

ARKANSAS TECH UNIVERSITY
HEALTH & SAFETY POLICY

ENERGY CONTROL/ ELECTRICAL SAFETY

Electricity is a serious work place hazard, capable of causing both employee injury (shocks, electrocution, fires and explosions) as well as serious property damage. By providing maintenance and electrical personnel with the proper training in safe electrical work practices and the proper tools, the Facilities Management Group hopes to reduce the risk of such incidents.

This policy applies to any Facilities Management employee who will work on or near electrical wiring, installing electrical conductors and equipment and installation of any cables near or with electrical wiring.

To establish electrical safety requirements for work on or near (within the limited approach and flash protection boundary) of exposed energized equipment, this policy includes but is not limited to:

1. Selection and use of work practices
2. Personal protective equipment requirements
3. Inspection requirements of electrical protective devices such as insulated gloves, blankets, sleeves, mats, line hoses ,or other approved insulating materials
4. Appropriate FR apparel/ protective clothing requirements
5. Temporary protective grounding requirements

ASSIGNMENT OF RESPONSIBILITIES

Supervisors shall be responsible for the following:

1. Anticipate all work hazards and utilize all safeguards as necessary.
2. Ensure that all employees are properly trained, instructed in the safe operation of electrical equipment and are aware of all hazards associated with the use of these electrical devices.
3. Request assistance from the Site Safety Coordinator on equipment and devices, which requires unique safety practice instruction/ training.
4. Review qualified employees to ensure they are capable of handling their specific job duties.
5. Ensuring that all new electrical equipment and components comply with codes and regulations.

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Employees shall be responsible for the following:

1. Follow Arkansas Tech Universities electrical safety policies/procedures and instructions of the responsible supervisor.
2. Bring to the attention of their supervisor and/or the Site Safety Coordinator potentially hazardous situations such as discrepancies between instruction, procedures, policies and manual, faulty equipment, misapplication of device, etc.
3. Recognize that malfunctioning electrical equipment must be repaired or replaced before use. The repair must be initiated as soon as possible after the malfunction is noted.
4. Employees must inspect all equipment prior to use for defects, unsafe conditions, or other hazards associated with using the equipment.

The Occupational Safety coordinator shall be responsible for the following:

1. Provide technical assistance in defining hazardous operations, designating safe practices and selecting proper devices.
2. In coordination with Facilities Services and other supervisors, review and approve standard operating procedures upon request.
3. Evaluate potential electrical hazards during facility inspections to ensure compliance with existing policy and other safety guidelines.
4. Support employees training relative to electrical safety.
5. Develop and revise the Arkansas Tech University electrical safety policy periodically, or when regulatory changes occur.

INITIAL TRAINING

Training must cover avoiding electrical hazards associated with work inside shock approach and arc flash boundaries of exposed energized parts.

Initial training is to include but not limited to:

1. Universal electrical safety practices and procedures for doing energized electrical work
2. Employer and employee awareness of electricity's hazardous effects of on the human body
3. Lockout/tagout training and safe work practices required to safely de-energize electrical equipment
4. Hazards associated with power electronic equipment
5. Avoid the electrical hazards associated with work inside shock approach and arc flash boundaries of exposed energized parts
6. Use arc flash analysis labels or the following *NFPA 70E* tables to determine hazards, risks and appropriate protective clothing and equipment requirements
7. Determine the approach distances corresponding to the voltages specified in the following *NFPA 70E* guidelines:

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- a) Approach Boundaries to Energized Electrical Conductors or Circuit Parts for Shock Protection for Alternating-Current Systems
 - b) Approach Boundaries to Energized Electrical Conductors or Circuit Parts for Shock Protection, Direct-Current Voltage Systems
8. Skills and techniques necessary to (or how to):
- a) Distinguish exposed live parts from other parts of electric equipment
 - b) Determine the nominal voltage of exposed live parts
 - c) Understand how read to use the National Fire Protection Association (NFPA) 70E Tables
9. Recognize the signs and symptoms of electric shock, heart fibrillation, electric burns and contacting emergency personnel at 911.

