accessible to Unqualified Persons

Electrical installations that are open to unqualified persons will be made with metal-enclosed equipment or will be enclosed in a vault or in an area, access to which is controlled by a lock. Metal-enclosed switch-gear, unit substations, transformers, pull boxes, connection boxes, and other similar associated equipment will be marked with appropriate caution signs. If equipment is exposed to physical damage from vehicular traffic, guards will be provided to prevent such damage. Ventilating or similar openings in metal-enclosed equipment will be designed so that foreign objects inserted through these openings will be deflected from energized parts.

Workspace About Equipment

Sufficient space will be provided and maintained about electric equipment to permit ready and safe operation and maintenance of such equipment. Where energized parts are exposed, the minimum clear workspace will not be less than 6 feet 6 inches (1.98 m) high (measured vertically from the floor or platform), or less than 3 feet (914 mm) wide (measured parallel to the equipment). The depth will be as required in Table 2. The workspace will be adequate to permit at least a 90-degree opening of doors or hinged panels.

Working Space

The minimum clear working space in front of electric equipment such as switchboards, control panels, switches, circuit breakers, motor controllers, relays, and similar equipment will not be less than specified in Table 2 unless otherwise specified in this Chapter. Distances will be measured from the live parts if they are exposed, or from the enclosure front or opening if the live parts are enclosed. However, working space is not required in back of equipment such as deadfront switchboards or control assemblies where there are no renewable or adjustable parts (such as fuses or switches) on the back and where all connections are accessible from locations other than the back. Where rear access is required to work on de-energized parts on the back of enclosed equipment, a minimum working space of 30 inches (762 mm) horizontally will be provided.

TABLE 2. MINIMUM DEPTH OF CLEAR WORKING SPACE IN FRONT OF ELECTRIC EQUIPMENT

Nominal voltage to ground	**Conditions [1]**		
	(a)	**(b)**	**(c)**
	Feet[2]	Feet[2]	Feet [2]
601 to 2,500	3	4	5
2,501 to 9,000	4	5	6
9,001 to 25,000	5	6	9
25,001 to 75 kV	6	8	10
Above 75 kV	8	10	12

[1] Conditions (a), (b), and (c) are as follows: (a) Exposed live parts on one side and no live or grounded parts on the other side of the working space, or exposed live parts on both sides effectively guarded by insulating material. Insulated wire or insulated busbars operating at not over 300 volts are not considered live parts. (b) Exposed live parts on one side and grounded parts on the other side. Walls constructed of concrete, brick or tile are considered to be grounded surfaces. (c) Exposed live parts on both sides of the workspace (not guarded as provided in Condition (a)) with the operator between.

[2] **NOTE:** For SI units: one foot = 0.3048 m.

Lighting Outlets & Points of Control

The lighting outlets will be so arranged that persons changing lamps or making repairs on the lighting system will not be endangered by live parts or other equipment. The points of control will be so located that persons are not likely to come in contact with any live part or moving part of the equipment while turning on the lights.

Elevation of Unguarded Live Parts

Unguarded live parts above working space will be maintained at elevations not less than specified in Table 3.

TABLE 3 ELEVATION OF UNGUARDED ENERGIZED PARTS ABOVE WORKING SPACE

Normal voltage between phases	Minimum elevation
601 - 7,500	8 feet 6 inches [1]
7,501 - 35,000	9 feet
Over 35 kV	9 feet + 0.37 inches per kV above 35 kV

[1] **NOTE:** For SI units: one inch = 25.4 mm; one foot = 0.3048 m.

Entrance & Access to Workspace

At least one entrance not less than 24 inches (610 mm) wide and 6 feet 6 inches (1.98 m) high will be provided to give access to the working space about electric equipment. On switchboard and control panels exceeding 48 inches (1.22 m) in width, there will be one entrance at each end of such board where practicable. Where bare energized parts at any voltage or insulated energized parts above 600 volts are located adjacent to such entrance, they will be guarded.

Working On or Near Energized Equipment

When an employee's work on exposed live parts involves direct contact or contact by means of tools or materials, or work is near enough to live parts for the employee to be exposed to a hazard, the following requirements apply.

Working On Energized Equipment - Only qualified persons may work on electric circuit parts or equipment that have not been de-energized. The qualified person must be capable of working safely on energized circuits and must know the proper use of special precautionary techniques, personal protective equipment, insulating and shielding materials, and insulated tools.

