

CALIFORNIA STATE UNIVERSITY, FRESNO ELECTRICAL SAFETY PROGRAM



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CALIFORNIA STATE UNIVERSITY, FRESNO

ELECTRICAL SAFETY PROGRAM

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1.0 Purpose

The purpose of this program is to establish minimum standards to prevent hazardous electrical exposure to personnel and ensure compliance with regulatory requirements applicable to electrical systems. Working on equipment in a de-energized state is required unless de-energizing equipment introduces an increased hazard or is infeasible. This program is designed to help ensure that energized electrical work at the University is performed safely by authorized employees, who are trained and provided with the appropriate safe work procedures, protective equipment and other controls. The program is intended to ensure the employees are protected against electrical shock, burns and other potential electrical safety hazards as well as comply with regulatory requirements. It does not, however, cover all requirements related to installation methods and procedures specifically learned through an electrician apprenticeship program.

2.0 Scope

This program applies to all qualified and non-qualified personnel working on or near energized electrical equipment or systems (50 volts or more), their supervisors and managers.

3.0 Responsibilities

The goal of the electrical safety program is to ensure that all employees understand the hazards associated with electric energy and are capable of performing the necessary steps to protect themselves and their coworkers. Primary responsibilities include:

- Hazard identification
- Training
- Reporting/correcting safety hazards

3.1 Supervisors and Facilities Management Responsibilities

Supervisors and managers of persons performing electrical work must be knowledgeable about the work to be performed and the hazards involved to determine who is qualified to perform the work.

Supervisors and Facilities Management are also responsible for:

- Determining which employees are Qualified High Voltage Electrical Workers and are allowed to work on energized systems. This process involves informal “certification” of the individual by another Qualified High Voltage Electrical Worker based upon observation of their safe work practices, knowledge level and familiarity with the tools and equipment for performing energized electrical work on high voltage systems, and documentation of the required two years of training and experience;
- Creating a Hazard Assessment and Standard Operating Procedure (SOP) for High Voltage Activities with a Qualified High Voltage Electrical Worker;
- Review and/or write switching procedures in conjunction with the high voltage electrical contractor;
- Ensure staff are trained, qualified, and authorized to work on electrical equipment;
- Conduct periodic hazard analysis of work areas;
- Correct identified safety hazards;
- Ensure appropriate Personal Protective Equipment is provided to authorized or qualified staff who work with electrical equipment.

3.2 Environmental Health and Safety (EHS) Responsibilities

- Interpreting the standards and regulations as they apply to work being performed on campus;
- Performing program implementation review on an annual basis on all electrical work including lockout/tagout procedure for specific equipment, and high voltage switching procedures written by Facilities Management or their high voltage electrical contractors;
- Partnering with Facilities Management and other departments on campus who perform high voltage work;
- Assisting in the coordination of appropriate training for Qualified High Voltage Electrical Workers and Authorized Lockout/Tagout Persons;
- Provide assistance in identifying electrical safety issues;
- Review electrical equipment safe operating procedures as necessary.

3.3 Qualified Electrical Worker Responsibilities

Qualified High Voltage Electrical Workers who perform energized electrical work on equipment or systems operating at greater than 600 volts must be able to:

- Understand how to use special tools and special work procedures for greater than 600 volts;
- Know the clearance requirements for high voltage equipment, barrier and barricading requirements;
- Understand special hazards associated with high voltage equipment;
- Understand special procedures and tools for extracting personnel from energized circuits and providing rescue and must maintain current resuscitation certification, and;
- Understand the workspace and guarding specified in the Cal/OSHA standard.

4.0 Definitions

Confined space – An enclosed space which has limited egress and access, and has an atmospheric hazard (e.g., explosive atmosphere or asphyxiating hazard) and/or other serious safety hazards (e.g., electrical hazard).

Current – (measured in amps/amperage) Term used to describe electric flow. It is current that can cause electric shock.

Damp location – Partially protected locations subject to moderate degrees of moisture, such as some basements.

De-energized – Electrical devices that are disconnected from all energy sources including direct electric connections, stored electric energy such as capacitors, and stored non-electrical energy in devices that could re-energize electric circuit parts.

Energized electrical work – Repair, maintenance, troubleshooting, or testing on electrical circuits, components, or systems while energized (i.e., live). Only Qualified High Voltage Electrical Workers are permitted to work on energized circuitry of 50 volts/25 amps to ground or greater.