RE-TRAINING

Mandatory retraining (or refresher) training is required a minimum of every three (3) years or when conditions change. The interval between retraining shall not exceed 36 months.

In addition, an employee must receive additional training (or retraining) when any of the following conditions are met:

1. Supervision or annual inspections indicate that the employee is not complying with the established safety-related work practices
2. Safety-related work practices not normally used during regular job duties are employed
3. New technology, new types of equipment, or changes in procedures require using safety-related work practices that differ from those normally used

QUALIFIED EMPLOYEE VS. UNQUALIFIED

A qualified employee is defined as a worker that has demonstrated skills and knowledge related to the construction and operation of electrical equipment and installations and has received safety training to identify and avoid the hazards involved. Qualified employees are the only ones designated with permission to:

1. Work on or near exposed electrical parts or equipment > 50 volts.
2. Test exposed electrical currents and equipment.
3. Must be able to identify arc flash approach boundaries

An unqualified employee is defined as any worker without knowledge of or not trained to perform the task. This includes the following workers:

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1. Employees who use power tools, perform services of equipment and machines or perform maintenance or repair functions on electrical equipment.
2. Employees who are close enough to parts of electrical circuits or equipment that is > 50 volts.

QUALIFIED EMPLOYEE TRAINING REQUIREMENTS

Training must be performed before the employee is assigned duties involving work around or on electrical systems. A qualified observer must record that the “qualified employee” has demonstrated that they can perform all required skills. This training may consist of but not limited to:

1. Medical services and first aid and rescue equipment
2. Must be trained on the specific equipment they will work with.
3. Lockout/Tagout
4. Know what personal protective equipment to wear and understand flash protection boundaries.
5. Can distinguish exposed energized parts from other parts of electrical equipment.
6. Determining the nominal voltage of exposed energized parts
7. Understand the specific hazards associated with electrical energy.
8. Acceptable Approach distances

Retraining will be performed whenever inspections performed by the employee’s supervisor or Safety Coordinator indicate that an employee does not have the necessary knowledge or skills to safely work on or around electrical systems. Retraining will also be performed when policies or procedures change and/or new equipment or systems are introduced into the work area.

PPE REQUIREMENTS

PPE use is mandatory when contact with exposed electrical sources is likely. PPE levels will be determined by the voltage that the employee will be exposed to.

PPE requirements can also be found in the NFPA 70E manual 130.7(C) (14).

PPE must consist of the following, but not limited to:

1. Electrically rated safety shoes must be worn.
2. Flame retardant (FR) clothing must be worn with all cotton undergarments.
3. Lineman’s gloves should be worn and must include an air test inspection before each use. Gloves should conform to ASTM standards based upon the voltage protection required. Protector gloves can be worn over the lineman’s gloves when needed for flash protection.
4. Face shields with arc rating exposures must be worn.
5. Hard hats with arc rating exposure must be worn.
6. Safety glasses must always be worn under face shields and hoods.
7. Flash suits should be worn in extreme high voltage situations (>1 kV).

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8. Appropriate hearing protection must be worn when working on live electrical circuits.

Below is an example of how to determine what PPE is required for the work you will be performing.

Electrical Personal Protective Equipment Chart <small>NFPA 70E 2012 Table 130.7 (C)(16) Protective Clothing & Personal Protective Equipment (PPE)</small> <small>*For More Detailed Information or Other Options Refer to NFPA 70E 2012 Edition, Table 130.7 (C)(16)</small>		
Hazard/Risk Category 0	Untreated natural fiber Shirt (long sleeve) Pants (long) Safety glasses Hearing protection Heavy duty Leather gloves (as needed)	
Hazard/Risk Category 1 4 cal/cm ²	Arc-rated long-sleeve shirt Arc-rated pants or coverall Arc-rated face shield with hard hat Safety glasses Hearing protection Leather & voltage rated gloves (as needed) Leather work shoes	
Hazard/Risk Category 2 8 cal/cm ²	Arc-rated long-sleeve shirt Arc-rated pants or coverall <small>(New 2012)</small> Arc-rated face shield & balaclava or arc flash suit hood with hard hat Safety glasses, Hearing protection Leather & voltage rated gloves (as needed) Leather work shoes	
Hazard/Risk Category 3 25 cal/cm ²	Arc-rated long-sleeve jacket Arc-rated pants Arc-rated flash hood with hard hat Safety glasses, Hearing protection Leather & voltage rated gloves (as needed) Leather work shoes	
Hazard/Risk Category 4 40 cal/cm ²	Arc-rated long-sleeve jacket Arc-rated pants Arc-rated flash hood with hard hat Safety glasses, Hearing protection Leather & voltage rated gloves (as needed) Leather work shoes	