Vehicular and Mechanical Equipment

Any vehicle or mechanical equipment capable of having parts of its structure elevated near energized overhead lines will be operated so that a clearance of 10 ft. (305 cm) is maintained. If the voltage is higher than 50kV, the clearance will be increased 4 in. (10 cm) for every 10kV over that voltage. However, under any of the following conditions, the clearance may be reduced:

- If the vehicle is in transit with its structure lowered, the clearance may be reduced to 4 ft. (122 cm). If the voltage is higher than 50kV, the clearance will be increased 4 in. (10 cm) for every 10 kV over that voltage.
- If insulating barriers are installed to prevent contact with the lines, and if the barriers are rated for the voltage of the line being guarded and are not a part of or an attachment to the vehicle or its raised structure, the clearance may be reduced to a distance within the designed working dimensions of the insulating barrier.
- If the equipment is an aerial lift insulated for the voltage involved, and if the work is performed by a qualified person, the clearance (between the uninsulated portion of the aerial lift and the power line) may be reduced per the OSHA standard.
- Employees standing on the ground may not contact the vehicle or mechanical equipment or any of its attachments, unless:
- The employee is using protective equipment rated for the voltage; or
- The equipment is located so that no uninsulated part of its structure (that portion of the structure that provides a conductive path to employees on the ground) can come closer to the line than permitted in the OSHA standard.

If any vehicle or mechanical equipment capable of having parts of its structure elevated near energized overhead lines is intentionally grounded, employees working on the ground near the point of grounding may not stand at the grounding location whenever there is a possibility of overhead line contact. Additional precautions, such as the use of barricades or insulation, will be taken to protect employees from hazardous ground potentials, depending on earth resistivity and fault currents, which can develop within the first few feet or more outward from the grounding point.

Illumination

Employees may not enter spaces containing exposed energized parts, unless illumination is provided that enables the employees to perform the work safely.

Where lack of illumination or an obstruction precludes observation of the work to be performed, employees may not perform tasks near exposed energized parts. Employees may not reach blindly into areas which may contain energized parts.

Confined or Enclosed Work Spaces

When an employee works in a confined or enclosed space (such as a manhole or vault) that contains exposed energized parts, Trinity will provide, and the employee will use, protective shields, protective barriers, or insulating materials as necessary to avoid inadvertent contact with these parts. Doors, hinged panels, and the like will be secured to prevent their swinging into an employee and causing the employee to contact exposed energized parts.

Conductive Materials and Equipment

Conductive materials and equipment that are in contact with any part of an employee's body will be handled in a manner that will prevent them from contacting exposed energized conductors or circuit parts. If an employee must handle long dimensional conductive objects (such as ducts and pipes) in areas with exposed live parts, Trinity will institute work practices (such as the use of insulation, guarding, and material handling techniques) which will minimize the hazard.

Portable Ladders

Portable ladders will have nonconductive siderails if they are used where the employee or the ladder could contact exposed energized parts.

Conductive Apparel

Conductive articles of jewelry and clothing (such a watch bands, bracelets, rings, key chains, necklaces, metalized aprons, cloth with conductive thread, or metal headgear) may not be worn if they might contact exposed energized parts. However, such articles may be worn if they are rendered nonconductive by covering, wrapping, or other insulating means.

Housekeeping Duties

Where live parts present an electrical contact hazard, employees may not perform housekeeping duties at such close distances to the parts that there is a possibility of contact, unless adequate safeguards (such as insulating equipment or barriers) are provided. Electrically conductive cleaning materials (including conductive solids such as steel wool, metalized cloth, and silicon carbide, as well as conductive liquid solutions) may not be used in proximity to energized parts unless procedures are followed which will prevent electrical contact.

Working On or Near Exposed Deenergized Parts

If conductors or parts of electric equipment have been deenergized but not locked out or tagged, they must be treated as energized parts. While any employee is exposed to contact with parts

of fixed electric equipment or circuits which have been deenergized, the circuits energizing the parts must be locked out or tagged or both. As used in this section, fixed equipment refers to equipment fastened in place or connected by permanent wiring methods. Lockout and tagging procedures must comply with the document "*The Control of Hazardous Energy (Lockout/Tagout Requirements and Procedures): OSHA Standard 1910.147*." The employer must maintain a written copy of the procedures followed in order to comply with this standard and must make it available for inspection by employees and by OSHA

Lockout and Tagging of Circuits

This portion of the plan has been created to maintain a written copy of procedures to be followed during work on or near enough to exposed de-energized parts of conductors and electric equipment to expose employees to any electrical hazard they present. The requirements apply to all of Trinity's construction job sites.

This written procedure includes procedural steps for each one of the following:

- de-energizing equipment,
- application of locks and tags,
- verification of de-energized condition, and
- re-energizing equipment.

While any employee is exposed to contact with parts of fixed electric equipment or circuits which have been de-energized, the circuits energizing the parts will be locked out or tagged or both according to the requirements of this written plan.

Conductors and parts of electric equipment that have been de-energized but have not been locked out or tagged according to these procedures will be treated as energized parts.

The requirements must be followed in the order in which they are presented.

Trinity maintains this written copy of procedures in the Operations Office and makes it available for inspection by employees and the Assistant Secretary of Labor (the head of OSHA) and his or her authorized representatives.

De-energizing Equipment

Safe procedures for de-energizing circuits and equipment will be determined by Site Supervisor before circuits or equipment is de-energized.

