

## High Voltage Electrical Safety Program

Responsible Administrator: EH&S Safety Specialist  
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**Summary:** This section outlines the policy and procedures related to the High Voltage Electrical Safety Program that is administered through the Environmental Health & Safety (EH&S) Department.

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### 1. Program Description

UC Irvine has developed a High Voltage Electrical Safety Program to establish minimum standards to ensure that our employees' health and safety are protected during high voltage electrical work at UC Irvine. UC Irvine is required by California OSHA (Cal/OSHA), as well as other regulatory agencies, to provide protective equipment, training, guidelines, procedures and other protective measures for employees exposed to potential high voltage electrical hazards.

### 2. Scope

This program applies to all UC Irvine employees, contractors working with UC Irvine employees, vendors, visitors, and temporary employees performing energized electrical work over 600 volts. This includes all maintenance, repair, and diagnostic procedures involving energized electrical equipment.

### 3. Definitions

**Authorized Lockout/Tagout Employee** - A person who has completed the required hazardous energy control training and is authorized to lockout or tagout a specific machine or equipment to perform service or maintenance. A person must be certified as an Authorized Lockout/Tagout Employee in order to apply a lock or tag to control hazardous energy. All Authorized Lockout/Tagout Employees must be trained in:

- Core IIPP Safety Training;
- Advanced Electrical Safety/Lockout/Tagout Training; and
- Equipment specific procedures in their individual work units.

**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).

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

**De-energized electrical work** - Electrical work that is performed on equipment that has been previously energized and is now free from any electrical connection to a source of potential difference and from electrical charges.

**Disconnecting (or isolating) switch** - A device designed to close and/or open an electric circuit.

**Dry location** - Locations not normally subject to dampness or wetness, as in the case of a building under construction.

**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 bare wiring.

**Ground fault circuit interrupt (GFCI)** - A device whose function is to interrupt the electric circuit to the load when a fault current to ground exceeds a predetermined value that is less than that required 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** - Circuits with a nominal voltage 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** - The placement of a lock on an energy-isolating device according to procedure, ensuring that the energy isolating device and the equipment being controlled cannot be operated until the lockout device is removed.

**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. See UC Irvine's Control of Hazardous Energy and Lockout/Tagout Program.

**Low voltage** - Circuits with a nominal voltage less than or equal to 600 volts.

**Switching devices** - Devices designed to close and/or open one or more electric circuits. Included in this category are circuit breakers, cutouts, disconnecting (or isolating) switches, disconnecting means, interrupter switches, and oil (filled) cutouts.

**Qualified High Voltage 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, who has demonstrated by performance familiarity with the work to be performed and the hazards involved, and has successfully completed the following training:

- Core Safety Training;
- Advanced Electrical Safety and Lockout/Tagout training;
- Hazardous Electrical High Voltage training ; and
- Demonstrated a minimum of two years' experience working on the specific equipment under the oversight of another Qualified High Voltage Electrical Worker.

Such training will be provided when the employee is initially assigned to the job and refresher training will be provided every three years.

Only a Qualified High Voltage 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.

**Note One:** Whether a person is considered to be a “qualified” person will depend upon various circumstances in the workplace. It is possible and, in fact, likely for an individual to be considered “qualified” with regard to certain equipment in the workplace, but “unqualified” as to other equipment.

**Note Two:** An employee who is undergoing on-the-job training and who, in the course of such training, has demonstrated an ability to perform duties safely at his or her level of training and who is under the direct supervision of a qualified person is considered to be a qualified person for the performance of those duties.

**Remote-control circuit** - Any electric circuit that controls any other circuit through a relay or an equivalent device.

**Service** - The conductors and equipment for delivering energy from the electricity supply system to the wiring system of the premises served.

**Service equipment** - The necessary equipment, usually consisting of a circuit breaker or switch and fuses, and their accessories, located near the entrance of supply conductors to the building and intended to constitute the main control and means of cutoff of the supply.

**Setting up** - Any work performed to prepare a machine or equipment to perform its normal production operation.

**Tagout** - The placement of a tagout device on an energy-isolating device according to procedure to indicate that the equipment may not be operated until the tagout device is removed.

**Voltage (of a circuit)** - The greatest root-mean-square (effective) difference of potential between any two conductors of the circuit concerned.

**Voltage, nominal** - An approximate value assigned to a circuit or system for the purpose of conveniently designating its voltage class, e.g., 120/240, 480/277, and 600.

**Wet location** - Installations subject to saturation with water or other liquids.

#### 4. Responsibilities

##### Supervisors and Facilities Management (FM) 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 responsible for:

- Determining which employees are Qualified High Voltage Electrical Workers and are allowed to work on energized systems. This process involves “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;
- Ensuring that the UC Irvine Qualified High Voltage Electrical Worker has reviewed and approved the Hazard Assessment and SOP for high voltage activities;
- Reviewing and/or writing switching procedures in conjunction with the high voltage electrical contractor; and
- Notifying EH&S one (1) to two (2) days prior to the commencement of high voltage work as necessary.

##### Environmental, Health, and Safety (EH&S) Responsibilities

EH&S is responsible for:

- 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 procedures for specific equipment, and high voltage switching procedures written by FM or their high voltage electrical contractors;
- Partnering with FM 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;

##### 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 resuscitation, and; understand the workspace and guarding specified in the Cal/OSHA standard.