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DRESS CODE REQUIREMENTS

Employees who deal with 50 volts or higher shall be required to follow the following dress code requirements:

1. Flame retardant work outfits shall be worn by employees who are potentially exposed to high-energy areas capable of igniting clothing as per NFPA 70E. These should consist of an outer layer of FR and an under layer of cotton materials.
 - a) The FR outfits shall be provided by the University at no cost to the employee.
 - b) Any outfit or garment above the normal FR outfit will be provided by the University once a task has been determined to require additional electrical/ arc flash protection.
2. Do not wear clothes that are so tight that they restrict your freedom of movement, or so loose that they get caught in equipment. Before starting work, button shirts, cuffs and remove neckties.
3. Employees should not wear conductive articles of clothing or jewelry (i.e. rings, watches, earrings, necklaces, electronic devices, key chains, etc...).
4. If you have long hair or facial hair, it must be tied up or restrained in some fashion as to not pose a hazard.
5. Electrically rated safety shoes cannot be steel toe when working around live, exposed electrical equipment.
 - a) The electrically rated footwear shall be provided by the University at no cost to the employee.
 - b) The employee will be provided with one pair of electrically rated safety shoes per year.
 - c) The employee will be required to sign a form stating they understand the requirements of the University purchasing the electrically rated safety shoes.

(REFER TO ELECTRICAL SAFETY SHOE PROGRAM)

(REFER TO ELECTRICAL FR CLOTHING REQUIREMENT FORM)

HAZARD IDENTIFICATION AND HAZARD ASSESSMENT

Before any work, including testing and troubleshooting can take place an electrical hazard assessment and risk assessment must be done.

The hazard assessment includes identifying the following:

1. Shock, arc flash, and arc blast hazards
2. Non-electrical hazards (e.g. falls, confined space, chemical, biological, radiation, and environmental hazards)
3. Means of mitigating hazards through engineering controls, administrative controls, and PPE
4. If an energized electrical work permit is required

(REFER TO APPENDIX N-1: HAZARD ASSESSMENT FOR ELECTRICAL WORK)

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GENERAL PRE-CAUTIONS

1. Two people should always be present during electrical operations, and one of those people should be trained in emergency procedures (first aid/CPR).
2. Follow the one hand rule when working on live circuits, if possible.
3. Treat all exposed wiring and electrical parts as potentially live until it has been checked with a meter.
4. Make sure area you are working in is properly illuminated before working on exposed wires. Do not reach into blind areas.
5. All ladders used near exposed energized sources must have non-conductive side rails and must be clean (free of oil, grease or contamination that would cause it to be conductive).
6. Never work around a source of electricity when you are wet, it is raining, or your surroundings, tools or clothes are wet. Keep a towel handy for drying your hands and change your clothes if they become wet.
7. All housekeeping duties should not be performed close to live parts, unless adequate safeguards are provided. Electrically conductive cleaning materials, such as steel wool, should not be used near energized parts.
8. Where flammable or ignitable materials are present, do not use electric equipment capable of igniting them unless measures are taken to prevent hazardous conditions from developing.
9. Worker must determine the fault current prior to beginning work.

EQUIPMENT INSPECTION REQUIREMENTS

Employees should inspect all electrical equipment for hazards that could cause employee injury or death. Consider the following factors when determining the safety of the equipment:

1. Suitability for the intended use
2. Proper insulation
3. Heating effects under conditions of use
4. Arcing effects
5. Classification by size, type, voltage, current capacity and intended use
6. Could the equipment have stored energy, hydraulic hazards, spring loaded dangers, etc.