The circuits and equipment to be worked on will be disconnected from all electric energy sources. Control circuit devices, such as push buttons, selector switches, and interlocks, may not be used as the sole means for de-energizing circuits or equipment. Interlocks for electric equipment may not be used as a substitute for lockout and tagging procedures.

Stored electric energy which might endanger personnel will be released. Capacitors will be discharged and high capacitance elements will be short-circuited and grounded, if the stored electric energy might endanger personnel.

If the capacitors or associated equipment are handled in meeting this requirement, they will be treated as energized. Stored non-electrical energy in devices that could re-energize electric circuit parts will be blocked or relieved to the extent that the circuit parts could not be accidentally energized by the device.

Application of Locks and Tags

A lock **and** a tag will be placed on each disconnecting means used to de-energize circuits and equipment on which work is to be performed. Employees can obtain these locks and tags from Site Supervisor.

The lock will be attached so it prevents persons from operating the disconnecting means unless they resort to undue force or the use of tools. Each tag will contain a statement prohibiting unauthorized operation the disconnecting means and removal of the tag.

If a lock cannot be applied, or if Trinity can demonstrate that tagging procedures will provide a level of safety equivalent to that obtained by the use of a lock, a tag may be used without a lock.

If a tag is used without a lock, the tag will be supplemented by at least one additional safety measure that provides a level of safety equivalent to that obtained by the use of a lock. Examples of additional safety measures include the removal of an isolating circuit element, blocking of a controlling switch, or opening of an extra disconnecting device.

A lock may be placed without a tag only under the following conditions:

- Only one circuit or piece of equipment is de-energized, and
- The lockout period does not extend beyond the work shift, and
- Employees exposed to the hazards associated with re-energizing the circuit or equipment are familiar with this procedure.

Use of either of these exceptions must be approved by Site Supervisor

Verification of De-energized Condition

The following requirements must be met before any circuits or equipment can be considered and worked as de-energized:

1. A qualified person will operate the equipment operating controls or otherwise verify that the equipment cannot be restarted.
2. A qualified person will use test equipment to test the circuit elements and electrical parts of equipment to which employees will be exposed and will verify that the circuit elements and equipment parts are de-energized.

The test will also determine if any energized condition exists as a result of inadvertently induced voltage or unrelated voltage backfeed even though specific parts of the circuit have been de-energized and presumed to be safe. If the circuit to be tested is over 600 volts, nominal, the test equipment will be checked for proper operation immediately before and immediately after this test.

Only authorized employees that have been trained and designated as qualified persons are authorized to perform duties in that capacity.

Re-Energizing Equipment

The following requirements will be met, in order given, before circuits or equipment is re-energized, even temporarily:

1. A qualified person will conduct tests and visual inspections, as necessary, to verify that all tools, electrical jumpers, shorts, grounds, and other such devices have been removed, so that the circuits and equipment can be safely energized.
2. Employees exposed to the hazards associated with re-energizing the circuit or equipment will be warned to stay clear of circuits and equipment.
3. Each lock and tag will be removed by the employee who applied it or under his or her direct supervision. However, if this employee is absent from the workplace, then the lock or tag may be removed by a qualified person designated to perform this task provided that the employee who applied the lock or tag is not available at the workplace, and the employee is aware that the lock or tag has been removed before he or she resumes work at that workplace.
4. There will be a visual determination that all employees are clear of the circuits and equipment.

See the Lockout Tagout Program for complete details.

Additional State Requirements - High-Voltage Electrical Installations and Equipment (>600 volts)

- All switches, circuit breakers, and other control devices must be located or marked to indicate clearly the equipment controlled by them.
- No building or premises may be supplied at more than one service point, except under certain conditions.
- Overhead or underground services or service entrance conductors must not supply one building through another.
- Open service entrance conductors must be attached to the building at one point only, and must be suitably guarded against accidental contact. The length of open conductor between such point of attachment and the point where the conductors enter the building or the raceway must be as short as practicable, but in no case greater than 3 feet. There must be a conspicuous and permanent "HIGH VOLTAGE" sign placed on the outside immediately adjacent to the point of attachment.

