Electrical + Arc Flash Safety Program
Chapter 8

INTRODUCTION

This program establishes minimum standards to prevent hazardous electrical exposures 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 introduces an increased hazard or is infeasible. This program is designed to help ensure that energized electrical work at UG2 is performed safely by qualified electrical workers, who are trained and provided with the appropriate safe work procedures, protective equipment other controls. The program is intended to protect employees against electrical shock, burns and other potential electrical safety hazards as well as comply with regulatory requirements.

ELECTRICAL HAZARDS

Electricity-related hazards include electric shock and burns, arc-flash burns, arc-blast impacts, and falls.

- **Electric shock and burns.** An electric shock occurs when electric current passes through the body. This can happen when touching an energized part. If the electric current passes across the chest or head, death can result. At high voltages, severe burns can result.

- **Arc-flash burns.** An electric arc flash can occur if a conductive object gets too close to a high-amp current source or by equipment failure (for instance, while opening or closing disconnects). The arc can heat the air to temperatures as high as 35,000°F and vaporize metal in the equipment. The arc flash can cause severe skin burns by direct heat exposure and by igniting clothing.

- **Arc-blast impacts.** The heating of air and vaporization of metal creates a pressure wave that can damage hearing and cause memory loss (from concussion) and other injuries. Flying metal parts are also a hazard.

- **Falls.** Electric shocks and arc blasts can cause falls, especially from ladders or unguarded scaffolding.

PURPOSE

This program has been established in order to:

- Ensure the safety of employees who may work on or near electrical equipment.
- Ensure that employees understand and comply with safety standards related to electrical work.
- Ensure that employees follow uniform practices during the progress of electrical work.
- Comply with OSHA Standards according to the following key points:
  1. Provide and demonstrate a safety program with defined responsibilities.
  2. Provide personal protective equipment (PPE) for workers.
  3. Provide documented training to workers.

4. Provide appropriate tools for safe work.

SCOPE

This program applies to all UG2 operations and work performed by its employees regardless of job site location.

ELECTRIC SAFETY PRINCIPLES-ENERGIZED CONDITION

- **De-energize whenever possible.**
- **Plan every job.** The approach and step-by-step procedures to complete the work at hand must be discussed and agreed upon between all involved employees before beginning. Write down first-time procedures. Discuss hazards and procedures in a job briefing with supervisors and other workers before starting any job
- **Identify the hazards.** Conduct a job hazard analysis. Identify steps that could create electric shock or arc-flash hazards.
- **Minimize the hazards.** De-energize any equipment, and insulate, or isolate exposed live parts so contact cannot be made. If this is impossible, obtain and wear proper personal protective equipment (PPE) and tools.
- **Anticipate problems.** If it can go wrong, it might. Make sure the proper PPE and tools are immediately available for the worst-case scenario.
- **Obtain training.** Make sure all involved employees are a qualified electrical worker with appropriate training for the job.

REFERENCES

- OSHA 29 CFR 1910.331 through 1910.335, “Electrical Safety-Related Work Practices”
- OSHA 29 CFR 1910.147, “The Control of Hazardous Energy (Lockout/Tagout)”
- NFPA 70E (2015 Edition) “Standard for Electrical Safety in the Workplace”

RESPONSIBILITIES

Safety Managers/Coordinators

- Evaluate work being performed and determine compliance with this program.
- Provide or assist in the task of specific training for electrical work qualifications.
- Training recordkeeping.
- Periodically review and update this written program.
- Evaluate the overall effectiveness of the electrical safety program on a periodic basis.
- Ensure that all electrical and arc flash PPE is properly inspected and maintained.

Supervisors

- Promote electrical safety awareness to all employees.

- Ensure employees comply with ALL provisions of the electrical safety program.
- Ensure employees receive training appropriate to their assigned electrical tasks and maintain documentation of such training.
- Develop and maintain a listing of all qualified employees under their supervision.
- Ensure employees are provided with and use appropriate protective equipment.

Employees

- Follow the work practices described in this document, including the use of appropriate protective equipment and tools.
- Attend all training required relative to this program.
- Immediately report any concerns related to electrical safety to supervision.
- Properly maintain and inspect all personal protective equipment prior to each use.
- Properly maintain and inspect all electrical safety equipment (insulated hand tools, arc-rated faceshields, etc.).