INSULATING MATERIALS AND TOOLS

Employees must use insulated tools and handling equipment rated for the voltages encountered when working inside the limited approach boundary and restricted approach boundary near exposed energized circuits, conductors, or parts.

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Insulated tools must be designed and constructed to meet the demands of use and the environment to which they are exposed. Insulating equipment made of materials other than rubber shall provide electrical and mechanical protection at least equal to that of rubber equipment.

If the insulating capability of protective equipment is subject to damage during use, the insulating material must be protected by an outer covering of leather or other appropriate material.

Insulating rubber equipment such as gloves, sleeves, blankets, and matting must be stored in an area protected from light, temperature extremes, excessive humidity, ozone, and other substances and conditions that may cause damage. In addition to being tested according to the schedule supplied by the manufacturer, rubber insulated equipment must be:

1. Inspected for damage before each day's use
2. Air tested before each use
3. Inspected immediately following any incident that could have caused damage
4. Dielectrically tested within 6 months of first use or 1 year of purchase if not used (rubber gloves used without the leather protectors must be removed from service until dielectrically tested)

Rubber insulated equipment found to have defects that might affect its insulating properties must be removed from service until testing indicates that it is acceptable for continued use. Do not attempt to repair defective rubber insulated equipment.

Fuse handling equipment insulated for the circuit voltage shall be used to remove or install a fuse if the terminals are energized. Ropes and hand-lines used near exposed energized parts shall be nonconductive and portable ladders used for electrical work shall have nonconductive side rails. Tools and handling equipment should be replaced if the insulating capability is decreased due to damage.

ELECTRICAL EQUIPMENT LABELING

Switchboards, panel boards, industrial control panels, motor control centers, disconnects and any other equipment posing an arc flash hazard will be field marked (labeled) to warn workers of potential electric arc flash hazards.

When arc flash and shock data are available for industrial control panels, labels shall include:

1. Information on arc flash hazard boundary
2. The hazard category,
3. Required PPE
4. Minimum arc rating
5. Limited approach distances
6. Restricted approach distances and prohibited approach distances

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Labeling is intended to reduce the occurrence of serious injury or death due to arcing faults to workers working on or near energized electrical equipment. Labels shall be located so they are visible to the personnel before examination, adjustment, servicing, or maintenance of the equipment.

Below are examples of some appropriate labels. These are merely examples and do not represent the labels on our campus:

⚠ WARNING



10-05-2011

Arc Flash and Shock Hazard
Appropriate PPE Required

Arc Flash Hazard Boundary	0.7 ft
Incident Energy (cal/cm ²)	0.2
Working Distance	18.0 in

Hazard Category 0

Non-melting or untreated natural fiber long-sleeve shirt, long pants, safety glasses, hearing protection, and leather gloves

Shock Hazard Exposure	208 V
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Shock Hazard when covers removed

Limited Approach	3.5 ft Class 00
Restricted Approach	1.0 ft Insulating Gloves
Prohibited Approach	0.1 ft V-rating 500 VAC

Equipment Name _____
Source Protective Device **CB_LDP_28**
Equipment **MACHINE**

⚠ DANGER

Arc Flash & Shock Hazard
Appropriate PPE Required

Flash Hazard Category _____	Flash Protection Boundary _____
Min. Arc Rating (cal/cm ²) _____	Limited Approach Boundary _____
VAC Shock Hazard When: _____	Restricted Approach Boundary _____
	Prohibited Approach Boundary _____

FLASH PPE	<input type="checkbox"/> FR shirt	<input type="checkbox"/> Hard hat	<input type="checkbox"/> Leather gloves
<input type="checkbox"/> Cotton underwear	<input type="checkbox"/> FR pants	<input type="checkbox"/> Face shield	<input type="checkbox"/> Leather shoes
<input type="checkbox"/> T-shirt	<input type="checkbox"/> FR coveralls	<input type="checkbox"/> Ear protection	<input type="checkbox"/> V-rating _____
<input type="checkbox"/> Long-sleeve shirt	<input type="checkbox"/> Flash suit	<input type="checkbox"/> Safety glasses	<input type="checkbox"/>
<input type="checkbox"/> Long pants	<input type="checkbox"/> Flash hood	<input type="checkbox"/> Safety goggles	<input type="checkbox"/>

