LIBERTY UNIVERSITY | ENVIRONMENTAL HEALTH & SAFETY

Liberty University Electrical Safety Program & Live Work Procedure

INTRODUCTION

Liberty University (LU) is committed to providing a safe and healthful work environment for our LU community. All employees, students, volunteers, and contractors working under direct LU supervision shall comply with all elements of the LU Electrical Safety Program and with all Federal, State, and Local Regulations. Additionally, any contractors working independently or through a general contractor on LU properties must comply with the LU Contractor Safety Program located on the EHS website under LU Contractor Safety.

I. PURPOSE & SCOPE

Purpose: The **Liberty University Electrical Safety Program and Live Work Procedure** will provide a safe and healthful work environment, free from hazardous energy, for all Liberty University (LU) employees, students, volunteers, and contractors working under direct and indirect LU supervision. This Program will establish a uniform set of electrical safety-related work practices to be utilized by all electrically responsible employees to prevent injuries from potential electrical hazards.

The Program further establishes the training requirements for “Qualified” and “Affected” (Unqualified) personnel who work on or near exposed energized and de-energized parts of electrical equipment. The Program covers all employees who face a risk of electrical shock, direct or indirect, that is not reduced to a safe level by general policy or proper electrical installation.

The Program complies with:

- The Occupational Safety and Health Administration (OSHA) Electrical Safety-Related Standards:
  - (29 CFR 1910 Subparts I, S and R)
  - (29 CFR 1926 Subparts E, K and V)
- The National Electric Safety Code (NESC)
- The National Fire Protection Association Standards:
  - (NFPA 70 National Electric Code (NEC)
  - (NFPA 70E Standard for Electrical Safety in the Workplace).

Scope: This Program is provided by Liberty University to ensure that employees are properly trained with respect to the hazards of Electrical work.

The provisions of this Program apply to all personnel at Liberty University on all Liberty Properties or on any property on which work is being conducted by the University. It is the policy of Liberty University to take every reasonable precaution to provide a work environment free from recognized hazards for its employees in accordance with the General Duty Clause per the OSH act Public Law 91-596 Section 5(a)(1) and in accordance with specific OSHA standards.

The Environmental Health and Safety Department is responsible for establishing and maintaining the Electrical Safety Program and Live Work Procedure. Appropriate Safety and Personal Protective Equipment (PPE) must be provided by the University when such equipment is necessary to protect the health and safety of the employee(s). The supervising department is responsible for acquiring such equipment from the Environmental Health & Safety Department or by purchasing through an outside vendor.

Refer to the LU EHS website under Policies, Programs & SOP’s for more information on this Program and associated Procedures.

Application

This standard operating procedure applies to Electrical Safety requirements for work on all Liberty University properties or work being performed by Liberty University employees regardless of jobsite location, including Procedures for potential Live Work.

II. PROGRAM RESPONSIBILITIES

A. Program Administrator

The LU Environmental Health and Safety Division (EHS) provides:

- Program oversight and consultation to LU departments.
- Training on the Electrical Safety Program in the associated hazards, general safe work practices, and program requirements.
- Guidance on maintenance of applicable records.
- Program reviews and updates, as necessary.
- Recommendations for Electrical Hazard mitigation during the building design process.

- Continual safety evaluations of work operations and enforcement of this Program. ********EHS staff are authorized to halt any unsafe work practice that is not in accordance* with this or any other LU Environmental Health and Safety Policy or Program where there is the potential for injury or death.**

B. Departmental Management

LU Departments are responsible for providing a safe work environment for their staff by following health and safety policies and procedures. LU Department supervisors are responsible for identifying any existing energy hazards and for identifying which employees require training prior to working near hazardous energy. LU Departments are expected to maintain a safe and healthy living, learning, and working environment for faculty, staff, students, and visitors to our campus. LU Departments should designate responsible persons to coordinate the requirements of this program with employees and ensure that adequate Lock-out devices and required PPE are provided and used. LU Departments must ensure that all personnel performing Electrical work have attended necessary training and are familiar with the requirements of this program and related programs, policies, and procedures.