- Conductors other than service entrance conductors and grounding conductors must not be installed in service entrance raceways.
- Service switching devices must simultaneously disconnect all ungrounded conductors supplied through the service entrance conductors, with certain exceptions.
- Surge and lightning protection equipment must be connected to the source side of switching devices.
- Service entrance conductors must have a protective device in each ungrounded conductor on the load side of or as an integral part of the service entrance switch. The protective device must be capable of detecting and interrupting all values of current in excess of its minimum trip setting or minimum melting point, which can occur at its location.
- Each set of service entrance conductors must have a service entrance switch which is group operated to open each set of ungrounded service entrance conductors, and it must be capable of being padlocked in the open position.
- A means must be provided to isolate the load and each overcurrent protective device in the service entrance conductors from all sources of supply.
- Two or more feeders or sets of service entrance conductors, which can be operated in parallel, must be provided with a suitable means to isolate each set or feeder from all others. Operation of paralleling switches must be restricted to qualified and authorized persons only. A written switching procedure must be made available to and followed by such personnel.
- Each feeder must be arranged so that it can be isolated from all sources of supply except that isolating switches are not required for taps.
- If a high-voltage system is to be grounded, a grounding connection must be made to the system neutral if available. This connection must be made at or on the source side of the service entrance equipment. Grounding connections must be arranged to prevent objectionable current in the equipment grounding conductor during normal system operation. Grounding equipment and connections must have ample thermal capacity to carry safely any current, which may be imposed on them by the system. Grounding connections must be clamp type, pressure type, welded, or other approved type, and grounding electrodes must be of corrosion-resistant material and of adequate size, number, and location to effectively ground the system. Local piping systems, well casings, building frames, and the like must not be used as system grounding electrodes unless their resistance to ground will be maintained low enough to insure effective grounding.
- Effective grounding of all equipment must be assured by the use of an equipment grounding conductor, where feasible, such that the path to ground will have impedance sufficiently low to limit the potential above ground, and to facilitate the operation of the overcurrent or ground fault detecting devices in the system. Where the conduit is intended to function as the equipment grounding conductor, approved threaded couplings, hubs, and joints, or double locknuts and bushings with bonding jumpers are required. Unless grounding conductors are an integral part of the cable, they must be no smaller than No. 6 AWG for mechanical strength. Grounding conductors must be of

corrosion-resistant approved material, or must be suitably protected against corrosion, and must have thermal capacity for the conditions imposed on them by the system.

- Portable high-voltage equipment must be supplied from a system having its neutral grounded through impedance. Where a delta-connected high-voltage system is used to supply portable equipment, a system neutral must be derived. The product of the maximum ground fault current and the impedance of the ground return conductor must be such as to limit the voltage developed between the portable equipment frame and ground (by the flow of ground fault current) to not more than 100 volts.
- Conductors of high-voltage and low-voltage systems must not occupy the same wiring enclosure or pull and junction boxes except in approved switchgear and control assemblies.
- Raceways, except those used for exposed work and having a removable cover, must first be installed as a complete raceway system without the conductors. Pull wires, if used, must not be installed until the raceway system is in place. Approved pulling compound may be used as a lubricant in inserting conductors in raceways. Cleaning agents or lubricants having a deleterious effect on conductor coverings must not be used.
- Conductors must not be bent to a radius less than 8 times the overall diameter for non-shielded conductors or 12 times the diameter for shielded or lead-covered conductors during or after installation.
- Pull boxes must be of sufficient size and design to accommodate the installation and maintenance of all conductors installed in them without damaging the insulation on any conductor. Where permanent barriers are installed in a box, each section must be considered as a separate box. One or more sides of a pull box must be removable. Horizontal conductors of 6 feet or more in length inside the box must be supported.
- Pull boxes must be made of material inherently resistant to corrosion or must be suitably protected both internally and externally, by enameling, galvanizing, plating, or other equivalent means. Suitable bushings, shields, or fittings having smooth rounded edges must be provided where conductors pass through partitions and at other locations where necessary. Pull boxes must be so installed that the wiring is accessible without removing any part of the building. Pull boxes must be of a type approved for the respective location in which they are installed.
- Covers for pull and junction boxes used in high-voltage raceway systems must be labeled "HIGH VOLTAGE" in block letters at least 1/2 inch high.
- Some state’s rules specify the minimum spacing, in inches, between bare energized parts and adjacent surfaces.
- Bus runs having sections located both inside and outside of a building must provide a vapor seal at the building wall to prevent interchange of air between indoor and outdoor sections unless forced cooled. Fire barriers must be provided at walls where fire separation is required.
- Flexible or expansion connections must be provided in long, straight runs of bus to allow for temperature expansion or contraction, or where the bus run crosses building vibration insulation joints. All conductor termination and connection hardware must be accessible for installation, connection, and maintenance. Where bus enclosures terminate at

machines cooled by flammable atmospheres, seal-off bushings, baffles, or other means must be provided to prevent accumulation of flammable gas in the bus enclosure.

