AM Safety ST 001 v1 - Guidelines FPS Isolation - Appendix 2 - English

UNIVERSITY of NORTHERN COLORADO

ENVIRONMENTAL HEALTH AND SAFETY

ELECTRICAL SAFETY GUIDELINE

June 2010

University of Northern Colorado

Electrical Safety Guidelines

Table of Contents

B. Hazard and Risk Personal Protective Equipment Matrix

I. General

Electrical Safety Guidelines have been developed and implemented for faculty, staff, and students of the University of Northern Colorado (UNC). This guidance applies to all University employees and students. It is the purpose of this plan to provide a practical safe working area relative to the hazards that arise from the use of electricity.

The National Fire Protection Association (NFPA) 70E was developed by the Technical Committee on Electrical Safety in the Workplace, released by the Technical Correlating Committee on National Electric Code and acted on by NFPA. The NFPA 70E committee was formed to assist Occupational Safety and Health Administration in preparing electrical safety standards that would meet OSHAs requirements of Section (6)b of the OSH Act of 1970.

This guideline does not cover all regulatory requirements regarding electrical safety in the workplace, but should be considered as minimum requirements in order to provide a safe working environment. Anyone using this plan should rely on his or her own personal judgment or seek the advice of a competent professional in determining the course of action for a given circumstance.

II. General Electrical Safety

Electrical safety is important in every work environment. The danger of injury due to electrical shock is possible whenever electrical power is present. When a person's body completes a circuit connecting a power source with the ground, an electrical burn or injury is imminent. Most fatal injuries result from high-voltage exposure; however, people can sustain severe injuries from low voltage power, if it has a high current flow. The purpose of this section is to provide basic safety guidance to those who work with electricity or electrical equipment.

A. Definitions

Amps: The standard unit for measuring electrical current.

Watt: A unit of electrical power, equal to the power developed in a circuit by a current of amp flowing through a potential difference of one volt.

Voltage: Electromotive force expressed in volts.

Circuit Breaker: A device that automatically interrupts the flow of an electrical current.

Electrical Panel: An insulated panel on which electrical wires are mounted.

Current Flow: The rate of flow of an electrical charge, generally expressed in amps.

Electrical Load: The amount of power delivered by a generator or carried by a circuit or a device to which the power is delivered.

Ground-Fault Circuit Interrupter (GFCI): A GFCI detects grounding problems and shuts electricity off to prevent a possible accident.

High Voltage: The term high voltage applies to electrical equipment that operates at more than 600 Volts (for terminal to terminal operations) or more than 300 Volts (for terminal to ground operation). Low voltage, high current AC or DC power supplies are also considered to be high voltage.

Hazardous Energy Sources: This term applies to stored or residual energy such as that in capacitors, springs, elevated machine members, rotating flywheels, hydraulic systems, and air, gas, steam, or water pressure.

Lockout: The placement of a lock on an energy-isolating device. This act prevents workers from operating a piece of equipment until the lock is removed.

Tagout: The placement of a tag on an energy-isolating device. A tagout device is a prominent warning device of a lockout and should contain the employee's name.

Energy-Isolating Device: A mechanical device that prevents the transmission or release of energy. Examples include manually operated circuit breakers, disconnect switches, and line or block valves. Push buttons, selector switches, and other control circuit devices do not isolate energy. Energy-isolating devices should be lockable by means of a hasp or other type of attachment. It should not

be necessary to dismantle or reassemble a device to lock it. However, where a lockout mechanism device is not available, removal of a handle or valve may be necessary.

Authorized Employee: A person who locks out or tags out equipment for service or maintenance. Authorized employees have received formal training in proper lockout/tagout procedures.

B. Circuit Breaker Loads

20 amp circuit breakers that serve two or more outlets are common in workplace locations. These breakers can handle most office equipment; however, the widespread use of personal computers and associated hardware can create an electrical overload. If necessary, determine your current electrical load by following these steps:

- Check workplace equipment for a manufacturer's rating label that indicates total watts or amps.
- Convert the watts (P) rating to amps to get current (I):
  - $I(Amps) = \frac{P(Watts)}{V(Volts)}$ (typically 120 Volts)
  - Total the amps for each circuit.
  - If the total equals more than 15 amps per 20 amp circuit, you may be overloading the circuit.
    - Move equipment to a different circuit to reduce the circuit load.