C. Supervisors

LU Supervisors must identify and provide the necessary Electrical Safety equipment and PPE (Personal Protective Equipment) to their employees for working on or near hazardous Energy. The LU Supervisor shall be a Competent person, as defined by OSHA, or assign someone to be the competent person for the work group. OSHA defines a Competent person as:

- A person who can identify existing and predictable hazards in the surroundings or identifying working conditions which are hazardous or dangerous to employees and who has authorization to take prompt corrective measures to eliminate them.

Note: It is the responsibility of Supervisors and Department Managers to assure that all employees under their direction, which have the potential to work on, or encounter, energized equipment, or where there is a potential for the release of stored energy, read and understand this document.

D. Employees

The degree of exposure to electricity and the hazards it poses varies among employees, depending on their job assignment and work area. LU Employees who work near exposed energized conductors or circuit parts are expected to attend Electrical Safety training and to use work practices developed in accordance with this Program to prevent injuries that could result from the unexpected start-up of equipment or the release of stored energy. **Refresher training is required every three years**, or due to incident, observation of unsafe work practices, or where there are requirement updates or changes to operating guidelines.

E. Contractors

Contractors must comply with all local, state, and federal safety requirements, and assure that all their employees performing work on Liberty University properties have been suitably trained as Qualified Electrical Workers. If University employees will be present on the Contractor's worksite, and employees of either Liberty University and/or the Contractor will be performing work that requires the use of Lock-out/Tag-out devices, Electrical PPE or test

equipment, the work activities must be performed in accordance with the **Liberty University Contractor Safety Program.**

III. Definitions

Affected Employee: Responsible for following established LOTO and Electrical policy rules and directives. Responsible for assuring non-affected (or unauthorized) employees are aware of LOTO and Electrical procedures and are kept out of harm's way.

Amperage: Strength measurement of electrical current flow in amperes

Attendant: An employee assigned to remain immediately outside the entrance to an enclosed or other space/area to aid employees inside the space/area and to protect unqualified personnel from entry.

Authorized Employee: An Affected employee becomes an Authorized employee when that employee's duties include performing servicing or maintenance covered under this Program/ Procedure. An employee who locks or tags machines or equipment to perform servicing or maintenance. This Employee is Authorized to control their own individual Lock-out/Tag-out Procedure but may or may not be the designated Person in Charge of a Group Lock-out/Tag-out Procedure.

Barricade: A physical obstruction intended to prevent contact with energized lines or equipment, or to prevent unauthorized access to a work area.

Barrier: A physical obstruction intended to prevent contact with energized lines or equipment, or to prevent unauthorized access to a work area.

Bond: The electrical interconnection of conductive parts designed to maintain a common electrical potential.

Bus: A conductor or a group of conductors serving as a common connection for two or more circuits.

Bushing: An insulating structure, including a through conductor and a passageway for such a conductor, with provision for mounting on a barrier.

Cable: A conductor with insulation; a stranded conductor with or without insulation and other coverings (single-conductor cable); or a combination of conductors insulated from one another (multiple-conductor cable).

Cable Sheath: A conductive protective covering applied to cables.

Capable of being Electrically locked out: An energy-isolating device is considered capable of being locked out if it will accept a lockout device to prevent physical closing of the device.

Circuit: A conductor or system of conductors through which an electric current is intended to flow

Clearance (between objects): The clear distance between two objects measured surface to surface Clearance (for work). Authorization to perform specified work, or permission to enter a restricted area.

Conductance: The ability to allow current flow

Conductor: A material, usually in the form of a wire, cable, or bus bar, used for carrying an electric current.

Covered Conductor: A conductor covered with a dielectric having no rated insulating strength, or having a rated insulating strength less than the voltage of the circuit in which the conductor is used

Current-Carrying Part: A conducting part intended to be connected in an electric circuit to a source of voltage. Non-current-carrying parts are those not intended to be so connected.