Energy source – Any source of electrical, mechanical, hydraulic, pneumatic, chemical, thermal, or other energy.

Exposed electrical parts – Energized parts that can be inadvertently touched or approached nearer than a safe distance by a person. Parts not suitably guarded, isolated, or insulated. Examples include terminal contacts or lugs, and bar wiring.

Ground fault circuit interrupt (GFCI) – A device whose function is to interrupt the electric circuit to the load when a current to ground exceeds a predetermined value that is less than that requires to operate the over-current protective device of the supply circuit.

Ground – A conducting connection, whether intentional or accidental, between an electrical circuit or equipment and the earth or to some conducting body that serves in place of the earth.

Hazardous location – An area in which an airborne flammable dust, vapor or gas may be present and would represent a hazard if a source of ignition were present (see National Fire Protection Association (NFPA) Class I & II and Division 1 & 2).

High Voltage – Electrical systems or equipment operating at or intended to operate at a sustained voltage of more than 600 volts.

Interlock – An electrical, mechanical, or key-locked device intended to prevent an undesired sequence of operations.

Isolating switch – A switch intended for isolating an electric circuit from the source of power. It has no interrupting rating, and is intended to operate only after the circuit has been opened by some other means.

Life safety equipment – Equipment that provides critical protection for safety in the event of an emergency or other serious hazard. Life safety equipment, which is electrically energized, should be worked on using Energized Electrical Equipment (EEW) procedures to ensure that the protection provided by the equipment is not lost (e.g., fire alarm and evacuation).

Lockout/Tagout – A standard that covers the servicing and maintenance of machines and equipment in which the unexpected re-energization of the equipment or release of stored energy could cause injury to employees. It establishes performance requirements for the control of such hazardous energy.

Low Voltage – Electrical systems or equipment operating at or intended to operate at a sustained voltage of 600 volts or less.

Personal Protective Equipment (PPE) – PPE used for electrical work shall comply with the standards given in Table 130.7 (c) (8) of NFPA 70E, Standard for Electrical Safety in the Workplace. See Appendix A) A flash hazard analysis shall form the basis of PPE selection or NFPA 70E Table 130.7 (c) (10).

Qualified Electrical Worker – A qualified person who by reason of a minimum of two years of electrical training and experience with high voltage circuits and equipment and who has demonstrated by performance familiarity with the work to be performed and the hazards involved. Only a Qualified Electrical Worker is allowed to work on energized conductors or equipment connected to energized high voltage systems. With the exception of replacing fuses, operating switches, or other operations that do not require the employee to contact energized high voltage conductors or energized parts of equipment, clearing trouble or emergencies involving hazard to life or property, no such employee shall be assigned to work alone.

Qualified Worker – one who has skills and knowledge related to the construction and operation of the electrical equipment and installations and has received safety training on the hazards involved.

Resistance – The ease with which electricity flows through the material (conductor). Materials (conductors) with higher resistance properties can become hot. (Measures in ohms)

UL – Underwriters laboratories is an independent product safety testing and certification organization.

Voltage – Electric potential or potential difference assigned to a circuit or system expressed in volts.

5.0 Program Components

5.1 Hazard Assessment and Standard Operating Procedures (SOP's)

Qualified employees must assess the tasks to be performed and note whether the work can be performed with the equipment in the de-energized state, as described below. The equipment manual, as well as personnel who are experienced with the equipment, shall be consulted for assistance in making these determinations. When work on equipment must be performed while energized, qualified employees must follow the procedures for energized electrical work as described in this program. All employees use electric powered equipment and systems throughout the campus. Whether in an office, lab or workshop, electricity is used continuously, usually without incident.

Voltages as low as 12 volts can be dangerous. When working with or around electrical equipment, one may inadvertently become part of an electrical circuit. Only trained and authorized or qualified individuals should do any repair or work on electrical equipment.

As part of the Injury and Illness Prevention Program, departments are required to conduct hazard analysis of the workplace. This analysis will provide a mechanism for defining work unit specific hazards associated with electricity and create a plan for hazard mitigation and employee training.