C. Electrical Grounding

Proper electrical grounding can help prevent electrical injury. Most electrical equipment is grounded with either a three-prong plug or a two-prong plug and insulation. GFCIs are required in moist or damp environments and near water sources.

D. Electrical Panels

Electrical panels or breaker boxes require special safety considerations, including the following:

- Ensure breaker switches or blanks are present in all locations within the panel box.
- Do not tape circuit switches to keep a breaker from tripping.

- Ensure that breaker circuits are accurately labeled within panel boxes.
- Ensure that panel box doors are securely attached.
- Do not block panel boxes. There should be at least 30 inches of clear space in front of a panel box.
- Make sure there are no missing knock-outs on the electrical panel.
- Report tripped breakers and refer any electrical questions to the Facilities Management Department.

E. Electrical Safety Guidelines

Follow these guidelines for general electrical safety:

- Be familiar with the electrical hazards associated with your workplace.
- Unplug electrical equipment before repairing or servicing it.
- If a prong breaks off inside an outlet, do not attempt to remove it yourself. Call for assistance.
- Ensure that outlets are firmly mounted. Report loose outlets.
- Report all electrical problems, including tripped breakers, broken switches, and flickering lights.
- All appliances used in UNC buildings must be UL (Underwriters Laboratories) or FM (Factory Mutual) labeled.
- Do not use an appliance that sparks, smokes, or becomes excessively hot, unless the appliance is specifically designed to exhibit these characteristics.
- Keep electrical equipment away from water, unless the appliance is specifically designed for use around water, such as a wet-dry shop vacuum.
- Be aware of overhead power lines when working with tall equipment (e.g., bucket trucks, crane, etc.).
- Follow lockout/tagout procedures, as appropriate. (Refer to section III)

Follow these guidelines for electrical plug and cord safety:

- Do not remove the prongs of an electrical plug. If plug prongs are missing, loose, or bent, replace the entire plug or the cord and plug.

- Do not use an adapter or extension cord to defeat a standard grounding device. (i.e., only place three-prong plugs in three-prong outlets; do not alter them to fit in a two-prong outlet.)

- Use extension cords only when necessary and only on a temporary basis. Do not use extension cords in place of permanent wiring. Request new outlets if your work requires equipment in an area without an outlet.

- Use extension cords that are the correct size or rating for the equipment in use. The diameter and conductor of the extension cord should be the same or greater than the cord of the equipment in use.

- Do not run electrical cords above ceiling tiles or through walls.

- Keep electrical cords away from areas where they may be pinched and areas where they may pose a tripping or fire hazard (e.g., doorways, walkways, under carpet, etc.)

- Avoid plugging more than one appliance in each outlet. If multiple appliances are necessary, use an approved power strip with surge protector and circuit breaker. Do not overload the circuit breaker.

- Do not plug a power strip into another power strip and/or extension cord. Appliances should be plugged directly into the power strip and power strip should be directly plugged into the wall outlet.

- Discard damaged cords, cords that become hot, or cords with exposed wiring.

- Never unplug an appliance by pulling on the cord; pull on the plug.

- Always unplug and secure an extension cord when not in use.

III. Lockout/Tagout

Lockout/tagout procedures are used to isolate hazardous energy sources, typically electricity. However, hazardous energy can also be in the form of hydraulic or pneumatic systems, pressurized airlines, steam or other thermal systems, chemical lines, or it may even be present in strictly mechanical systems. Apart from stored energy sources, lockout/tagout should be used to protect employees from unintended releases of hazardous substances such as natural gas, CO_2 or Halon in automated fire-extinguishing systems, and hot or large-volume water systems during maintenance and repair. When service or maintenance work is required, lockout and tagout devices help ensure that employees are safe from possible energy releases. All employees whose work involves hazardous energy sources must be formally trained in lockout/tagout procedures.

Before performing service or maintenance work on systems or machines, turn equipment off and disconnect it from energy sources. To further ensure employee safety use lockout and tagout *energy-isolating devices*. A lockout/tagout checklist can be used to ensure proper steps are taken during shutdown and startup (Refer to Appendix A). The following provides information on lockout/tagout procedures in accordance with OSHA.