De-Energized: Free from any electrical connection to a source of potential difference and from electric charge; and where possible, not having a potential different from that of the earth

Designated Employee: An employee who is assigned by the employer to perform specific duties under the terms of this section, and who is knowledgeable in the construction and operation of the equipment, and the hazards involved

Dielectrically Tested: Tested by high-voltage using laboratory water-based conductance methods

Energized (alive, live): An electrical circuit “having a potential difference from that of the earth" (OSHA) and "electrically connected to, or is a source of voltage" (NFPA 70E)

Energy Isolating Device: A physical device that prevents the transmission or release of energy, including, but not limited to, the following: a manually operated electric circuit breaker, a disconnect switch, a manually operated switch, a slide gate, a slip blind, a line valve, blocks, and any similar device with a visible indication of the position of the device. (Push buttons, selector switches, and other control-circuit-type devices are not energy isolating devices.)

Energy Source: Any electrical, mechanical, hydraulic, pneumatic, chemical, nuclear, thermal, or other energy source that could cause injury to personnel.

Exposed: Not isolated, guarded or shielded, able to be touched.

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

Grounded: Connected to earth or to some conducting body that serves in place of the earth

Grounded conductor: Neutral or Common wire (normally white or gray)

Grounding conductor: Earth grounding conductor (normally green, green striped or bare)

Guarded and/or Shielded: Covered, fenced, enclosed, or otherwise protected by means of suitable covers or casings, barrier rails or screens, mats, or platforms. Designed to minimize the possibility, under normal conditions, of accidental contact by persons or objects.

High-Power Tests: Tests in which fault-currents, load-currents, magnetizing-currents, and line-dropping currents are used to test equipment, either at the equipment’s rated voltage or at lower voltages

High-Voltage Test: Test in which voltages of approximately 1000 volts are used as a practical minimum and in which the voltage source has sufficient energy to cause injury

Insulated: Separated from other conducting surfaces by a dielectric (including air space) offering a high resistance to the passage of current

Insulation (cable): That which is relied upon to insulate the conductor from other conductors or conduction parts, or from ground

Lines:

1) Communications lines: The conductors and their supporting or containing structures which are used for public or private signal or communication service, and which operate at potentials not exceeding 400 volts to ground or 750 volts between any two points of the circuit, and the transmitted power of which does not exceed 150 watts. If the lines are operating at less than 150 volts, no limit is placed on the transmitted power of the system. Under certain conditions, communication cables may include communication circuits exceeding these limitations where such circuits are also used to supply power solely to communication equipment.

2) Electric supply line: The Conductors used to transmit electric energy and their necessary supporting or containing structure.

Live Work: Energized and Exposed; Equipment or circuits are considered to be "Live" until they are electrically isolated, locked-out, tested, and grounded (where feasible). If it is not possible to complete these steps, the equipment or circuit must be treated as if it were energized (Live) at all times.

Lock-out: The placement of a Lock-out device on an energy-isolating device, in accordance with an established procedure, ensuring that the energy-isolating device and the equipment being controlled cannot be operated until the Lock-out device is removed.

Lock-out devices: Any device that uses positive means, such as a lock, blank flanges, and bolted slip blinds, to hold an energy-isolating device in a safe position, thereby preventing the energizing of machinery or equipment

Minimum Approach Distance: The closest distance an employee, or any conductive object they may be carrying, is permitted to approach an energized or an ungrounded object, unless the employee is insulated from the energized parts (i.e., electrically rated gloves), or the energized part is insulated from the employee or other conductive object.

Normal production operations: The utilization of a machine or equipment to perform its intended production function.

Other Employees: All employees who are or may be in an area where Electrical energy control procedures may be employed (i.e., Innocent Bystanders).