SHOCK PPE
 Class _____

Equipment ID: _____

⚠ WARNING

Arc Flash & Shock Hazard
Appropriate PPE Required

Flash Protection Flash Hazard Category 1 Incident Energy 2.8 (cal/cm ²) Flash Protection Boundary 30 inches Glove Class 00 PPE REQUIRED CAT.1 OR 2 FR SHIRT & PANTS, AR FACE SHIELD, SAFETY GLASSES, LEATHER GLOVES, EAR PLUGS	Shock Protection 480 VAC Shock Hazard When Cover is Removed Limited Approach Boundary 42 inches Restricted Approach Boundary 12 inches Prohibited Approach Boundary 1 inch <small>*Warning: Changes in equipment settings or system configuration will invalidate the calculated values and PPE requirements. Review every 5 yrs.</small>
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Bus Name: CLKR-CLR-EF Prot: PD-CLKR-CLR February 4, 2010

⚠ DANGER





Arc Flash and Shock Hazard

Appropriate personal protection equipment (PPE) required prior to work on or near energized parts.

Failure to comply may result in shocks, burns, injury or death.

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EXTENSION CORD/GFCI SAFETY GUIDELINES

Extension cords provide a convenient method of bringing AC power to a device that is not located near a power source. They are also used as temporary power sources. As such, extension cords are heavily used. They are also often involved in electrical code and safety violations. Improper use of extension cords can lead to shock hazards. In addition, use of an undersized extension cord results in an overheated cord and insufficient voltage delivered to the device, thus causing device or cord failure and a fire hazard. Below are some guidelines to follow for extension cord safety:

1. Extension cords shall be inspected daily prior to use. Any cord found with damage such as exposed ungrounded metal parts, splices, or any other form of damage should be removed from service and tagged out of service immediately.
2. Flexible cords permitted for use must be No. 14 gauge or larger
3. Around construction sites, in damp areas, or in an area where a person may be in direct contact with a solidly grounded conductive object such as working in a wash bay, extension cords must be protected by a ground fault circuit interrupter (GFCI). The GFCI can consist of a special circuit breaker, a GFCI outlet, or an extension cord with a built-in GFCI.
4. Cords and leads running through doorways and/or other openings must be protected.
5. Extension cords must be three-conductor (grounded) even if the device has a two-conductor cord.
6. GFCI protection shall be utilized when power is supplied from permanent building receptacles. Protection shall be supplied via GFCI circuit breaker receptacle or “pigtail”. test and reset GFCI’s before each use.
7. Portable/vehicle mounted generators must be equipped with ground-fault receptacles (GFCI). Those not equipped with GFCI receptacles must utilize GFCI plug assemblies (pigtails) to provide power to all tools and equipment. Generators must be grounded in accordance with manufacturer’s recommendations.
8. Never yank cords from their receptacles
9. Never carry tools by their cords or hoses
10. Keep cords away from heat, oil, and sharp edges
11. Never remove the grounding prong to make the plug fit into a two-prong socket.

ELECTRICAL INSTALLATION REQUIREMENTS

The following practices are to be followed when installing electrical components or equipment:

1. Free from Recognized Hazards - Electrical equipment must be free from recognized hazards that are likely to cause death or serious physical harm. Equipment must be suitable for the installation and use, and must be installed and used in accordance with the National Electrical Code (NEC) and/or Occupational Safety and Health Administration (OSHA).