- Switching devices or disconnecting links provided in the bus run must have the same momentary rating as the bus. Disconnecting links must be plainly marked to be removable only when the bus is de-energized. Switching devices which are not load break must be interlocked to prevent operation under load, and disconnecting link enclosures must be interlocked to prevent access to energized parts.
- Each bus run must be provided with a permanent nameplate listing rated voltage, rated continuous current, rated frequency, rated impulse withstand voltage, rated 60-cycle withstand voltage (dry), rated momentary current, and the manufacturer's name and address.
- Drain plugs, filter drains, or similar methods must be provided to remove condensed moisture from low points in bus runs.
- Secondary control devices and wiring which are provided as part of the metal-enclosed bus run must be isolated by grounded metal barriers from all primary circuit elements with the exception of short lengths of wire, such as at instrument transformer terminals.
- Continuous rigid cable supports may extend vertically through floors and platforms if the cable support is totally enclosed where it passes through the floor or platform opening and for a distance of 6 feet above the floor or platform to provide protection from physical damage.
- A working space of 24 inches minimum must be maintained on one side of each rigid cable support. A minimum vertical clearance of 6 inches must be maintained from the top of the rigid cable support to all ceilings, beams, and other similar obstructions exceeding 24 inches, measured along the length of the cable support.
- Metal-clad cable may be installed on metal racks, trays, troughs, or continuous rigid cable supports which are effectively grounded. Each cable must be supported at intervals not exceeding 6 feet and within 2 feet of every box or fitting, and each cable must be attached to the support at intervals of not more than 10 feet horizontally and 2 feet vertically.
- For metal-clad cable, the flexible metal enclosure must provide the equivalent mechanical strength of not less than .025 inch of steel.
- Cable supplying energy to mobile equipment or machinery must be IPCEA Type SHD-GC or other approved portable type.
- Suitable fencing, barriers, or other means must be provided to prevent access of other than authorized and qualified personnel to temporary wiring.
- Temporary wiring must not be used for longer than 90 days, except for construction purposes in which case it may be used for up to one year. All temporary wiring must be removed immediately upon the completion of construction or purpose for which the wiring was installed; or upon the expiration of the time limit specified above.
- When a cable is suspended by its conductor(s), the total suspended weight must not be greater than one-seventh of the ultimate tensile strength of the supporting conductor(s). Cable supports must be designed to carry adequately the weight of the cable. Separate supports must be provided for the sheath of unarmored lead-sheathed cable. When a cable is suspended by wire armor or messenger, the total suspended weight must not be

greater than one-fifth of the ultimate tensile strength of the armor or messenger. When wire mesh mechanical holding devices are used, either as the sole means of support or in conjunction with other means of support, the total suspended weight on each device and the distance between devices must not exceed recommendations of the cable and wire mesh manufacturers.

- Vault interior walls must be of assemblies of materials approved for not less than one-hour, non-combustible fire-resistive construction. Door openings to vaults must be protected by approved one-hour rated fire door and frame assemblies. Vault ceiling access opening covers or grates weighing less than 100 pounds must be securely fastened in place. Openings must be a minimum of 26 inches in diameter or 24 inches by 26 inches in size. Safe access must be provided from the opening to the floor or other working surface. All ventilating flues or ducts must be of noncombustible construction. Ventilating openings must not be through the vault door, except where the door opens to outdoors. Vaults must be provided with adequate ventilation. Where drainage from sumps in vaults is to a sewage system, a suitable trap must be installed capable of preventing the entrance of sewer gas into the vault. Pipelines such as sewer, water, gas, oil, etc., must be installed outside the vault enclosure unless they constitute an integral part of operation of the equipment installed in the vault. Where it is impracticable for such lines to be installed outside the vault, they must contain no appurtenances (such as valves, faucets, or fittings) inside the vault that require maintenance.
- In vaults containing oil-filled equipment, walls, roofs, and floors (other than when laid on earth) must be of assemblies of materials approved for three-hour non-combustible fire-resistive construction. Door openings to vaults must be protected by approved three-hour rated fire doors and frame assemblies. A door sill or curb of sufficient height (at least 4 inches) to confine within the vault the oil from the largest oil-filled equipment must be provided. Ventilating openings must be located as far away as practicable from building doors, windows, fire escapes, and combustible material. All openings from vaults into buildings, except approved fire door openings and viewing ports, must be connected to a non-combustible duct or flue leading directly to the exterior, or must be equipped with approved three-hour rated fire doors or fire dampers. Ducts and flues must not be connected with any other ventilating or air distribution system, except that ventilation may be supplied from conditioned air systems into the vault, provided approved three-hour rated fire doors or fire dampers are installed in each opening. Water-type fire sprinkler systems are prohibited.
- Electrical equipment containing flammable gas or more than 10 gallons of flammable oil per unit must not be installed indoors except in a vault or a separate building. Neither the building nor its contents may present a fire hazard to any other building or property, and the building must be used only for supplying electrical service.
- Electrical equipment may be installed on the roof of a building, provided that the building structure has sufficient strength to support the entire installation, and where oil-insulated equipment is used, the roof must be of two-hour, non-combustible fire resistive construction, and a curb high enough to contain the oil from the largest oil-filled equipment (at least 6 inches) must be provided. A drain must be provided from the curbed enclosure to carry any oil away from the building.