Person in Charge: An Authorized Employee delegated responsibility to lead and control Group Lock-out/Tag-out Procedures due to knowledge of Electrical equipment under Energy Control. This may not necessarily be the most senior employee.

Potentially Energized: A non-insulated conductor or device that, by nature of design or location, may be energized by an adjacent energized conductor, switch closure, or back-feed

Power: Electrical energy transferred to a circuit to accomplish work, measured in watts (1 watt= one joule per second), reactive power is measure in volt-amps or va, which includes resistance and reactance components (inductance and capacitance) also known as "real power".

PPE: Personal Protective Equipment

Qualified Employee: An employee knowledgeable in the construction and operation of the electric power generation, transmission, and distribution equipment involved, along with the associated hazards and who has the authority to direct or stop work.

Servicing and/or maintenance: Workplace activities such as constructing, installing, setting up, adjusting, inspecting, modifying, and maintaining and/or servicing machines or equipment. These activities include lubricating, cleaning or unjamming machines or equipment and making adjustments, or tool changes where the employee may be exposed to the unexpected energization or startup of the equipment or release of hazardous energy.

Switch: A device for opening and closing, or for changing the connection of a circuit. In this section, a switch is understood to be manually operable, unless otherwise stated.

System Operator: A qualified person designated to operate the system or its parts

Ten (10) Foot Rule: To prevent physical contact with an energized or isolated ungrounded power line, equipment or machines shall be operated as follows: the minimum clearance between the lines and every part of the equipment or machine or its load shall be 10 feet (305 cm) for lines rated 50kV or below. This distance shall increase 4 inches (10 cm) for each 10kV above 50kV.

Vault: An enclosure, above or below ground, which personnel may enter, and which is used for the purpose of installing, operating, or maintaining equipment or cable

Vented Vault: A vault that has provision for air changes using exhaust flue stacks and low-level air intakes, operating on differential of pressure and temperature providing for airflow which precludes a hazardous atmosphere from developing

Voltage: The effective (rms) potential difference between any two conductors, or between a conductor and ground. Voltages are expressed in nominal values unless otherwise indicated. The nominal voltage of a system of circuit is the value assigned to a system or circuit of a given voltage class for the purpose of convenient designation. The operating voltage of the system may vary above or below this value.

IV. Electrical Activities and Execution

General Requirements

PPE (Personal Protective Equipment) (See Appendix Attachment A below)

To assist in selection of Protective Clothing and PPE, the NFPA 70E Article 130 Tables “Hazard Risk Category Classifications” and “Protective Clothing and Personal Protective Equipment (PPE) Matrix” should be utilized.

- **Head Protection:** Must meet the ANSI Z89.1 requirements for Electrical Class E
- **Rubber Gloves:** Must meet the requirements of ASTM D 120.
    - Electrical testing of insulating rubber gloves must be in accordance with in-service care of insulating gloves and sleeves per ASTM Standard Specification Designation F 496.
    - Gloves shall be dielectrically tested by high-voltage using laboratory water-based conductance methods before their first use and every six (6) months thereafter.
    - Gloves shall be visually inspected and air-tested by the worker at the beginning of each workday they will be used. The test date is verified at this time. **If the test date on the cuff of the glove is older than six (6) months, the gloves must not be used.**
    - If it is suspected the gloves have been damaged, they shall be dielectrically tested before their next use.
    - Shall be stored in canvas bags when not in use.
    - Shall never be used when turned inside out.
    - Shall be stored with the cuffs down.

Insulated Blanket, Sleeves, and Line Hoses:

- A visual inspection is performed prior to use each day.
- Blankets and sleeves are dielectrically tested before their first use and every 12 months thereafter. Electrical insulation blankets shall not be used to stand on unless the area is carefully inspected to be free from any possible materials which could compromise the electrical integrity of the blanket.
- Line hoses must be tested if there is indication the insulating value is suspect.

First Aid Supplies: (per OSHA 29 CFR 1910.151(b))

- As approved by a physician.
- Must be readily accessible.
- A standard First-Aid supply list is maintained, and all supplies are kept up to date.