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2. Labeling of disconnects -each *disconnecting means*, must be clearly labeled to indicate the circuit's function unless it is located and arranged so the purpose is evident. Identification should be specific rather than general and all labels and marking must be durable enough to withstand the environment to which they may be exposed and must include nominal voltage being utilized by the device.
3. Energy from more than one source – motors and motor operated equipment with more than one source of power may have multiple disconnects. Where multiple *disconnecting means* are provided, a permanent warning sign shall be provided on or adjacent to each *disconnecting means*.
4. Guarding of Live Parts - Live parts of electric equipment operating at 50 volts or more must be guarded by use of an approved cabinet or in a room or vault that is accessible to *qualified employees* only.
5. Warning Signage – Entrances to rooms and other guarded locations that contain exposed live parts operating at 50 volts or more shall be marked with conspicuous warning signs forbidding *unqualified employees* to enter.

GENERAL WIRING DESIGN AND PROTECTION

New electrical wiring, and the modification, extension or replacement of existing wiring must conform to the requirements of NEC, the National Fire Protection Association (NFPA). To make sure all wiring is in compliance use the following:

1. No grounded conductor may be attached to any terminal or lead so as to reverse designated polarity.
2. The grounding terminal or grounding-type device on receptacles, cord connector, or attachment plug may not be used for any purpose other than grounding.
3. Conductors and equipment must be protected from overcurrent above their listed current carrying capacity.
4. All alternating current systems of 50 to 1,000 volts must normally be grounded as required by the NEC and OSHA. The path to ground from circuits, equipment and enclosures must be permanent and continuous.
5. Conductors entering boxes, cabinets or fittings must be protected from abrasion, and openings through which conductors enter must be effectively closed.
6. All pull boxes, junction boxes and fittings must be provided with covers approved for the purpose. If metal covers are used they must be grounded. In completed installations, each outlet box must have a cover, faceplate or fixture canopy.
7. Switchboards and panel boards that have exposed live parts must be located in permanently dry locations and accessible to *qualified employees* only. Panel boards must be mounted in cabinets, cutout boxes or other approved enclosures, and must be *dead front* unless accessible to *qualified employees* only. Receptacles installed in damp or wet locations must be suitable for the location.
8. Fixtures, lamp holders, lamps, rosettes, and receptacles may have no live parts normally exposed to employee contact.

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9. Cabinets, cutout boxes, fittings, boxes and panel board enclosures in damp or wet locations must be installed to prevent moisture or water from entering and accumulating within the enclosure. In wet locations the enclosures must be weatherproof.
10. Multi-plug receptacle adapters may not maintain ground continuity or may overload circuits and must not be used. If additional receptacles are needed in a work location, additional circuits and/or receptacles must be installed.
11. Electrical equipment, wiring methods and installations of equipment in hazardous classified locations must be intrinsically safe, approved for the location, or safe for the location.

APPROACH DISTANCES TO ENERGIZED PARTS

NFPA 70E defines four (4) boundaries for electrical work. Three (3) boundaries are approach distances related to shock hazards and the fourth boundary is related to arc flash protection.

LIMITED APPROACH BOUNDARY

The following are guidelines pertaining to *unqualified person* near the limited approach boundary:

1. No *unqualified person(s)* should be allowed to approach near the limited approach boundary of energized conductors and circuit parts.
2. Where one or more *unqualified person(s)* are working at or close to the limited approach boundary, the designated person in charge of the work space where the electrical hazard exists shall advise the *unqualified person(s)* of the electrical hazard and warn him or her to stay outside of the limited approach boundary.
3. Where there is a need for an *unqualified person(s)* to cross the limited approach boundary, a *qualified person* shall advise him or her of the possible hazards and continuously escort the *unqualified person(s)* while inside the limited approach boundary. Under no circumstance shall the escorted *unqualified person(s)* be permitted to cross the restricted approach boundary.

RESTRICTED APPROACH BOUNDARY

Within the restricted approach boundary, only *qualified persons* with proper PPE and tools may cross. Inside this boundary, accidental movement can put a part of the body or conductive tools in contact with live parts or inside the prohibited approach boundary. To cross the restricted approach boundary, the *qualified person* must:

1. Perform hazard identification and risk assessment
2. Have an energized work permit that is approved by the supervisor when performing work beyond testing and trouble shooting

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3. Use PPE rated for working near exposed energized parts and rated for the voltage and energy level involved
4. Ensure that no part of the body enters the prohibited space
5. Minimize risks from unintended movement by keeping as much of the body as possible out of the restricted space (body parts in the restricted space should be protected)
6. No *unqualified person* shall be allowed in the restricted approach boundary area if electrical equipment is energized.