A. Applying Lockout/Tagout Devices

Only *authorized employees* may apply lockout/tagout devices. *The following steps provide a brief outline of approved application procedures:*

- Notify affected employees and/or departments that the equipment requires service or maintenance and is scheduled for shutdown.
- Use established procedures to identify the type, magnitude, and hazards of the equipment's energy source. Make sure you know the proper methods for controlling the energy source.
    - If the equipment is operating, shut it down using normal shutdown procedures.
- Isolate the equipment from its energy source by activating the *energy-isolating device(s)*.
- Lockout and tagout the energy-isolating device(s). Each authorized employee will be given their own lock and key in order to eliminate the possibility of others inadvertently unlocking an isolation device when it is being worked on by another. When isolating devices are not lockable, tagout will be used instead of lockout. When isolating devices are lockable, lockout along with tagout should be employed.

- Every authorized employee working on a system shall independently lockout and tagout the system using his or her own lock and tag or by use of a lockout hasp(at no time should any employee depend on the lock and tag of another worker to protect them during their service activities. Use your own lock and tag.)
- Dissipate or restrain stored and residual energy using methods such as grounding, repositioning, blocking, bleeding, etc. (Capacitors, springs, hydraulic systems, and air/gas/water pressure systems may contain stored or residual energy.)
- Ensure that all employees are clear from the equipment. Then, test the equipment for successful isolation by attempting to operate it. Return the operating control to off or neutral after verifying the isolation.
- The machine or equipment is now locked/tagged out.

B. Removing Lockout/Tagout Devices

When service and maintenance are complete, authorized employees may remove their lockout/tagout devices and return equipment to normal operations. The following steps provide a brief outline of approved removal procedures:

- Inspect the work area and remove any nonessential items. Make sure the isolation equipment is intact and in good working condition.
- Ensure that all employees are safely removed from the equipment and that they have been informed that the system will be turned on.
- Verify that the equipment controls are in neutral or off.
- Remove the lockout/tagout devices and re-energize the equipment (You should only remove your own lockout/ tagout device. It is the responsibility of each authorized employee to remove his or her own lock and tag).
    - **Note:** The removal of some forms of blocking may require the equipment to be re-energized before safe removal.
- Notify affected employees and departments that the service is complete and the equipment is ready for operation.

If it is necessary to remove a lock of an authorized employee that is not present, the following procedures should be employed along with the normal lock/tag removal procedures previously described (see section III-B). Only the Foreman

of the work crew involved can remove the lock of the authorized employee and only under the following conditions:

- A thorough visual inspection of the work site must be performed to ensure that the work area is clear and the authorized employee is not present;

- The foreman or authorized employer representative shall verify that the authorized employee is not on campus (under no circumstance should any lockout or tagout device be removed unless it is **confirmed** that the authorized employee is not on campus);

- All reasonable efforts to contact the authorized employee shall be made to inform the employee that his/her lockout/tagout device has been removed;

- The employer shall ensure that the authorized employee is aware that the device has been removed before he/she resumes work on campus.

The focus of these removal procedures is to ensure that the authorized employee is not in the work area, and that they will not return to the work area assuming that the equipment is still locked/tagged out.

C. Lockout/Tagout Training

Employees whose work requires them to service systems containing any of the potentially hazardous energy sources described above (Section III) must receive documented training on proper lockout/tagout procedures. This initial training must be supplemented by documented annual refresher training. Only those employees who have received proper training will be authorized to work on systems containing hazardous energy sources. New Facility Management employees must receive a copy of this procedural document, documented training, and their own lock, tag and key before they are allowed to work alone on systems containing recognized hazardous energy sources.

All employees working with the equipment or at the work site must receive awareness training on lockout/tagout procedures.

D. Contractors

Due to the added risk of both contractors and UNC Facilities Management employees working on a given system, the requirements for lockout/tagout should receive special emphasis. Contractors shall notify UNC Facilities Management whenever working around campus energy sources. Whenever possible, campus systems are to be operated only by UNC Facilities Management staff.

IV. High Voltage Procedures

In addition to the guidelines associated with general electrical safety and lockout/tagout procedures, there are more stringent safety requirements for high voltage systems.