- Permanent and conspicuous warning signs must be posted on all doors or gates that provide access to enclosures containing exposed energized parts and conductors. The signs must be legible at 12 feet and must read substantially as follows: "WARNING—HIGH VOLTAGE—KEEP OUT."
- The height of fenced or walled enclosures must be at least 8 feet, or floor to ceiling if the ceiling is less than 8 feet, or 10 feet where any exposed energized part is more than 8 feet above the ground (unless the energized part is located more than 5 feet horizontally from the enclosure). The enclosure must be constructed so that it cannot be readily climbed. The size and location of openings in fences or similar enclosures must be such that persons are not liable to come into accidental contact with energized parts, or to bring conducting objects into contact with them. The gate or door in the enclosure must have minimum dimensions of 2 feet 6 inches wide and 6 feet 6 inches high, and must be readily operable. No reduction in enclosure height at the door or gate is permitted. Metal gates or doors must be grounded or bonded to a grounded metal enclosure.
- Where oil-filled apparatus is installed within an enclosure adjacent to combustible material or combustible buildings, provision must be made to confine within the enclosure the largest amount of oil contained in a single piece of apparatus. Pressure relief devices of oil-filled apparatus must be designed and located to minimize the hazard to persons from escaping oil.
- The inside measurement of any manhole, subway, chamber, or underground room containing any electrical wiring or equipment must be at least 4 feet between the end walls and between the side walls, or if circular in shape, at least 4 feet in diameter inside measurement, and at least 6-1/2 feet at all points between the floor and the top or ceiling. Any access opening to outer air must be at least 26 inches if circular in shape, or at least 24 inches by 26 inches clear measurement if rectangular in shape.
- The ampacities of conductors must be as shown in IPCEA Publication No. P46-426, Volumes I and II, "Power Cable Ampacities," published September 1, 1966 by the Insulated Power Cable Engineers Association.
- Underground ducts of rigid metallic steel conduit, Schedule 80 PVC conduit, or equivalent, containing cables operating at a potential above 35,000 volts, must be installed at a depth of at least 36 inches, with certain exceptions. A lesser depth is permitted for ducts containing cables operating at 35,000 volts or less, if the duct is rigid metallic conduit, Schedule 80 PVC conduit, or equivalent, or if the duct has a layer of concrete at least 3 inches thick above the duct.
- Direct buried cables or cables in flexible nonmetallic enclosures must be installed at a depth of at least 36 inches. Lesser depths may be employed if the cable is armored with a minimum of No. 12 BWG steel wire closely wound or two layers of steel tape each at least 0.020 inch thick, or if the cable is protected by a layer of concrete at least 3 inches thick above the cable.
- Some state’s rules contain specific, detailed requirements for:
    - pole- and structure-supported risers;
    - interrupter switches;
    - power fuses;
    - expulsion-type distribution cutouts and fuse links;
    - oil-filled cutouts;

  - metal-enclosed power switchgear and industrial control assemblies;
  - transformers;
  - rotating machinery and its control apparatus;
  - capacitors;
  - resistors and reactors;
  - minimum clear distances when performing work with live line tools;
  - fall protection;
  - aerial lift equipment and derrick trucks, cranes, and other lifting equipment;
  - material handling related to electrical equipment;
  - work on or in proximity to overhead high voltage lines;
  - metal tower construction;
  - the washing of insulators supporting energized conductors or equipment;
  - tubular steel poles;
  - work on or in proximity to underground high-voltage cables, conductors, or equipment;
  - work on or in proximity to conductors and equipment in high-voltage stations or switchyards;
  - access and workspaces at electric utilities;
  - operations in proximity to overhead lines;
  - line clearance tree trimming operations; and
  - signs and outline lighting exceeding 600 volts.
- The covers of all terminal enclosures must be posted with a permanent "HIGH VOLTAGE" warning sign having letters at least 1/2 inch high.
- Where installed in buildings, cables energized above 35,000 volts must be encased in at least 3 inches of concrete or equivalent fire-resistant material.
- Cables must be labeled at all circuit terminals, sectionalizing points, vaults, rooms, etc. The labels must, as a minimum, show phase and circuit designation and nearest sectionalizing points.
- All cables normally operated above 5,000 volts must have insulation shielding, except that shielding is not required for series street lighting circuits operating at less than 7,500 volts. Metallic shielding (or each section thereof) at terminations must be effectively grounded.
- Circuits must be labeled at all accessible points with suitable warning signs stating the locations from which feedback may occur because of circuits energized by manually or automatically operated equipment, circuit configurations or connections, circuits feeding a load which can be connected to auxiliary generating equipment, or circuits feeding synchronous motor-driven generator sets which can be energized by reverse power flow from batteries or other sources.
- Provision must be made to observe the position of the blades of disconnecting switches. If viewing windows are provided, they must be shatterproof, of adequate size, and suitably located to permit viewing of all contacts.
- Disconnecting switches must have a permanent and legible nameplate showing the continuous current rating, maximum voltage rating, and momentary current rating. Suitable barriers must be installed on both sides of each pole of disconnecting switches mounted indoors.