DEFINITIONS (for general electrical safety)

- **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:

    - Electrical Safety/Lockout/Tagout Training
    - Equipment-specific procedures (if applicable)

- **Awareness-Level Employee** – An employee who is not authorized or qualified to perform any task which exposes him or her to live conductors of 50VAC or greater, however, due to their job functions in the workplace, may encounter or be in the vicinity of qualified workers who are conducting live electrical tasks. Awareness-level employees need to have sufficient training in order for them to understand how to avoid electrical exposures and hazards.
- **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).
- **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.
- **Qualified-Level Employee (Qualified Electrical Worker) –** A qualified person trained and knowledgeable of construction and operation of equipment or a specific work method and is trained to recognize and avoid the electrical hazards that might be present with respect to that equipment or work method.

    - Qualified electrical workers shall be familiar with the proper use of the special precautionary techniques, personal protective equipment (PPE), including arc-flash, insulating and shielding materials, and insulated tools and test equipment. A person can be considered qualified with respect to certain equipment and methods but is unqualified for others.

- An employee who is undergoing on-the-job training and who, in the course of such training, has performed duties safely at his or her level of training and who is under the direct supervision of a qualified person shall be considered to be qualified.

- Only a Qualified Electrical Worker is allowed to work on energized circuits.

  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 ofsuch 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 (if approved by the Safety Manager).

- **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 itsnormal production operation.
- **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.
- **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.

DEFINITIONS (for arc flash safety)

- **Arc blast** - A pressure wave containing gaseous forms of metal created from an electrical current fault. The arc blast may be of sufficient intensity to knock a standing person down or off a ladder. The arc blast may also be of sufficient intensity to produce human injury.

- **Arc flash** - The arc flash may be composed of radiant and convective energy, arc blast vapors, molten metal droplets, sound pressure, shock waves, intense light, and projectiles.

- **ATPV** - Arc Thermal Performance Exposure Value. The minimum incident arc energy in calories per centimeter squared capable of causing the onset of a second-degree burn. ATPV is defined in American Society for Testing of Materials standard F1959/F 1959/M as a test method for flame retardant clothing.
- **Boundary, Flash Protection** - The linear distance in all directions from an exposed energized electrical component that is just far enough away from the source to prevent permanent injury from an arc flash due to a fault current.
- **Break-open threshold energy (EBT)** - Maximum incident energy values that do not cause Flame Resistant (FR) material to break-open, and do not cause second degree burns on skin covered by the FR material.
- **Current limiting devices** - *C*ertain types of fuses or circuit breakers that, when interrupting current within its current-limiting range, will reduce the current in the faulted circuit to a substantially lower magnitude. Properly selected current limiting devices can limit the let-through energy to a level within the rating of downstream circuit components, even in the presence of high available system short-circuit current.

- **Electrically Safe Work Condition** - De-energizing and securing energy sources to ensure employee safety. An electrically safe work condition is established by:

  - *Identifying all sources of the electrical supply*
  - *Opening the disconnecting device for each supply*
  - *Visually inspecting where possible, the disconnecting device to ensure that the switch has opened*
  - *Locking out all disconnecting devices to prevent unexpected re-energization*
  - *Testing the circuit with an adequately rated test device (voltage tester or volt ohmmeter). The performance of the test instrument must be verified before and after each use*
  - *Grounding the phase conductors or components if induced voltage or stored electrical energy is present.*

- **Electrical Systems** - Systems and associated equipment, which provides for the generation, transmission, conversion, distribution and use of electrical power.

- **Fault current** - An electrical current that is following the path of least resistance, either from one phase to another, or to ground. This alternate path may be insufficient to contain the current, resulting in damage from extreme heat, fire, or flying components.

- **High Voltage** - Voltage exceeding 600 Volts A.C. and D.C.
- **Incident energy** - Energy from arc, both radiant and convective, that is actually received per unit area, in calories/cm2
- **Low Voltage** - Voltage less than 600 Volts A.C. and D.C.
- **Qualified Person** - A person with relevant training and experience to enable him or her to avoid dangers which electricity may create, and are authorized and competent to carry out specific work on the electrical distribution system.
- **Unqualified Person** - Person adequately trained to enable him/her to avoid dangers which electricity may create but are not authorized to work on electrical systems.
- **Voltage Tester** - A device capable of measuring the presence of voltage. These may be either solenoid operated or digital indicating. These units may also incorporate special features, such as the ability to indicate continuity. For the purposes of this procedure it does not include tick-tracers.
- **Volt-Ohm Meter (VOM)** - A metering device capable of measuring continuity, voltage, and current. These units may also incorporate other special features, such as the ability to indicate capacitance and true Root Mean Square (RMS). These devices are also called multimeters.