5.2 General Precautions for All Staff

- Only properly trained employees should work on electrical equipment.
- Know how to respond to emergencies such as electrical shock incidents or fires.
- Never work on “hot” or energized equipment unless it is necessary to conduct equipment troubleshooting.
- Use extension cords only as temporary power sources.
- Do not plug too many pieces of equipment into the same circuit or outlet as the circuit or outlet could become overloaded.
- Be sure that ground-fault circuit interrupters (GFCI) are used in high risk areas such as wet locations.
- Plug strips, such as those used on computers, should be plugged directly into outlets and not into extension cords or other plug strips.
- Inspect all equipment periodically for defects or damage.
- All cords that are worn, frayed, abraded, corroded or otherwise damaged must be replaced.
- Grasp the plug to remove it from a socket-never pull the cord.
- Keep all cords away from heat, oil and sharp edges.
- Always follow the manufacturer’s instruction for use and maintenance of all electrical tools and appliances.
- Keep equipment operating instructions on file.
- Never touch an electrical appliance and plumbing at the same time.
- Always unplug electrical appliances before attempting any repair or maintenance.
- All electrical devices must be properly grounded with approved three wire plugs unless they are “double insulated.”

Grounding provides a safe path for electricity to the ground, preventing leakage of current in circuits or equipment.

- All electrical equipment used on campus should be UL or Fire Marshal approved.
- Keep cords out of the way of foot traffic so they don’t become tripping hazards or become damaged by traffic.
- Never use electrical equipment in wet areas or run cords across wet floors.
- Ensure energized parts of electrical equipment operating at 50 volts or more are guarded against accidental contact.

5.3 Localized Electrical Outage

- All staff should immediately report electrical outages to Plant Operations at 278-2373.
- If possible, identify the defective equipment or the cause of the failure and remove it from service.
- Report this information to Plant Operations’ personnel upon their arrival.

5.4 Best Safety Practices

- NEVER work with electricity greater than 600 volts without specific permission, training and written procedures.
- Notify your supervisor immediately if you have any questions.
- Be able to recognize electrical safety hazards in your work area.
- Ensure that all authorized or qualified persons have received appropriate training in order to operate or repair equipment.

- Keep equipment in good working order to help prevent electrical accidents.
- Maintain a three-foot clearance around electrical panels.
- Electrically operated equipment must be de-energized before work may commence.
- Always follow lockout/tagout procedures when working on electrical equipment and wear appropriate Personal Protective Equipment (PPE) such as , non-melting clothing, safety glasses, rated rubber gloves, rated rubber sleeves, insulated boots, or face shield.
- Never override safety devices such as electrical interlocks.
- Remove all rings, key chains, or other metal objects when working around electricity.
- Never use metal ladders when working near energized wiring.
- Damp or wet environments may be dangerous when working with electricity.
- Never plug in cords that are wet or touch electrical equipment with wet hands.
- Employees working with lasers, performing hardware or software testing, or other activities that do not require direct contact with electrical components, should be aware of electrical safety issues and be alert to the possibility of other employees conducting energized work in the area.

5.5 De-Energized Electrical Work

Electrical systems must be worked on in the de-energized state, whenever feasible, following the work practices described in the University's Lockout/Tag out Program. Energized electrical work should only be performed in situations where utilizing Control of Hazardous Energy practices increases the hazard(s) to the employee and/or equipment or it is not feasible (e.g., performing metering and testing).

5.6 High Voltage Work

Energized electrical work is acceptable for tasks which can only be performed with the equipment energized or when the use of de-energized electrical work procedures presents a greater hazard. Cal/OSHA has defined such work as repair, maintenance, troubleshooting, or testing on electrical circuits, components, or systems while energized (i.e., live). No other activities shall be performed while energized.

Due to the degree of electrical hazards associated with this type of work, the procedures, equipment, and other controls described in this section must be used when performing energized electrical work. The university's energized electrical work practices and procedure shall incorporate all other applicable provisions of Cal/OSHA regulations covering work in confined or enclosed workspaces, work space illumination, alerting techniques, and personal equipment requirements.

5.7 Operating Procedures

Qualified Electrical Worker

Energized electrical work on systems shall only be performed by a Qualified Electrical Worker. A Facilities Manager or Supervisor is responsible for determining whether an employee is qualified to perform energized electrical work. This qualification shall be made based on completion of applicable training and experience.

Only Qualified Electrical Workers shall work on energized conductors or equipment connected to energized high voltage systems. This includes replacing fuses, operating switches. No such employee shall be assigned to work alone.

Observers - During the time that high voltage work is being performed, a Qualified Electrical Worker, or an employee in training wearing the appropriate Personal Protective Equipment, must be in close proximity at each work location to:

- Act primarily as an observer for the purpose of preventing an accident;
- Render immediate assistance in the event of an accident.