Additionally, all Qualified High Voltage Electrical Workers must also have the skills and techniques necessary to distinguish exposed live parts from other parts of electrical equipment and to determine the nominal voltage of exposed live parts. FM and EH&S will work together to determine who is a designated Qualified High Voltage Electrical Worker.

## 5. Program Components

UC Irvine will develop and implement written High Voltage Standard Operating Procedures (SOP) using the Hazard Assessment and Standard

Operating Procedures for High Voltage Activities. All activities, performed by either a UC Irvine employee or by a High Voltage Electrical contractor, must have a SOP developed, documented, and reviewed by both the employee's supervisor.

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.

### De-Energized Electrical Work

Electrical systems must be worked on in the de-energized state, whenever feasible, following the work practices described in UC Irvine's Control of Hazardous Energy and Lockout/Tagout 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).

### High Voltage Work

#### *Energized Electrical 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. UC Irvine 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 protective equipment requirements.

[https://ehs.uci.edu/safety/\\_pdf/Energized-Electrical-Work-Guidance.pdf](https://ehs.uci.edu/safety/_pdf/Energized-Electrical-Work-Guidance.pdf)

### Operating Procedures

#### *Qualified High Voltage Electrical Worker*

Energized electrical work on systems shall only be performed by a UC Irvine Qualified High Voltage Electrical Worker. UC Irvine 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 High Voltage Electrical Workers shall work on energized conductors or equipment

connected to energized high voltage systems. Except for replacing fuses, operating switches, other operations that do not require the employee to contact energized high voltage conductors or energized parts of equipment or clearing trouble or emergencies involving hazard to life or property, no such employee shall be assigned to work alone.

### *Observers*

During the time that work is being performed on any exposed conductors or exposed parts of equipment connected to high voltage systems, a Qualified High Voltage 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
- Render immediate assistance in the event of an accident.

All Safe Work Practices must be followed while performing energized electrical work. 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 to be performed. The electrical tools and protective equipment must be specifically approved, rated, and tested for the levels of voltage of which an employee may be exposed.

Electrical Protective Equipment 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).

Insulating equipment made of materials other than rubber shall provide electrical and mechanical protection at least equal to that of rubber equipment.

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.

UC Irvine 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.

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 protective equipment for the eyes or face wherever there is a potential danger of electric arcs, flashes or flying objects resulting from electric explosion. This should include polycarbonate safety glasses with side shields and a full-face shield. The following scenarios are examples of situations with the potential for arcs:

- Working with a metal or conductive tool near a live electrical contact point with voltages above 600 volts;

- Accidentally making contact across two live electrical contact points with a metal or conductive tool; and
- 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 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; and
- 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.

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 uninsulated 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.

**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 Electrical Worker. The following work practices are required, in addition to the requirements described above, for energized electrical work.

***Work Practices***

Work on greater than 600 volts must be performed following the same requirements as described above under Operating Procedures, including the use of 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 clearances must comply with Cal/OSHA Clearance and Access Distances

## **Tools and Probe**

Insulating gloves and blankets shall be visually inspected before each use, electrically re-tested in accordance with ASTM standards (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.

## **Overhead Voltage Lines**

Special requirements are required for work on overhead voltage lines. In general, this work should only be performed by personnel (e.g., outside vendors) who are experienced in this type of electrical work and have the appropriate tools including hoists and fall protection.

## **Hazardous Locations**

### **Wet or Damp Locations**

Work in wet or damp work locations (i.e., areas surrounded or near water or other liquids) should not be performed unless it is absolutely critical.

Electrical work should be postponed until the liquid can be cleaned up. If the work cannot be avoided, the Senior Superintendent or FM Project Manager responsible for the task, prior to performing the work, must grant approval.

Every attempt should be made to provide an insulated workspace if the work must be performed. The following special precautions must be incorporated while performing work in damp locations:

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

The following special precautions 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;
- Do not use electrical extension cords in wet or damp locations; and
- Keep electrical cords away from standing water.

## **Working on Life Safety Systems**

### **Protection from Life Safety Systems**

Life safety systems (e.g., emergency lighting) 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 locations, which would require shutting off the ventilation systems in order to perform de-energized electrical work; and
- 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 when the life safety systems can be taken out of service to ensure the life safety protection provided by these systems is maintained. Specific procedures need to be developed by the individual departments to work on these systems safely.

### **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 security, and an ERT are also required if a life safety system is to be de-energized.

### **Overriding Safety Interlocks**

Overriding safety interlocks are often required when performing metering, in emergency situations, or when troubleshooting equipment with the power on (i.e., energized electrical work). The following safe work practices shall be followed:

- Overriding safety interlocks shall only be performed by Qualified High Voltage 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; and
- Positive confirmation should be made to verify that each interlock functions as intended.

### **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, such as voltmeters, must be verified to be functional. This is accomplished by testing the 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 yearly, at a minimum. If there is any doubt as to the equipment's calibration, the equipment should be recalibrated

## **6. Reporting Requirements**

UC Irvine 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.

## **7. 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 of Materials (ASTM) for Electrical Protective Equipment; and
- National Fire Protection Association (NFPA) Article 70.