TRAINING

Requirements

Workers near 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 and retrained as necessary.

Qualified-Level Training

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 annually or when conditions change.

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

- The Lockout/Tagout Training Program including safe work practices required to safely de-energize electrical equipment.
- Universal electrical safety procedures.

- Skills and techniques necessary to distinguish exposed live parts from other parts of electric equipment.
- Skills and techniques necessary to determine the nominal voltage of exposed live parts.
- Selection and use of proper work practices, personal protective equipment, tools, insulating and shielding materials and equipment for working on or near energized parts.
- Recognition of electrical shock and electrical arc flash/blast hazard potentials, how to minimize the risk of arc flash incidents, and the proper care and maintenance of arc flash PPE.

UG2 will have employees trained in recognizing signs and symptoms of electric shock, heart fibrillation, electric burns, and proper first aid protocols for these conditions. They will have the following training:

- Basic Cardio Pulmonary Resuscitation (CPR/AED) – if applicable;
- Contacting emergency personnel and basic first aid.

Awareness-Level Training

- All employees who are not permitted to perform live electrical tasks are required to receive Awareness-Level Electrical/Arc Flash safety training upon hire and at least once every three (3) years thereafter.

Documentation of Training and Experience

UG2 will document that all required training has been provided. Training sign-in sheets and/or training certificates will be part of this documentation.

PORTABLE ELECTRICAL EQUIPMENT AND EXTENSION CORDS

The following requirements apply to the use of cord-and-plug-connected equipment and flexible cord sets (extension cords):

- Extension cords may only be used to provide temporary power.

- Portable cord-and-plug connected equipment and extension cords must be visually inspected before use on any shift for external defects such as loose parts, deformed and missing pins, or damage to outer jacket or insulation, and for possible internal damage such as pinched or crushed outer jacket. Any defective cord or cord-and-plug-connected equipment must be removed from service and no person may use it until it is repaired and tested to ensure it is safe for use.

- Extension cords must be of the three-wire type. Extension cords and flexible cords must be designed for hard or extra hard usage (for example, types S, ST, and SO). The rating or approval must be visible.

- Job-made extension cords are forbidden per the electrical code.

- Personnel performing work on renovation or construction sites using extension cords or where work is performed in damp or wet locations must be provided, and must use, a ground-fault circuit interrupter (GFCI).

- Portable equipment must be handled in a manner that will not cause damage. Flexible electric cords connected to equipment may not be used for raising or lowering the equipment.

- Extension cords must be protected from damage. Sharp corners and projects must be avoided. Flexible cords may not be run through windows or doors unless protected from damage, and then only on a temporary basis. Flexible cords may not be run above ceilings or inside or through walls, ceilings or floors, and may not be fastened with staples or otherwise hung in such a fashion as to damage the outer jacket or insulation.

- Cords must be covered by a cord protector or tape when they extend into a walkway or other path of travel to avoid creating a trip hazard.

- Extension cords used with grounding-type equipment must contain an equipment-grounding conductor (i.e., the cord must accept a three-prong, or grounded, plug).

- Attachment plugs and receptacles may not be connected or altered in any way that would interrupt the continuity of the equipment grounding conductor. Additionally, these devices may not be altered to allow the grounding pole to be inserted into current connector slots. Clipping the grounding prong from an electrical plug is prohibited.

- Flexible cords may only be plugged into grounded receptacles. The continuity of the ground in a two-prong outlet must be verified before use. It is recommended that the receptacle be replaced with a three-prong outlet. Adapters that interrupt the continuity of the equipment grounding connection may not be used.

- All portable electric equipment and flexible cords used in highly conductive work locations, such as those with water or other conductive liquids, or in places where employees are likely to contact water or conductive liquids, must be approved for those locations.

- Employee's hands must be dry when plugging and unplugging flexible cords and cord-and-plug connected equipment if energized equipment is involved.