Clothing

Clothing must not be worn which increases the extent of injury in the event of an electrical flash. In accordance with the latest revisions of NFPA 70E arc-flash requirements, as Category "0" no longer exists, cotton or other natural fiber material garments may only be used as undergarments where the potential for arc-flash hazard exists.

When work is performed within reaching distance of exposed energized parts of equipment, and hazards associated with contact with the energized parts are a factor, employees must remove articles such as keys or key chains, watches, chains, rings, or wristwatches, bands, necklaces, and other conductive items capable of melting into the skin or clothing.

Liberty University supervision ensures that each employee who is exposed to the hazards of flames or electric arcs does not wear clothing that, when exposed to flames or electric arcs, could increase the extent of injury to the employee, and this includes wearing of natural fiber non-melting garments as underwear and outerwear.

Liberty University Qualified Electrical personnel who perform work on <u>or near</u> exposed energized voltages greater than 50 volts AC or DC will not wear melting clothing but wear only non-melting long sleeve shirts and long pants, or an alternate arc-rated coverall.

Clothing made from the following types of fabrics, either alone or in blends, is prohibited, unless it can be demonstrated that the fabric has been treated to withstand the conditions that may be encountered, or that the clothing is worn in such a manner as to eliminate the hazard involved:

- acetate
- nylon
- polyester
- rayon

Inspection

Each employee inspects all Personal Protective Equipment before the first use each day. If equipment is found to be defective, it is removed from service to be repaired or replaced.

- Specific requirements for testing of electrical protective equipment are such that **Electrical-Insulating Gloves shall be dielectrically tested every six (6) months** at a certified test laboratory and as per ASTM prescribed methods and shall be delineated as tested by renewable stamps (i.e., clearly visible non-conductive ink) on the PPE.

- **Electrical Sleeves and Blankets are dielectrically tested every twelve (12) months** and shall be delineated as tested by renewable stamps (i.e., clearly visible non-conductive ink) on the PPE.
- **Live-line Tools (hot sticks) are dielectrically tested every 24 months** by recognized test methods and delineated as tested by renewable stamps (i.e., clearly visible non-conductive ink) on the PPE or tool.

Mechanized Equipment

Insulated, extensible-boom aerial personnel devices, articulating-boom aerial personnel devices, and any combination thereof (such as line trucks) are inspected annually, and follow the inspection and test methods outlined by the manufacturer, ANSI A92.2 and ASTM Standard Designation A 10.31.

Whenever aerial personnel devices are used to elevate a worker into close proximity of energized or potentially energized lines or equipment, a basket liner is inserted into the basket. This liner should totally cover all surfaces exposed to the worker and should be dielectrically tested per ANSI A92.2 every six (6) months.

The critical safety components of mechanical elevating and rotating equipment are inspected before use on each shift, using the manufacturer's recommended checklist.

Live-Line Tools

A test schedule is established that provides visual inspection of tools for defects and contamination, and **dielectrically tested every 24 months.** The IEEE Guide for In-Service Maintenance and Electrical Testing of Live-Line Tools, 978-1984 may be used for reference (see below).

- A visual inspection for defective hardware attachments, cracks, deformities, contamination, proper orientation, and cleanliness is performed before use of the tool each day.

* Referenced Tools and Documents

IEEE Guide for In-Service Maintenance and Electrical Testing of Live-Line Tools, 978-1984

Records

Test records are maintained on all equipment and live-line tools that require testing.

V. Safe Work Practices

Selection and Use of Work Practices

Safety-related work practices are employed to prevent electrical shock or other injuries resulting from direct or indirect electrical contact when work is performed **on or near equipment or circuits which may be energized**.

Live parts which may expose an employee to more than 50 volts AC or DC are to be de-energized before the employee works on or near them. These two sentences need to be strongly emphasized.