The following list provides high-voltage safety guidelines. For more information, please refer to Title 29 Section 1910.269 of the Code of Federal Regulations or NFPA 70E.

- Ensure that only authorized employees work around high voltage equipment.
- Provide a High Voltage warning sign when necessary.
- Ensure that terminal voltage ratings can withstand surges caused by electrical faults or switching transients.
- Be careful around output circuits even when the input power is off. Parallel power sources and energy storage devices can still be dangerous.
- Be careful when working with power supplies that serve more than one area.
- Before working in a high voltage area, inspect the power supply and check all protective devices.
- Do not work alone near high voltage.
- Label equipment to identify power sources. Label input power sources to identify connected power supply loads.
- Attach emergency shutdown instructions and phone numbers to equipment that is remotely controlled or unattended while energized.

Before entering a power supply or associated equipment enclosure to work on hazardous energy sources, complete the following:

- De-energize the equipment.
- Lockout/tagout the main input power circuit breaker.

- Check for auxiliary power circuits that could still be energized.
- Inspect automatic shorting devices for proper operation.
- Short the power supply with grounding hooks.

A. Minimum Clear Working Space

The following table from the National Electric Code provides minimum depth of clear working space in front of electrical equipment:

Minimum Clear Distance [NEC Table 110.34(A)]			
Normal Voltage to Ground	**Condition 1**	**Condition 2**	**Condition 3**
601-2,500 V	900 mm (3 ft)	1.2 m (4 ft)	1.5 m (5 ft)
2,501-9,000 V	1.2 m (4 ft)	1.5 m (5 ft)	1.8 m (6 ft)
9001-25,000 V	1.5 m (5 ft)	1.8 m (6 ft)	2.8 m (9 ft)
25,001-75 kV	1.8 m (6 ft)	2.5 m (8 ft)	3.0 m (10 ft)
Above 75 kV	2.5 m (8 ft)	3.0 m (10 ft)	3.7 m (12 ft)

Where conditions (1), (2), and (3) are as follows:

(**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 bus bars operating at not over 300 volts shall not be considered live parts.

(**2**) Exposed live parts on one side and grounded parts on the other side. Concrete, brick, or tile walls will be considered as grounded surfaces.

(**3**) Exposed live parts on both sides of the workspace [not guarded as provided in condition (1)] with the operator between.

V. Electrical Arc

An arc flash occurs when a vast amount of concentrated radiant energy explodes outwards from electrical equipment creating a high-intensity flash that can damage eyesight, may damage hearing, and send damage equipment or objects through the air. A ball of gas may severely burn a worker's body and melt metals.

A. Definitions

Arc Flash Hazard: A dangerous condition associated with the possible release of energy caused by an electric arc.

Arc Flash Hazard Analysis: A study investigating a workers potential exposure to arc-flash energy, conducted for the purpose of injury prevention and the determination of safe work practices, arc flash protection boundary, and the appropriate levels of PPE.

Boundary, Arc Flash Protection: When an arc flash hazard exists, an approach limit at a distance from prospective arc source within which a person could receive a second degree burn if an electrical arc flash were to occur.

Deenergized: Free from any electrical connection to a source of potential difference and from electrical charge; not having a potential different from that of the earth.

Electrical Hazard: A dangerous condition such that contact or equipment failure can result in electric shock, arc flash burn, thermal burn, or blast.

Energized: Electrically connected to, or is, a source of voltage.

Shock Hazard: A dangerous condition associated with the possible release of energy caused by contact or approach to energized electrical conductors or circuit parts.

B. Flash Hazard Analysis

The NFPA 70E requires facilities to perform flash hazard analysis before workers are allowed to work with energized equipment. A flash hazard analysis shall be done by a qualified consultant or authorized employee in order to protect personnel from the possibility of being injured by an arc flash. The analysis shall determine the Flash Protection Boundary and the personal protective equipment that people within the Flash Protection Boundary shall use.