- If the connection could provide a conducting path to employees hands (for example, if a cord connector is wet from being immersed in water), the energized plug and receptacle connections must be handled only with insulating protective equipment.

- Locking-type connectors must be properly locked into the connector.

- Lamps for general illumination must be protected from breakage, and metal shell sockets must be grounded.

- Temporary lights must not be suspended by their cords unless they have been designed for this purpose.

- Extension cords are considered to be temporary wiring and must also comply with the section on "Requirements for Temporary Wiring" in this program.

REQUIREMENTS FOR TEMPORARY WIRING

Temporary electrical power and lighting installations 600 volts or less, including flexible cords, cables and extension cords, may only be used during and for renovation, maintenance, repair, or experimental work. The duration for temporary wiring used for decorative lighting for special events and similar purposes may not exceed 90 days. The following additional requirements apply:

- Ground-fault protection (e.g., ground-fault circuit interrupters, or GFCI) must be provided on all temporary-wiring circuits, including extension cords, used on construction sites.

- In general, all equipment and tools connected by cord and plug must be grounded. Listed or labeled double insulated tools and appliances need not be grounded.

- Feeders must originate in an approved distribution center, such as a panel board, that is rated for the voltages and currents the system is expected to carry.

- Branch circuits must originate in an approved power outlet or panel board.

- Neither bare conductors nor earth returns may be used for the wiring of any temporary circuit.

- Receptacles must be of the grounding type. Unless installed in a complete metallic raceway, each branch circuit must contain a separate equipment-grounding conductor, and all receptacles must be electrically connected to the grounding conductor.

- Flexible cords and cables must be of an approved type and suitable for the location and intended use. They may only be used for pendants, wiring of fixtures, connection of portable lamps or appliances, elevators, hoists, connection of stationary equipment where frequently interchanged, prevention of transmission of noise or vibration, data processing cables, or where needed to permit maintenance or repair. They may not be used as a substitute for the fixed wiring, where run through holes in walls, ceilings or floors, where run through doorways, windows or similar openings, where attached to building surfaces, or where concealed behind building walls, ceilings or floors.

- Suitable disconnecting switches or plug connects must be installed to permit the disconnection of all ungrounded conductors of each temporary circuit.

- Lamps for general illumination must be protected from accidental contact or damage, either by elevating the fixture or by providing a suitable guard. Hand lamps supplied by flexible cord must be equipped with a handle of molded composition or other approved material and must be equipped with a substantial bulb guard.

- Flexible cords and cables must be protected from accidental damage. Sharp corners and projections are to be avoided. Flexible cords and cables must be protected from damage when they pass through doorways or other pinch points.

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. The following special precautions must be incorporated while performing work in *damp locations*:

- Only use electrical cords that have Ground Fault Circuit Interrupters (GFCIs);
- 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 DE-ENERGIZED EQUIPMENT

Electrically Safe Work Condition

The most important principle of electrical safety is to **assume all electric circuits are energized unless each involved worker ensures they are not.** Every circuit and conductor must be tested every time work is done on them. Proper PPE must be worn until the equipment is proven to be de-energized.

- Voltage rated gloves and leather protectors must be worn
- Safety glasses must be worn
- The required Arc Flash PPE must also be worn when verifying the de-energized state. All arc flash and electrical PPE can be removed once the enclosure has been verified as "dead."

The National Fire Protection Association (NFPA) lists six steps to ensure conditions for electrically safe work:

- Identify all sources of power to the equipment.
- Remove the load current, and then open the disconnecting devices for each power source.

- Where possible, visually verify that blades of disconnecting devices are fully open or that draw out-type circuit breakers are fully withdrawn.
- Apply lockout/tagout devices in accordance with a formal, written policy.
- Test each phase conductor or circuit part with an adequately rated voltage detector to verify that the equipment is de-energized. Test each phase conductor or circuit part both phase-to-phase and phase-to-ground. Check the voltage detector before and after each test to be sure it is working.
- Properly ground all possible sources of induced voltage and stored electric energy (such as, capacitors) before touching. If conductors or circuit parts that are being de-energized could contact other exposed conductors or circuit parts, apply ground-connecting devices rated for the available fault current.

The process of de-energizing is "live" work and can result in an arc flash due to equipment failure. When de-energizing, follow the procedures described in "Working On or Near Live Equipment."