- Unless interlocked so that they cannot be opened under load, disconnecting switches must be provided with permanent warning signs having letters at least 2 inches high and reading as follows: "Warning—Disconnecting Switch—Do Not Open Under Load."
- Circuit breakers must comply with all the provisions of American National Standard ANSI/IEEE C37.04--1979, Rating Structure for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis.
- Circuit breakers must:
    - have an accessible mechanical or other approved means for manual tripping, independent of control power;
    - be release free (trip free);
    - have positive means to prevent unintended operation during inspection or maintenance;
    - open and close the main contacts independent of the speed of the manual operation, when operated manually while energized; and
    - be equipped with a mechanical position indicator to show the open or closed position of the main contacts.
- Circuit breakers must have a permanent and legible nameplate that includes the manufacturer's name or trademark, manufacturer's type or identification number, continuous current rating, interrupting rating in MVA or amperes, and maximum voltage rating.
- Means must be provided to isolate each circuit breaker or circuit breaker installation from all sources of potential. The isolating means must provide a visible gap in the electrical circuit adequate for the operating voltage. Isolating or disconnecting switches (with no interrupting rating) must be mechanically interlocked with the circuit breaker or provided with prominently displayed caution signs to prevent switching load current.
- Automatic circuit reclosers must comply with all the provisions of American National Standard ANSI/IEEE C37.60-1981, Requirements for Overhead, Pad Mounted, Dry Vault, and Submersible Automatic Circuit Reclosers and Fault Interrupters for AC Systems.
- Lightning arresters (e.g., expulsion arresters, valve arresters with external series gap, etc.) that produce or expel ionized gases to the atmosphere during normal operation must not be used in flammable atmosphere locations. All parts of the arrester must be at least 10 feet above ground, unless enclosed in such a way as to prevent access to unauthorized persons. Connections to lightning arresters must be adequate to carry the discharge current, but must not be smaller than No. 6 AWG copper or equivalent. Lightning arresters must have a permanent and legible identification including the name of the device, manufacturer's name and/or trademark, manufacturer's type and identification number, and voltage rating of the arrester.
- On portable and/or mobile high-voltage power distribution and utilization equipment, the metallic enclosures covering the terminals of the power cable and the energized switching and control parts must be marked "DANGER--HIGH VOLTAGE."
- Electrical controls for a tunnel ventilation system must be so arranged that the air flow can be reversed.

- Switch or contactor enclosures in tunnels must not be used as junction boxes or raceways for conductors feeding through or tapping off to other switches, unless special designs are used to provide adequate space for this purpose.
- Portable ladders may be used to provide access to the working space around electrical equipment installed on platforms, balconies, mezzanine floors, or in attic or roof rooms or spaces.
- In the table showing the minimum depth of clear working space about electrical equipment, some states have modified the federal requirements by altering the voltage ranges. Specifically, the voltage of 9,000 has been reduced to 7,500.
- Employers must furnish such safety devices and safeguards as may be necessary to make the employment or place of employment as free from danger to the safety and health of employees as the nature of the employment reasonably permits. The employer must examine or test each safety device at such intervals as may be reasonably necessary to ensure that it is in good condition and adequate to perform the function for which it is intended. Any device furnished by the employer found to be unsafe must be repaired or replaced.
- Employees must be instructed to inspect each safety device, tool, or piece of equipment each time it is used and to use only those in good condition. The employer must require the use of safety devices and safeguards where applicable.
- Except for replacing fuses, operating switches, or other operations that do not require an employee to contact energized high-voltage conductors or energized parts of equipment, clearing "trouble" or in emergencies involving hazard to life or property, no such employee may be assigned to work alone.
- While work is being done on any exposed conductors or exposed parts of equipment connected to high-voltage systems, a qualified electrical worker, or an employee in training, must be in close proximity at each work location to act primarily as an observer for the purpose of preventing an accident, and to render immediate assistance in the event of an accident.
- Work on or from structures must be discontinued when adverse weather, such as high winds, ice on structures, or the progress of an electrical storm in the immediate vicinity, makes the work hazardous, except during emergency restoration procedures.
- When work is performed over or near water and when danger of drowning exists, suitable protection must be provided.
- Whenever rubber gloves are used, they must be protected by outer canvas or leather gloves. Insulating equipment fabricated of material other than rubber must provide electrical and mechanical protection at least equal to that of rubber equipment.
- Employers are responsible for the periodic visual and electrical re-testing of all insulating gloves, sleeves, and blankets, according to ASTM standards. Gloves, sleeves, and blankets must be marked to indicate compliance with the re-test schedule and must be marked with either the date tested, or the date the next test is due.
- When not being used, insulating gloves and sleeves must be stored in glove bags or suitable containers. Insulating blankets must be stored in a canister or other means that offers equivalent protection.