C. Flash Protection Boundary

For systems that are 600 volts or less, the Flash Protection Boundary shall be 4.0 ft, based on the product of clearing times of 2 cycles (0.033 second) and the available bolted fault current of 50 kA or any combination not exceeding 100 kA cycles (1667 ampere seconds). For clearing times and bolted fault currents other than 100 kA cycles, or under engineering supervision, the Flash Protection Boundary shall be calculated based on this formula:

$$D_c = [2.65 \times MVA_{bf} \times t]^{\frac{1}{2}}$$

or

$$D_c = [53 \times MVA \times t]^{\frac{1}{2}}$$

- **D_c** = distance in feet from an arc source for a curable burn
- **MVA_{bf}** = bolted fault Mega Volt Amps at point involved
- **MVA** = rating of transformer. (For transformers with MVA ratings below 0.75 MVA, multiply the transformer MVA rating by 1.25.)
- **t** = time of arc exposure (in seconds).

At voltage levels above 600 volts, the Flash Protection Boundary is the distance at which the incident energy equals 5 J/cm^2(1.2 cal/cm^2). For situations where fault clearing time is equal to or less than 0.1 sec, the Flash Protection Boundary is the distance at which the incident energy level equals 6.24 J/cm^2(1.5 cal/cm^2).

***Note**: J/cm^2 describes the units of energy, given in Joules, per square centimeter, cal/cm^2 describes the units of incident energy that the PPE can withstand and expressed in calories per cubic centimeter squared*

Refer to the NFPA 70E, Standard for Electrical Safety in the Workplace T130.2(C)-Approach Boundaries to Energized Electrical Conductors for additional approach boundary information.

D. Personal Protective Equipment

In accordance with the NFPA 70E, employees working in areas where electrical hazards are present shall be provided with, and shall use, protective equipment that is designed and constructed for the specific part of the body to be protected and for the work to be perform.

Protective equipment shall be maintained in a safe, reliable condition. Protective equipment shall be visually inspected before each use and shall be stored in a manner to prevent damage from physically damaging conditions and from moisture, dust and other deteriorating agents. When an employee is working within the Flash Protection Boundary he/she shall wear protective clothing and other personal protective equipment.

Movement and Visibility

- When flame-resistant (FR) clothing is worn to protect an employee, it shall cover all ignitable clothing and shall allow for movement and visibility.

Head, Face, Neck, and Chin (Head Area) Protection

- Employees shall wear nonconductive head protection wherever there is a danger of head injury from electric shock or burns due to contact with energized electrical conductors or circuit parts or from flying objects resulting from electrical explosion.

- Employees shall wear nonconductive protective equipment for the face, neck, and chin whenever there is a danger of injury from exposure to electric arcs or flashes or from flying objects resulting from electrical explosion. If employees use hairnets and/or beard nets, these items must be non-melting and flame resistant.

Face Protection

- Face shields shall have an arc rating suitable for the arc flash exposure. Face shields without an arc rating shall not be used.

- Face shields made with energy-absorbing formulations that can provide higher levels of protection from the radiant energy of an arc flash are available, but these shields are tinted and can reduce visual acuity and color perception. Additional illumination of the task area might be necessary when these types of arc protective face shields are used.

Eye Protection

- Employees shall wear protective equipment for the eyes whenever there is danger of injury from electric arcs, flashes, or from flying objects resulting from electrical explosion.

- Eye protection (safety glasses or goggles) shall always be worn under face shields or hoods.

Body Protection

- Employees shall wear FR clothing wherever there is possible exposure to an electric arc flash above the threshold incident-energy level for a second-degree burn, 5 J/cm^2 (1.2 cal/cm^2).

- Such clothing can be provided as an arc flash suit jacket and arc flash suit pants, shirt and pants or as coveralls, or a combination of jacket and pants or for increased protection, as coveralls with jacket and pants. Various weight fabrics are available.

- The higher degree of protection is provided by heavier weight fabrics and/or by layering combinations of one or more layers of FR clothing. In some cases one or more layers of FR clothing are worn over flammable, non-melting clothing.

Arc Flash Suits

- Arc Flash suit design shall permit easy and rapid removal by the wearer. The entire flash suit, including the hood's face shield, shall have an arc rating that is suitable for the arc flash exposure.

- When exterior air is supplied into the hood, the air hoses and pump housing shall be either covered by FR materials or constructed of non-melting and nonflammable materials.