Tools and Personal Protective Equipment (PPE)

Employees working in areas where there are potential electrical hazards must be provided with and use personal protective equipment (PPE) that is appropriate for the specific work that must be performed. The electrical tools and protective equipment that must be specifically approved, rated, and tested for level of voltage of which an employee may be exposed.

Employees must only use appropriate tools for the job being performed. The Qualified Electrical Worker is responsible for determining appropriate levels of personal protective equipment and type of tools to use.

Personal Protective Equipment (Appendix A) must be selected to meet the criteria established by the American Society of Testing and Materials (ASTM) and by the American National Standards Institute (ANSI).

PPE must be maintained in a safe, reliable condition and be inspected for damage before each day's use and immediately following any incident that can reasonably be suspected of having caused damage. It is the responsibility of the Qualified Electrical Worker to inspect all PPE prior to using the PPE. The Qualified Electrical Worker must reject all PPE that does not pass the inspection.

Qualified employees must use insulated tools and handling equipment that are rated for the voltages to be encountered when working near exposed energized conductors or circuit. Tools and handling equipment should be replaced if the insulating capability is decreased due to damage. Protective gloves must be used when employees are working with exposed electrical parts above fifty (50) volts. Fuse handling equipment (insulated for circuit voltage) must be used to remove or install fuses when the fuse terminals are energized. Ropes and hand lines used near exposed energized parts must be non-conductive. The Qualified Electrical Worker is responsible for inspecting all PPE and insulated equipment prior to use. Any PPE or insulated equipment that does not pass an inspection is prohibited from being used.

Protective shields, barriers, or insulating materials must be used to protect each employee from shock, burns, or other electrical injuries while that person is working near exposed energized parts that might be accidentally contacted or where dangerous electric heating or arcing might occur.

Precautions about Arcing and Flashes

Employees must wear appropriate personal protective equipment for the eyes or face wherever there is a potential danger of electric arcs or flashes or when there is a mechanical hazard that may cause eye damage. This must include ANSI or ASTM certified eye protection with side shields or a full-face shield. Employees must also wear any other appropriate personal protective equipment whenever there is a potential danger of electric arcs. This equipment may include appropriate gloves, boots, hearing protection, flame resistant clothing, and any other personal protective equipment identified by NFPA 70E for the type of work being performed. The following scenarios are just a few of the examples of situation with the potential for arcs:

- Working with a metal or conductive tool near a live electrical contact point with voltages above 200 volts;
- Accidentally making contact across two live electrical contact points with a metal or conductive tool;
- Utilizing conductive materials or tools to connect a circuit in place of properly rated fuses or circuit breakers.

Precautions to prevent arcs or flashes include, but may not be limited to, the following:

- Keep covers over live electrical contact points closed;

- Avoid using metal or conductive tools around live electrical contact points, when possible;
- Avoid pointing or placing metal tools near live electrical contact points in equipment with voltages above 600 volts;
- Verify the voltages present when working near live electrical contact points;
- Utilize test fixture boxes while performing adjustments, calibrations, or function tests of energized parts;
- Use properly rated fuses for the capacity of the line or protection needed for the equipment in question.

Workspace Clearances

Clearances and Access Distances for Energized Electrical Work must comply with Cal/OSHA regulations (Appendix B). At least one entrance not less than 24 inches wide and six (6) and a half (1/2) feet high must be provided to give access to the working space around energized electrical equipment. When un-insulated energized parts are located adjacent to such entrance, they must be guarded.

The area in the immediate vicinity of the workspace must be surveyed and all potential hazards such as ladders, stacked boxes, ceiling tiles, or doors that may fall or swing into the workspace must be secured to prevent interference with the work being performed. A clear escape path must be maintained from the work space to an exit from the area.

5.8 Special Requirements

High Voltage

Work on systems greater than 600 volts must be performed using de-energized electrical work practices, whenever possible. Energized electrical work on greater than 600 volt electrical systems must only be performed by a Qualified High Voltage Electrical Worker. The following work practices are required, in addition to the requirement described in NFPA 70E for energized electrical work.

Work Practices

A written Work Plan must be developed identifying: the location of work, the equipment on which work will be performed, highest voltage expected to be encountered, the type of work to be performed, the name and task assigned to each member of the work crew, the type of personal protective equipment required for each member of the work crew, the type of tools required for the work, and the emergency procedures to be followed in the event of an accident. Work on greater than 600 volts must be performed following the same requirements as described above under Operating Procedures and in NFPA 70E, including the use of any required permits, Qualified High Voltage Electrical Workers, tools, PPE, and safety observers.