- Insulating equipment must be stored away from direct sunlight, steampipes, radiators, and other sources of excessive heat and must be protected from physical damage. Gloves, sleeves, and blankets must not be folded while in storage; however, blankets may be rolled for storage.
- Insulating equipment must be visually inspected for defects and damage, and must be cleaned prior to use each day.
- Rubber gloves must be air and water tested at the beginning of each work period and at any other time when the glove's condition is in doubt. The gloves must be visually examined over their entire inner and outer surface for any defects (i.e., burns, cuts, cracks, punctures and weak spots), and must have the cuff stretched to detect abrasions and weak spots.
- Portable conductive ladders must be legibly marked with signs reading “Caution--Do Not Use Near Energized Electrical Equipment” or equivalent wording.
- Live line tools must be visually inspected for defects before use each day. Tools to be used must be wiped clean and if defects are indicated the tools must not be used.
- Hydraulic and pneumatic tools used on or near exposed energized conductors or equipment must use non-conductive hoses having adequate strength for normal operating pressures. In addition, such pneumatic tools must have an accumulator on the compressor to collect moisture. Hydraulic fluids used for the insulated sections of derrick trucks, aerial lifts, and hydraulic tools that are used on or near energized conductors or equipment must be of the insulating type.
- Lines used for emergency rescue such as lowering a person to the ground must have a minimum breaking strength of 2650 pounds and must be readily available on the job site.
- Employers must ensure that each employee who is exposed to the hazards of flames or electric arcs does not wear clothing made from acetate, nylon, polyester, or rayon, either alone or in blends, unless treated with flame retardant.
- When working near energized lines or equipment, aerial lift trucks must be grounded or barricaded and considered as energized equipment, or the aerial lift truck boom must be insulated for the voltage being worked on.
- During construction, operation, or maintenance of power transmission and distribution systems, employees operating equipment such as cranes, booms, or derricks must not be permitted to stand on a grounded surface, other than the equipment itself, when such equipment is operated within 6 feet of exposed energized high voltage conductors or equipment. During movement of such cranes, booms, or derricks, employees on the ground must be required to stay clear of the equipment. Also, wire rope or chains, except slings, must not be used to raise or lower transformers, poles or any other material within 6 feet of exposed energized high voltage conductors or equipment.
- Before contacting the high voltage side of deenergized transformer(s), or conductor(s) connected thereto, all possible sources of backfeed must be eliminated by disconnecting or grounding the high voltage side, or disconnecting or short circuiting the low voltage side.
- The owner, agent, or employer responsible for the operations of equipment must post and maintain in plain view of the operator and driver on each crane, derrick, power shovel, drilling rig, hay loader, hay stacker, pile driver, or similar apparatus, a durable

warning sign legible at 12 feet reading: "Unlawful To Operate This Equipment Within 10 Feet Of High-Voltage Lines of 50,000 Volts Or Less." In addition, the following statement in small lettering must be provided on the warning sign: "For Minimum Clearances of High-Voltage Lines In Excess of 50,000 Volts.

Training

Training is provided to ensure that employees are familiar with the requirements of this plan. This training is provided to employees at the time of hire and annually thereafter. The Training and Compliance Officer is responsible for conducting training.

The training program addresses the required written elements for electrical safety for:

- The assured equipment grounding conductor program.
- Lockout and tagging procedures to be used when working on exposed de-energized parts.

Training for Unqualified Employees

Employees who face a risk of electric shock but who are not qualified persons will be trained & familiar with electrically related safety practices. Employees will be trained in safety related work practices that pertain to their respective job assignments. Employees will be trained on appropriate clearance distances.

Electrical Safety Rules for Non-Qualified Workers:

1. Do not conduct any repairs to electrical equipment
2. Report all electrical deficiencies to your supervisor
3. Do not operate equipment if you suspect and electrical problem
4. Water and electricity do not mix.
5. Even low voltages can kill or injure you
6. Do not use cords or plugs if the ground prong is missing
7. Do not overload electrical receptacles

Training for Qualified Employees

Training for Qualified Employees includes specific equipment procedures and requirements of applicable OSHA standards. Qualified persons (i.e. those permitted to work on or near exposed energized parts) shall, at a minimum, be trained in and familiar with the following:

- The skills and techniques necessary to distinguish exposed live parts from other parts of electric equipment.
- The skills and techniques necessary to determine the nominal voltage of exposed live parts, and
- The clearance distances specified in 1910.333(c) and the corresponding voltages to which the qualified person will be exposed.

Note 1: For the purposes of 1910.331 through 1910.335, a person must have the training required by paragraph (b)(3) of this section in order to be considered a qualified person.

Note 2: Qualified persons whose work on energized equipment involves either direct contact or contact by means of tools or materials must also have the training needed to meet 1910.333(C)(2

Program Evaluation

The Electrical Safety Plan is evaluated and updated annually by the TCM to ensure the continued effectiveness of the program.