Hand and Arm Protection

- Employees shall wear rubber insulating gloves with leather protectors where there is danger of hand and arm injury from electric shock due to contact with energized electrical conductors or circuit parts.

- Employees shall wear rubber insulating gloves with leather protectors and rubber insulating sleeves where there is a danger of hand and arm injury from electric shock due to contact with energized electrical conductors or circuit parts. Rubber insulating gloves shall be rated for the voltage for which the gloves will be exposed.

Hand Protection

- Leather or FR gloves shall be worn where required for arc flash protection. Where insulating rubber gloves are used for shock protection, leather protectors shall be worn over the rubber gloves.

Foot and Leg Protection

- Where insulated footwear is used as protection against step and touch potential, dielectric overshoes shall be required. Insulated soles shall not be used as primary electrical protection.

- Heavy-duty leather work shoes provide some arc flash protection to the feet and shall be used in all tasks in Hazard/Risk Category 2 and higher and in all exposures greater than 4 cal/cm^2.

Refer to Appendix B for Table 130.7(C)(10) Protective Clothing and Personal Protective Equipment (PPE)

E. Training Requirements

The training requirements apply to employees who face a risk of electrical hazard that is not reduced to a safe level by the applicable electrical installation requirements. Employees shall be trained to understand the specific hazards associated with electrical energy. Employees shall be trained in safety-related work practices and procedural requirements as necessary to provide protection from the electrical hazards associated with their respective job or task assignment, and be able to identify and understand the relationship between electrical hazards and possible injury.

(1) Training

- The training shall be classroom or on-the-job type training as required by the NFPA 70E.

- Employees exposed to shock hazards shall be trained in methods of release of victims from contact with exposed energized electrical conductors or circuit parts.

- Employees shall be regularly instructed in methods of first aid and emergency procedures such as approved methods of resuscitation.

(2) Retraining

Employees must receive additional training or retraining under any of the following conditions:

- If the supervision or annual inspections indicate that the employee is not complying with the safety-related work practices.

- If new technology, new types of equipment, or changes in procedures necessitate the use of safety-related work practices that are different from those that the employee would normally use.

- If he or she must employ safety-related work practices that are not normally used during his or her job duties.

- Annual refresher training must supplement the initial training.

(3) Training Documentation

- The employer shall document that each employee has received proper training.

- This documentation, including name and dates of training, shall be made when the employee demonstrates proficiency in the work practices involved and shall be maintained for the duration of the employee's employment.

VI. Electrical Emergency Response

The following instructions provide guidelines for handling two types of electrical emergencies:

A. Electric Shock Emergency

When someone suffers serious electrical shock, he or she may be knocked unconscious. If the victim is still in contact with the electrical current, immediately turn off the electrical power source. If the power source cannot be disconnected, try to separate the victim from the power source with a non-conductive object, (such as a wood handled broom).

Important: *Do not touch a victim that is still in contact with a power source; you could electrocute yourself.*

Call 911 for emergency medical assistance immediately. Administer first-aid, as appropriate, once the individual is free from the live power source.

B. Electrical Fire Emergency

If an electrical fire occurs, try to disconnect the electrical power source, if possible. Call 911. If the fire is small, you are not in immediate danger, and you

have been trained in fire extinguisher use, use a type C fire extinguisher to extinguish the fire.

Important: *Do not use water on an electrical fire.*

Appendices

Appendix A—Lockout/Tagout Checklist

INSPECTION CHECKLIST FOR CONTROL OF HAZARDOUS ENERGY			
Employee Name:			
Equipment:		Date:	
Procedure:		Location:	
Hazardous Energies Involved: a) Electrical Voltage:____ b) Chemical c) Pressure (pneumatic/hydraulic) d) Vacuum e) Thermal: High Temp:_____ Cyrogenics:_____		f) Ionizing Radiation g) Non-Ionizing Radiation: Ultraviolet____ Infrared____ RF/Microwave____ Laser____ Magnetic Fields____ h) Stored i) Mechanical	