Voltage Detection

The operating voltage of equipment and conductors must be determined before performing any energized electrical work on high voltage systems. This should be performed using a calibrated and working high voltage probe designed for high voltage circuits at the level of voltage to be encountered.

Clearances

Workspace clearance must comply with Cal/OSHA clearance and access distances. (Appendix B)

Tools and Personal Protective Equipment (PPE)

Employees working in areas where there are potential electrical hazards must be provided with and use personal protective equipment (PPE) that is appropriate for the specific work that must be performed. The electrical tools and protective equipment that must be specifically approved, rated, and tested for level of voltage of which an employee may be exposed. Employees must only use appropriate tools for

the job being performed. The Qualified Electrical Worker is responsible for determining appropriate levels of personal protective equipment and type of tools to use.

Personal Protective Equipment (Appendix A) must be selected to meet the criteria established by the American Society of Testing and Materials (ASTM) and by the American National Standards Institute (ANSI).

PPE must be maintained in a safe, reliable condition and be inspected for damage before each day's use and immediately following any incident that can reasonably be suspected of having caused damage. It is the responsibility of the Qualified Electrical Worker to inspect all PPE prior to using the PPE. The Qualified Electrical Worker must reject all PPE that does not pass the inspection.

Qualified employees must use insulated tools and handling equipment that are rated for the voltages to be encountered when working near exposed energized conductors or circuits. Tools and handling equipment should be replaced if the insulating capability is decreased due to damage. Protective gloves and arc-rated clothing must be used when employees are working with exposed electrical parts above fifty (50) volts. Fuse handling equipment (insulated for circuit voltage) must be used to remove or install fuses when the fuse terminals are energized. Ropes and hand lines used near exposed energized parts must be non-conductive. The Qualified Electrical Worker is responsible for inspecting all PPE and insulated equipment prior to use. Any PPE or insulated equipment that does not pass an inspection is prohibited from being used.

Protective shields, barriers, or insulating materials must be used to protect each employee from shock, burns, or other electrical injuries while that person is working near exposed energized parts that might be accidentally contacted or where dangerous electric heating or arcing might occur.

Insulating gloves and blankets shall be visually inspected before each use, electrically re-tested in accordance with ASTM standards [typically every six (6) months for gloves and sleeves and every twelve (12) months for blankets]. Gloves and blankets shall be marked with either the date tested or with the date the next test is due. Whenever rubber gloves are used, they must be protected by outer canvas or leather gloves. Insulating protective equipment found to be defective or damaged must be immediately removed from use.

When not in use, protective equipment must be stored in suitable containers and stored away from direct sunlight, steam pipes, sources of excessive heat, and protected from physical damage.

Equipment Inspection and Calibration

All electrical test equipment must be inspected for damage before use. The equipment must not be used if it is damaged or if its functionality is questionable. Equipment must be handled in a manner that will not damage the equipment. Prior to each use, electrical test equipment must be verified to be functional and undamaged. This is accomplished by testing, for example, a voltmeter on a known voltage to verify correct readings. After metering or testing is completed, the voltmeter should again be tested on a known voltage to verify functionality of the voltmeter.

Electrical test equipment should be calibrated according to the manufacturer's instructions. If there is any doubt as to the equipment's calibration, the equipment should be recalibrated.

Overhead Voltage Lines

Special requirements are required for work on overhead high voltage electrical lines. In general, this work should only be performed by personnel (e.g., outside contractors or vendors) who are experienced

in this type of electrical work and have the appropriate tools including hoists and fall protection. At this time, no employee is permitted to work on overhead high voltage electrical lines.

5.9 Hazardous Locations

Wet or Damp Locations

Work in wet or damp locations (i.e., areas surrounded or near water or other liquids) should not be performed unless it is absolutely critical. Procedures for working in wet environments must be written on the Work Plan.

In almost every case electrical work should be postponed until the liquid can be cleaned up. If the work cannot be avoided, the Manager responsible for the task must grant approval prior to the work being performed.

Every attempt should be made to provide insulated workspace if the work must be performed.