Lockout/Tagout Program

- Each applicable UG2 employee shall be trained in Lockout/Tagout procedures by the Health & Safety Manager or equivalent.

- **Lockout/tagout application.** Each person who could be exposed to electric energy must be involved in the lockout/tagout process.

- Follow the posted lockout/tagout procedures: 1) Prepare & Notify 2) Shut-Down equipment 3) Isolate Hazardous Energy 4) Apply LOTO Devices 5) Control Stored Energy 6) Verify & Test 7) Begin LOTO work.
- A lock/lockout device with a tag that will be attached to a disconnecting device to prevent the re-energizing of the equipment being worked on without removal of the lock. The lockout device will have a “Danger Do Not Operate” tag with the employee name on the tag. That employee must be the only person who has the key for the lockout device they install, and that employee will be the only person to remove the lock after all work has been completed.
- A tagout device is a tag and a way to attach it that can withstand at least 50 pounds of force. Tagout devices should be used alone only when it is not possible to install a lockout device.
- The tag used in conjunction with a lockout or tagout device must have a label prohibiting unauthorized operation of the disconnecting means or unauthorized removal of the device. It will also be used as a means of identifying the lock holder.
- Electric lockout/tagout procedures should be posted on each piece of equipment. If an employee discovers that a piece of equipment lacks a posted lockout/tagout procedure, that employee shall contact the Safety Manager immediately.
- **Individual qualified-employee control procedure.** For minor servicing, maintenance, inspection, and so on, on plug-connected equipment, work may be done without attaching lockout/tagout

devices if the plug is next to where the employee is working, is always easy to see, and the equipment is never left alone while being serviced.

- **Return to service.** Once work is completed and lockout/tagout devices removed, tests and visual inspection must confirm that all tools, mechanical restraints, electric jumpers, shorts, and grounds have been removed. Only then is it safe to re-energize and return to service. Employees responsible for operating the equipment and needed to safely re-energize it should be out of the danger zone before equipment is re-energized.
- **Temporary release.** If the job requiring lockout/tagout is interrupted for testing or positioning equipment, follow the same steps as in return to service (above).

WORKING ON OR NEAR ENERGIZED EQUIPMENT

Working on live circuits means actually touching energized parts. Working near live circuits means working close enough to energized parts to pose a risk even though work is on de-energized parts. Common tasks where there may be a need to work on or near live circuits include:

- Taking voltage measurements
- Opening and closing disconnects and breakers
- Racking breakers on and off the bus
- Removing panels and dead fronts
- Opening electric equipment doors for inspection

Precautions

When working on de-energized the parts, but still inside the flash protection boundary for nearby live exposed parts:

- If the parts cannot be de-energized, barriers such as insulated blankets must be used to protect against accidental contact or PPE must be worn.

- Employees shall not reach blindly into areas that might contain exposed live parts.

- Employees shall not enter spaces containing live parts unless illumination is provided that allows the work to be performed safely.

- Conductive articles of jewelry and clothing (such as watchbands, bracelets, rings, key chains, necklaces, metalized aprons, cloth with conductive thread, metal headgear, or metal frame glasses) shall not be worn where they present an electrical contact hazard with exposed live parts.

- Conductive materials, tools, and equipment that are in contact with any part of an employee's body shall be handled in a manner that prevents accidental contact with live parts. Such materials and equipment include but are not limited to long conductive objects such as ducts, pipes, tubes, conductive hose and rope, metal-lined rules and scales, steel tapes, pulling lines, metal scaffold parts, structural members, and chains.
- When an employee works in a confined space or enclosed spaces (such as a manhole or vault) that contains exposed live parts, the employee shall use protective shields, barriers or insulating materials as necessary to avoid contact with these parts. Doors, hinged panels, and the like shall be secured to prevent them from swinging into employees. Refer to the confined space entry program.