Procedural Steps	YES	NO	Comments
TO LOCK OUT THE EQUIPMENT			
1. Notified affected employees and/or outside contractors of LOTO.			
2. Identified all power disconnect points:_____			
3. Stopped or powered down equipment.			
4. Isolated equipment from all hazardous energies sources. Number of isolation points:____			
5. Applied LOTO device(s) energy isolating device locked in OFF position.			
6. Attached LOTO Tag to Lock.			
7. Dissipated, drained, or safely released stored or residual energy.			
8. Blocked mechanical parts or removed mechanical links.			
9. Attempted to re-start machinery or re-energize equipment through normal means. Returned switch to OFF position.			
10. Verified no hazardous energies present or isolated. Identify test equipment/meters.			
TO RE-ENERGIZE THE EQUIPMENT			
1. Inspected work zone to ensure it is clear of equipment, workers, tools and test equipment.			
2. Unlocked and removed any blocking devices and replaced mechanical linkages.			
3. Repositioned safety valve(s) left open to prevent re-buildup of pressure.			
4. Checked all guarding and safety controls properly replaced.			
5. Warned workers to stay clear of area.			
6. Removed all locks and tags from energy control points.			

7. Verified area clear of personnel.			
8. Restarted/re-energized equipment.			
9. Notified Affected Employees and/or contractors LOTO completed.			

Appendix B—Hazard and Risk Personal Protective Equipment Matrix

Table 130.7(C)(10) Protective Clothing and Personal Protective Equipment (PPE)	
Hazard/Risk Category	**Protective Clothing and PPE**
Hazard/Risk Category 0 Protective Clothing, Nonmelting (according to ASTM F 1506-00) or Untreated Natural Fiber FR Protective Equipment	 Shirt (long sleeve) Pants (long) Safety glasses or safety goggles (SR) Hearing protection (ear canal inserts) Leather gloves (AN) Note 2
Hazard/Risk Category 1 FR Clothing, Minimum Arc Rating of 4 (Note 1) FR Protective Equipment	 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) Hard hat Safety glasses or safety goggles (SR) Hearing protection (ear canal inserts) Leather gloves (Note 2) Leather work shoes (AN)
Hazard/Risk Category 2 FR Clothing, Minimum Arc Rating of 8 (Note 1) FR Protective Equipment	 Arc-rated long-sleeve shirt (Note 5) Arc-rated pants (Note 5) Arc-rated coverall (Note 6) Arc-rated face shield or arc flash suit hood (Note 7) Arc rated jacket, parka, or rainwear (AN) Hard hat Safety glasses or safety goggles (SR) Hearing protection (ear canal inserts) Leather gloves (Note 2) Leather work shoes
Hazard/Risk Category 2* FR Clothing, Minimum Arc Rating of 8 (Note 1) FR Protective Equipment	 Arc-rated long-sleeve shirt (Note 5) Arc-rated pants (Note 5) Arc-rated coverall (Note 6) Arc-rated face shield or arc flash suit hood (Note 10) Arc rated jacket, parka, or rainwear (AN) Hard hat Safety glasses or safety goggles (SR) Hearing protection (ear canal inserts) Leather gloves (Note 2) Leather work shoes

Table 130.7(C)(10) *Continued*	
Hazard/Risk Category 3	
FR Clothing, Minimum Arc Rating of 25 (Note 1)	Arc-rated long-sleeve shirt (AR) (Note 8) Arc-rated pants (AR) (Note 8) Arc-rated coverall (AR) (Note 8) Arc-rated flash suit jacket (Note 8) Arc-rated flash suit pants (Note 8) Arc-rated flash suit hood (Note 8) Arc rated jacket, parka, or rainwear (AN)
FR Protective Equipment	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
Hazard/Risk Category 4	
FR Clothing, Minimum Arc Rating of 40 (Note 1)	Arc-rated long-sleeve shirt (AR) (Note 9) Arc-rated pants (AR) (Note 9) Arc-rated coverall (AR) (Note 9) Arc-rated flash suit jacket (Note 9) Arc-rated flash suit pants (Note 9) Arc-rated flash suit hood (Note 9) Arc rated jacket, parka, or rainwear (AN)
FR Protective Equipment	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

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/cm^2.
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 requirement.
3. The FR shirt and pants used for Hazard/Risk Category 1 shall have a minimum arc rating of 4.
4. Alternate 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.
8. 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.
9. 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.

10. 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.