The following are some special precautions that must be incorporated while performing work in damp locations:

- Only use electrical cords that have Ground Fault Circuit Interrupters (GFCIs);
- Place a dry barrier over any wet or damp work surface;
- Remove standing water before beginning work. Work is prohibited in areas where there is standing water;
- Keep electrical cords away from standing water.

5.10 Working on Life Safety Systems

Protection from Life Safety Systems

Life safety systems (e.g., emergency lighting, etc.) are intended to provide safety features additional to the safety features of the equipment being serviced, therefore, de-energized procedures should not be used. Examples:

- Work on alarm systems, which would require deactivation of the system in order to perform de-energized electrical work;
- Work on ventilation systems for hazardous location, which would require shutting off the ventilation systems in order to perform de-energized electrical work;
- Work on illumination systems, which would create a safety hazard if they are turned off in order to perform de-energized electrical work.

Energized Electrical Work for Life Safety Systems

Work on life safety systems should be performed using energized electrical work practices or preferably, during off hours if the life safety systems can be taken out of service to ensure the life safety protection provided by these systems does not compromise the safety of occupants relying on the life systems.

De-Energized Electrical Work for Life Safety Systems

When work requires that a life safety system be de-energized, EH&S approval is required prior to work being performed.

Additional safeguards such as a fire watch, notification of University Police and building occupants, may also be required if a life safety system is to be de-energized.

Overriding Safety Interlocks

Overriding safety interlocks is often required when performing metering, in emergency situations, or when troubleshooting energized equipment. The following safe work practices shall be followed:

- Overriding safety interlocks shall only be performed by Qualified Electrical Workers who are experienced with the equipment being serviced and understand the consequences of overriding the interlocks (NOTE: Interlocks must not be used as the sole means of de-energizing equipment);
- Work Areas must be marked with labels, tags, or barriers when such work is being performed;
- All safety interlocks should be restored after the work has been completed;
- Positive confirmation should be made to verify that each interlock functions as intended.

Reporting Requirements

The University shall make all energized electrical work practices and procedures available to all affected employees and to all Cal/OSHA and Department of Labor officials upon request.

5.11 Training Requirements and Competency Assessment

Training Requirement, Class Title	Target Audience	Frequency
IIPP Safety Training	All Employees	At time of employment
Electrical Safety and Lockout/Tagout Training	Employees who work directly with electrical systems from 50 to 600 volts, Authorized Lockout/Tagout Persons	Annually
Electrical Safety Training	Employees who work with, or in the proximity of electrical equipment (Qualified Electrical Workers)	As Necessary

Employee Training

All employees involved with work on or around energized, or potentially energized electrical circuitry of fifty (50) volts to ground or greater, shall be trained in energized electrical safe work practices and procedures. All electricians fall into this category and receive this training.

5.12 Qualified Electrical Worker

University employees must receive training in avoiding the electrical hazards associated with working on or near exposed energized parts prior to performing energized electrical work. Such training will be provided when the employee is initially assigned to the job and refresher training will be provided as necessary.

The following items will be included in the training of Qualified Electrical Workers:

- The University's Lockout/Tagout Training Program including safe work practices required to safely de-energize electrical equipment;
- Skills and techniques necessary to distinguish exposed live parts from other parts of electric equipment;
- Performing on-the-job training with a skilled technician;
- Skills and techniques necessary to determine the nominal voltage of exposed live parts;
- Clearance distances corresponding to the voltage of exposed live parts;
- Selection and use of personal protective equipment, tools, insulating and shielding materials and equipment for working on or near energized parts;
- Selection and use of proper work practices for working on or near energized parts.

Qualified Electrical Workers must also be trained in recognizing sign and symptoms of electrical shock, heart fibrillation, electric burns, and proper first aid protocols for these conditions. They must have training in:

- Basic Cardio Pulmonary Resuscitation (CPR);
- Automatic External Defibrillator (AED); and
- Contacting emergency personnel.

5.13 Emergency Response

In case of an emergency, employees must initiate emergency response by calling the emergency number 911, then notifying their supervisor.

5.14 Documentation of Training and Experience

Documentation of the training as described in the table above will be kept by the Department, EH&S and Human Resources. Documentation is necessary to demonstrate that individuals have met the training and experience requirements for the types of work being performed.

Qualified High Voltage Electrical Workers who have obtained the required two years' experience and training must demonstrate their knowledge before becoming authorized to perform energized electrical work on high voltage circuits. This process involved "certification" of the individual by another Qualified High Voltage Electrical Worker based upon observation of their safe work practices, knowledge level and familiarity with the tools and equipment for performing energized electrical work on high voltage systems, and documentation of the required two years of training and experience. Documentation of certification shall be retained by the Department, EH&S and Human Resources.