PERSONAL PROTECTIVE EQUIPMENT

General Requirements

- 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.
- Employees shall wear nonconductive head protection whenever there is a danger of head injury from electric shock or burns due to contact with live parts or from flying objects resulting from an electrical explosion.
- Employees shall wear protective equipment for the eyes whenever there is a danger of injury from electric arcs, flashes, or from flying objects resulting from an electrical explosion.
- Employees shall wear rubber insulating gloves where there is a danger of hand or arm contact with live parts or possible exposure to arc flash burn. Leather 'protector' gloves shall be worn over the rubber insulating gloves.
- Face shields without arc rating shall not be used for electrical work. Safety glasses or goggles must always be worn underneath face shields.
- Additional illumination may be needed when using tinted face shields asprotection during electrical work.
- Electrical Protective Equipment must be selected to meet the criteria established by the American Society of Testing and Materials (ASTM) and by the America 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.
- 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

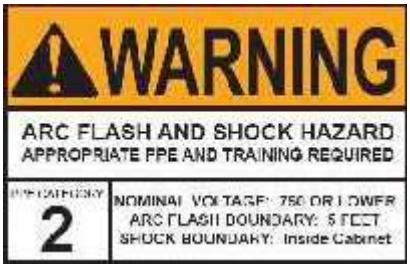
gloves must be used when employees are working with exposed electrical parts above fifty (50) volts.

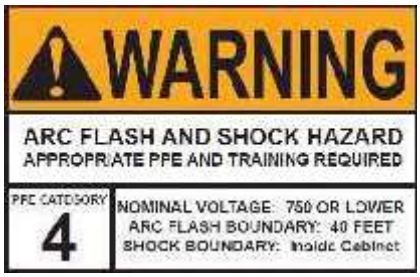
- Fuse handling equipment (insulated for circuit voltage) must be used to remove or install fuses when the fuse terminals are energized. Ropes and hand lines used near exposed energized parts must be non-conductive.
- Protective shields, barriers or insulating materials must be used to protect each employee 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.

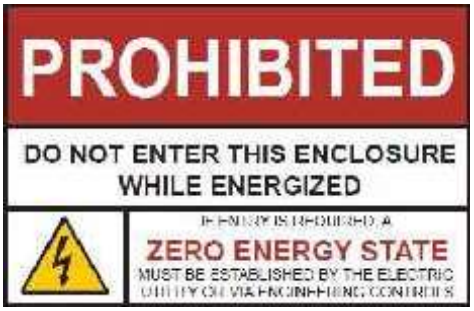
A. Each location shall have an electrical arc flash risk assessment conducted by a qualified contractor who has negotiated and agreed to a Master Services Agreement, and has met all requirements therein, with UG2. UG2 has selected The Hilgeman Group, Inc. to perform these services on an as-needed basis. The arc flash risk assessments shall be updated whenever significant changes are made to the processes or facility, or when new electrical enclosures are installed.

B. Switchboards, disconnects, bussplugs, panel boards, industrial control panels, motor control centers, and all other applicable electrical enclosures shall be labeled to indicate the presence of an arc flash and shock hazard. The required labels shall also indicate the PPE category level (which dictates the personal protective equipment) necessary to prevent injuries resulting from these hazards.

All UG2 properties will have all electrical enclosures labeled per the findings of the electrical arc flash risk assessment. Examples of the arc flash labels include:

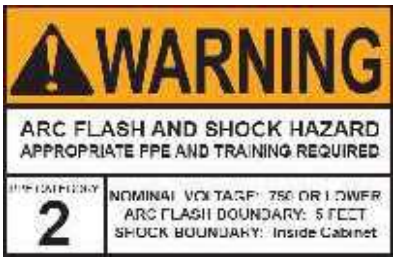


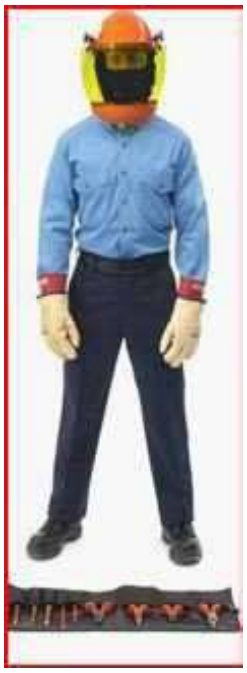




Specific Requirements for Proper PPE Usage and Maintenance

All electrical enclosures on the UG2 property that have been classified as **PPE Category 2** require the following personal protective equipment and tools:

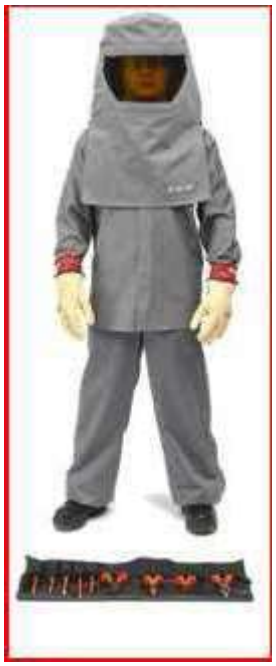




Clothing	**Arc Rated (AR) Long Sleeve Shirt** (min 8 cal/cm^2) **Arc Rated (AR) Pants** (min 8 cal/cm^2) **Arc Rated (AR) Balaclava** (min 8 cal/cm^2)
Gloves	**Insulating Rubber Electrical Gloves** (min Class 00) **Leather Protector Gloves**
Other PPE	**Safety Glasses** **Arc Rated Hardhat, Face Shield and Chin Cup** (min 10 cal/cm^2) **Ear Plugs** **Leather Shoes**
Tools	**Insulated Tools Only** (1000 VAC min rating)

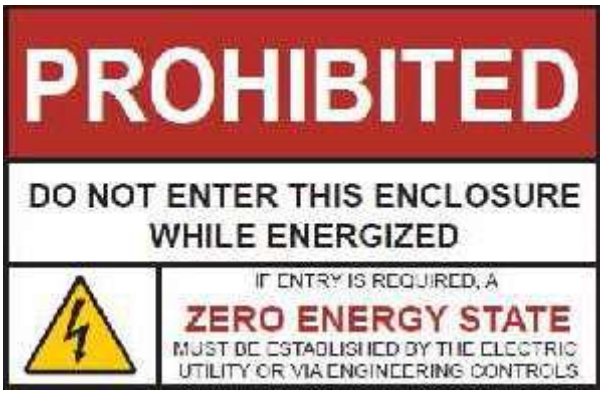
All electrical enclosures on the UG2 property that have been classified as **PPE Category 4** require the following personal protective equipment and tools:

Clothing	**Arc Rated (AR) Jacket** (min 40 cal/cm^2) **Arc Rated (AR) Pants** (min 40 cal/cm^2) **Natural Fiber or AR Shirt and Pants (Undergarments)**
Gloves	**Insulating Rubber Electrical Gloves** (min Class 00) **Leather Protector Gloves**



Other PPE	**Safety Glasses** **Arc Rated Hood** (min 40 cal/cm^2) **Ear Plugs** **Leather Shoes**
Tools	**Insulated Tools Only** (1000 VAC min rating)

Any electrical enclosure that is labeled as **PPE Category PROHIBITED** cannot be opened or worked in at any time. The only contractors who have permission to de-energize, verify a zero-energy state, and perform any tasks in **PPE Category PROHIBITED** enclosures are medium/high voltage specialists with special permission granted from our company, and who are working in coordinating with the electric utility company.



A. Protective equipment must be stored and used in accordance with manufacturer's recommendations. Regular tests and inspections will be required to ensure that any equipment is still fit for purpose and use. Equipment can include but is not limited to voltage-rated gloves, arc-rated hard hats and face shields, safety glasses, hearing protection, safety footwear and arc-rated (AR) clothing.

B. All arc-rated clothing (AR) shall be laundered and maintained according to the manufacturer's specifications. Employees are not permitted to make alterations to any AR apparel. It is recommended that a uniform company be contacted to discuss the proper care and maintenance/laundering/repair of the AR garments.

C. In addition to the arc-rated (AR) clothing, applicable employees will also be provided with insulated hand tools, arc-rated hardhat and faceshield, and electrically-insulated rubber gloves.

D. It is recommended that insulating gloves be provided to each qualified person.

E. Electrically-insulated rubber gloves are required to be inspected each day (prior to use) by the qualified employee, and, every six (6) months by a certified third party.

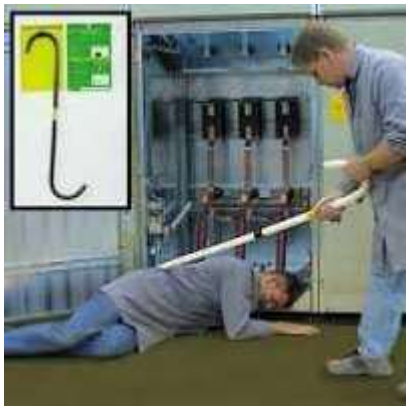
F. Any additional PPE (fall protection, etc.) shall be determined by a hazard assessment of the task.