PROHIBITED APPROACH BOUNDARY/ARC FLASH BOUNDARY

Within the prohibited approach boundary, also known as the arc flash boundary, body parts may not cross the prohibited approach boundary, only insulated tools and testing equipment.

Approaching any closer is comparable to making direct contact with an exposed energized electrical conductor or circuit part. The *qualified person(s)* must:

1. Have specified training to work on exposed energized electrical conductor or circuit part
2. Have an energized work permit with proper written work procedures and justifying the need to work that close.
3. Perform hazard identification and risk assessment.
4. Have (2) and (3) approved by the appropriate supervisor.
5. Use PPE appropriate for working near exposed energized parts and rated for the voltage and energy level involved.

A *qualified person* can use the arc flash analysis label to determine the arc flash hazard if an arc flash analysis has been performed.

ENERGIZED ELECTRICAL SYSTEMS

Live parts to which an employee may be exposed will be de-energized, using approved *lockout/tagout* procedures, before the employee works on or near them.

For work on all energized systems over 50 volts, an *energized electrical work permit* will need to be filled out by the employee requesting to work on the equipment and will need to be reviewed and approved by the Occupational Safety Coordinator and the employee's supervisor or the Director of Facilities Management prior to performing the work. An energized electrical work permit may be obtained from the safety office or from the online health and safety manual.

(REFER TO ENERGIZED ELECTRICAL WORK PERMIT)

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The following are a list of circumstances that are approved “exemptions” to the electrical work order permit requirement:

1. Work is performed on or near live parts by *qualified employees* related to tasks such as testing, trouble- shooting, voltage measuring, etc., provided **appropriate safe work practices** and **personal protective equipment** are used or, the live parts operate at less than 50 volts to ground and there is no increased exposure to electrical burns or to explosion due to electric arcs.
2. De-energizing introduces “additional or increased hazards.” (i.e. shutdown of critical fume hood ventilation systems)
3. De-energizing is not possible due to equipment design or operational limitations.
4. Thermography and visual inspections are observed without crossing the restricted approach boundary
5. General housekeeping and miscellaneous non-electrical tasks if the restricted approach boundary is not crossed.

Always have an observer trained in emergency shutdown and first aid. Follow the one hand rule when working on live circuits, if possible.

VERIFICATION OF DE-ENERGIZED ELECTRICAL SYSTEMS

The following requirements must be met before any circuit or equipment is considered de-energized or may be worked on as de-energized.

1. A *qualified employee* must activate the equipment operating controls or use other methods to verify that the equipment cannot be restarted.
2. A *qualified employee* must use test equipment to ensure that electrical parts and circuit elements are de-energized. The test must confirm there is no energized condition from induced voltage or voltage back-feed.
3. Test equipment and instruments must be visually inspected for external defects or damage before being used to verify that the equipment or circuit is de-energized.

RE-ENERGIZING ELECTRICAL SYSTEMS

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

1. If electrical jumpers, shorts, grounds or other such devices have been used as part of a lockout/tagout, a *qualified employee* must conduct tests and visual inspections as necessary to

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verify that all electrical jumpers, shorts, grounds and other such devices have been removed so that circuits and equipment can be safely energized

2. Employees potentially exposed to the hazards of re-energizing the circuit must be warned to stay clear; and each employee removes his or her own lock(s) and tag(s).

REFERENCES:

1. NFPA 70: National Electric Code
2. NFPA 70B: Electrical Equipment Maintenance
3. NFPA 70E: Standard for Electrical Safety in the Workplace
4. IEEE: Institute of Electrical and Electronic Engineers
5. (OSHA) Electrical Standard (29 CFR 1910.301)
6. America National Standards Institute (ANSI)
7. American Society of Testing and Materials (ASTM)
8. OSHA 1910 Subpart S "Electrical" (29 CFR 1910.301 – 29 CFR 1910.399)
9. Purdue University Control of Hazardous Energy Program