5.15 Information and External References

- California Code of Regulations, 8 CCR Subchapter 5, Group 2, "High Voltage Electrical Safety Orders";
- American National Standards Institute (ANSI) Standards Z89.1 (head protection), Z87.1 (eye protection), Z41 (protective footwear);
- American Standards for Testing Materials (ASTM) for Electrical Protective Equipment;
- National Fire Protection Association (NFPA) Article 70; 70E.

Appendix A (From NFPA 70E, Table 130.7(C)(10))

Personal Protective Equipment Categories

Hazard/Risk Category	Protective Clothing and PPE
<p>Hazard/Risk Category 0 Protective Clothing, Non-melting (according to ASTM F1506-00) or Untreated Natural Fiber</p> <p>FR Protective Equipment</p>	<p>Shirt (long sleeve) Pants (long)</p> <p>Safety glasses or safety goggles (SR) Hearing protection (ear canal inserts) Leather gloves (AN) (Note 2)</p>
<p>Hazard/Risk Category 1 FR Clothing, Minimum Arc Rating of 4 (Note 1)</p> <p>FR Protective Equipment</p>	<p>Arc-rated long-sleeve shirt (Note 3) Arc-rated pants (Note 3) Arc-rated coverall (Note 4) Arc-rated face shield or arc flash suit hood (Note 7) Arc-rated jacket, parka, or rainwear (AN)</p> <p>Hard hat Safety glasses or safety goggles (SR) Hearing protection (ear canal inserts) Leather gloves (Note 2) Leather work shoes (AN)</p>
<p>Hazard/Risk Category 2 FR Clothing, Minimum Arc Rating of 8 (Note 1)</p> <p>FR Protective Equipment</p>	<p>Arc-rated long-sleeve shirt (Note 5) Arc-rated pants (Note 5) Arc-rated coverall (Note 6) Arc-rated face shield Note 7) or arc flash suit hood (Note 10) Arc-rated jacket, parka, or rainwear (AN)</p> <p>Hard hat Safety glasses or safety goggles (SR) Hearing protection (ear canal inserts) Leather gloves (Note 2) Leather work shoes</p>
<p>Hazard/Risk Category 3 FR Clothing, Minimum Arc Rating of 25 (Note 1)</p> <p>FR Protective Equipment</p>	<p>Arc-rated long-sleeve shirt (AR) (Note 8) Arc-rated pants (AR) (Note 8) Arc-rated coverall (AR) (Note 8) Arc-rated arc flash suit jacket (AR) (Note 8) Arc-rated arc flash suit pants (AR) (Note 8) Arc-rated arc flash suit hood (Note 8) Arc-rated jacket, parka, or rainwear (AN)</p> <p>Hard hat FR hard hat liner (AR) Safety glasses or safety goggles (SR) Hearing protection (ear canal inserts) Arc-rated gloves (Note 2) Leather work shoes</p>

<p>Hazard/Risk Category 4 FR Clothing, Minimum Arc Rating of 40 (Note 1)</p>	<p>Arc-rated long-sleeve shirt (AR) (Note 9) Arc-rated pants (AR) (Note 9) Arc-rated coverall (AR) (Note 9) Arc-rated arc flash suit jacket (AR) (Note 9) Arc-rated arc flash suit pants (AR) (Note 9) Arc-rated arc flash suit hood (Note 9) Arc-rated jacket, parka, or rainwear (AN)</p>
<p>FR Protective Equipment</p>	<p>Hard hat FR hard hat liner (AR) Safety glasses or safety goggles (SR) Hearing protection (ear canal inserts) Arc-rated gloves (Note 2) Leather work shoes</p>

AN= As needed (optional)

AR= As required

SR = Selection required

Notes:

1. See Table 130.7(C)(11). Arc rating for a garment or system of garments is expressed in cal/cm².
2. If rubber insulating gloves with leather protectors are required by Table 130.7(C)(9), additional leather or arc-rated gloves are not required. The combination of rubber insulating gloves with leather protectors satisfies the arc flash protection required.
3. The FR shirt and pants used for Hazard/Risk Category 1 shall have a minimum arc rating of 4.
4. Alternated is to use FR coveralls (minimum arc rating of 4) instead of FR shirt and FR pants.
5. FR shirt and FR pants used for Hazard/Risk Category 2 shall have a minimum arc rating of 8.
6. Alternate is to use FR coveralls (minimum arc rating of 8) instead of FR shirt and FR pants.
7. A face shield with a minimum arc rating of 4 for Hazard/Risk Category 1 or a minimum arc rating of 8 for Hazard/Risk Category 2, with wrap-around guarding to protect not only the face, but also the forehead, ears, and neck (or, alternatively, an arc-rated arc flash suit hood), is required.
9. An alternate is to use a total FR clothing system and hood, which shall have a minimum arc rating of 25 for Hazard/Risk Category 3.
10. The total clothing system consisting of FR shirt and pants and/or FR coveralls and /or arc flash coat and pants and hood shall have a minimum arc rating of 40 for Hazard/Risk Category 4.
11. Alternate is to use a face shield with a minimum arc rating of 8 and a balaclava (sock hood) with a minimum arc rating of 8 and which covers the face, head and neck except for the eye and nose areas.

Appendix B Workspace Clearances

CCR, Title 8, Section 2940.2

- (a) No employee shall be permitted to approach or take any conductive object without an approved insulating handle closer to exposed energized parts than shown in Table 2940.2 unless:
- (1) The employee is insulated or guarded from the energized part (gloves or gloves with sleeves rated for the voltage involved shall be considered insulation of the employee from the energized part), or
 - (2) The energized part is insulated or guarded from the employee and any other conductive object at a different potential.
- (b) When performing work with live line tools, minimum clear distances in Table 2940.2 shall be maintained. Conductor support tools, such as link sticks, strain carriers, and insulator cradles, shall be permitted to be used provided that the clear insulation is at least as long as the insulator string or the minimum distance specified in Table 2940.2 for the operating voltage.

**TABLE 2940.2
ALTERNATING CURRENT--MINIMUM APPROACH DISTANCE**

Nominal Voltage Range (Phase to Phase) Kilovolt	Minimum Approach Distance Phase to Ground Exposure
Above 0.6 to 15	2 ft. 1 in.
Above 15 to 36	2 ft. 4 in.
Above 36 to 46	2 ft. 7 in.
Above 46 to 72.5	3 ft. 0 in.
Above 72.5 to 121	3 ft. 4 in.
Above 121 to 145	3 ft. 7 in.
Above 145 to 169	4 ft. 0 in.
Above 169 to 242	5 ft. 3 in.
Above 242 to 362	8 ft. 6 in.
Above 362 to 552	11 ft. 3 in.
Above 552 to 765	15 ft. 0 in.

Note: Above 242 KV the minimum working distance and the minimum approach distance shall be permitted to be reduced provided that such distances are not less than the shortest distance between the energized part and a grounded surface.

CCR, Title 8, Section 2340.16

Table 2340.16. Minimum Depth of Clear Working Space at Electrical Equipment, 600 V or Less

Nominal Voltage to Ground	Minimum Clear Distance (Feet)					
	Condition 1		Condition 2		Condition 3	
	Feet	Meters	Feet	Meters	Feet	Meters
0-150	3*	0.9	3*	0.9	3	0.9
151-600	3*	0.9	3.5	1.0	4	1.2

Notes to Table 2340.16:

Where the "Conditions" are as follows:

Condition 1 – 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 suitable wood or other insulating materials. Insulated wire or insulated busbars operating at 300 volts or less shall not be considered live parts.

Condition 2 – Exposed live parts on one side and grounded parts on the other side.

Condition 3 – Exposed live parts on both sides of the work space (not guarded as provided in Condition (1)) with the operator between.

CCR, Title 8, Section 2375.18

Installations built on or after May 5, 2008:

Table 2375.18 Clearances from Ground.

Distance	Voltage to Ground	Conditions
12 ft. (3.66 m)	<300V	Above finished grade or sidewalks, or from any platform or projection from which they might be reached. Over residential property and driveways. Over commercial areas subject to pedestrian traffic or to vehicular traffic other than truck traffic.
16 ft. (4.88 m)	301 to 600 V	Over residential property and driveways. Over commercial areas subject to pedestrian traffic or to vehicular traffic other than truck traffic. (This category includes conditions covered under the 12 ft. (3.66 m) category where the voltage exceeds 300 V.)

Note: California Public Utilities Commission (CPUC) General Order No. 95 applies in areas subject to CPUC jurisdiction