G. Prior to establishing an electrically safe work condition, all qualified persons within the flash protection boundary of a presumed live component must be suitably protected with personal protective equipment for that specific hazard category. Once an electrically safe work condition has been established and verified, electrical personal protective equipment can be removed.

H. Conductive articles of clothing or jewelry (such as watchbands, bracelets, rings, key chains, pens, necklaces, metalized aprons cloth with conductive thread, metal headgear, metal frame glasses, etc.) shall not be worn where they present an electrical contact hazard with live parts, unless they are rendered non-conductive by covering or wrapping with insulated material.

I. All unqualified personnel shall be kept a safe distance from exposed energized components. Safe distance shall be the longer of the two boundaries (Shock and Flash Protection).

J. Each facility will maintain at least one (1) non-conductive “deadman’s hook” for use in the event that a person is making accidental contact with live conductors and cannot free himself.



Insulated Tools and Materials

- Only insulated tools and equipment shall be used when exposed to energized parts.
- Insulated tools shall be rated for the voltages on which they are used.
- Insulated tools shall be designed and constructed for the environment to which they are exposed and the manner in which they are used.
- Fuse or fuse holder handling equipment, insulated for the circuit voltage, shall be used to removed or install a fuse if the fuse terminals are energized.
- Ropes and hand-lines used near exposed energized parts shall be nonconductive.
- Portable ladders used for electrical work shall have nonconductive side rails.

Access Limiting Equipment (Guarding the Arc Flash and Shock Boundary)

- Barricades shall be used in conjunction with safety signs to prevent or limit access to work areas containing live parts. Conductive barricades shall not be used where they might cause an electrical hazard. These barricades are designed to prevent un-qualified and/or unprotected workers from entering the electrical hazard area.

- If signs and barricades do not provide sufficient protection, an attendant will be assigned to warn and protect pedestrians. The primary duty of the attendant shall be to keep an unqualified person out of the work area where an electrical hazard exists. The attendant shall remain in the area as long as there is a potential exposure to electrical hazards.

WORKING SPACE AROUND ELECTRIC EQUIPMENT

Spaces Around Electric Equipment:

- Sufficient access and working space shall be provided and maintained about all electric equipment to permit ready and safe operating and maintenance of such equipment. Enclosures that house electric apparatus and are controlled by lock and key shall be considered accessible to qualified persons.

Working Spaces

- OSHA requires a minimum of 36" of clear space be kept in front of all electrical enclosures to ensure safe, efficient access in the event of an emergency, and to allow proper heat ventilation from the enclosure.

Illumination

- Illumination shall be provided for all working spaces about service equipment, switchboards, panel boards, or motor control centers installed indoors. Additional lighting outlets shall not be required where the work space is illuminated by an adjacent light source. In electrical equipment rooms, the illumination shall not be controlled by automatic means only.

Dedicated Equipment Space

- All switchboards, panel boards, distribution boards, and motor control centers shall be located in dedicated spaces and protected from damage. *Exception: Control equipment that by its very nature or because of other rules of the standard must be adjacent to or within sight of the operating machinery shall be permitted in those locations.*

OVERHEAD POWER LINES

- Employees are not permitted to work in close proximity to any overhead power lines near our operations.

- Each facility will use the following OSHA table to determine the minimum safe distance:

Voltage	Insulated Lines (Minimum Distance)
< 300 v	3 feet
300 v – 50 kv	10 feet
> 50 kv	10 feet plus 0.4" for each 1 kv over 50 kv.

Voltage	Un-Insulated Lines (Minimum Distance)
< 50 kv	10 feet
> 50 kv	10 feet plus 0.4" for each 1 kv over 50 kv.

CONTRACTOR EMPLOYEES

- UG2 will communicate the electrical and arc flash expectations to all applicable contractors who may be exposed to 50VAC or greater during the anticipate scope of work duties.
- Safety programs used by contractors must meet or exceed all applicable guidelines of this Safety Program.
- Contractors are required to comply with applicable Safety and Health regulations such as OSHA and NFPA.
- Contractors may be required to submit copies of their safety program to the safety coordinator upon request.