If exposed live parts are not locked or tagged out, they are treated as energized parts, and other safety-related work practices are used to protect employees who may be exposed to the electrical hazards involved.

When working around exposed high voltage (greater than 600 volts) electrical parts, an authorized **Safety Observer** is assigned to be in close proximity to the work location and must have access to a suitable non-conducting device for rescue, such as an insulated hook stick and be trained at least every 3 years to know how to use the device for rescue. This **Safety Observer** understands the hazards of the work to be performed and is knowledgeable of the safe work practices required. The **Safety Observer** must not be involved in the work performed and is trained in rescue procedures including CPR and First-Aid techniques.

Only qualified persons work on live exposed parts. Qualified persons are persons that meet both OSHA and NFPA 70E training and experience requirements.

Ladders

****ONLY LADDERS WITH NON-METAL SIDE RAILS SHALL BE USED NEAR ENERGIZED ELECTRICAL CIRCUITS OR PARTS, REGARDLESS OF VOLTAGE LEVEL.**

Extension Cords and Power Strips

Employees must be aware of the hazards of misusing extension cords and power strips. These hazards include electrocution and fire.

- Extension cords and power strips must be inspected for damage to the outer insulation prior to use. An Extension and Power Cord Checklist document can assist employees performing inspections on extension cords and power strips. (See Appendix Attachment E)
- Extension cords and power strips must be plugged into a wall outlet and may not be plugged into another extension cord or power strip (Daisy Chaining).
- Extension cords and powers strips that have a ground pin may only be plugged into grounded outlets.
- Devices that have a ground pin may only be plugged into extension cords and power strips that accept ground pins. Do not remove the ground pin from the plug of the device or the extension cord or power strip.
- Extension cords may never be used in place of permanent wiring and may only be used for a temporary period of up to 90 days.

The following work practices shall be followed when using extension cords:

- Never use an extension cord to lift or lower power tools
- Avoid running cords over sharp corners and projections

- Do not run cords through windows or doors unless they are protected from damage and only used on a temporary basis
- Do not run cords above ceilings and inside or through walls, ceilings, or floors
- Do not fasten cords with staples or otherwise hang them in such a fashion as to damage the outer jacket or insulation
- Cover cords with a cable bridge or tape when they extend into a walkway or other path of travel to avoid tripping hazards.
- Unless they are specifically designed to do so, extension cords must not be used to suspend portable lighting.
- Extension cords must be heavy-duty and rated for the power tool with which it is being used.
- Only extension cords rated for outdoor use may be used outdoors.
- Cord repairs shall only be accomplished by Qualified Electrical Workers using UL approved methods (OSHA 29 CFR 1910.399).
- Metal "J" Boxes may not be used to construct multiple outlet cords, only UL approved devices and methods can be used for this purpose.
- Two prong outlet cords and pigtail adapters are forbidden for use at Liberty University.
- Power strips must be UL approved and are to be used within the manufacturer's guidelines. Industrial equipment, power tools, and other high-current devices may not be plugged into power strips unless they are UL-approved for industrial use (the manufacturer's guidelines will specify the rating of the power strip).

Portable Electric Equipment

Portable equipment should be handled in a manner that will not cause damage. Flexible electric cords connected to equipment should not be used for raising and lowering the equipment.

If there is a defect or evidence of damage that might expose an employee to injury, the damaged item is to be immediately tagged and removed from service until such time that repairs can be made.

Portable electric equipment that is used in highly conductive locations (such as near water) shall be approved for operation in those locations. Employees should never use inappropriately rated equipment. In addition, employees' hands should never be wet when plugging and unplugging flexible cords.

Electric Power and Lighting Circuits

Only devices that are specifically designed as a disconnecting means, such as load rated switches and circuit breakers, shall be used for the opening, reversing, or closing of circuits under load conditions. Fuses, terminal lugs, and cable splice connections may not be used for such purposes, except in the event of an emergency.

After a circuit is de-energized by a circuit protective device, the circuit may not be manually re-energized until such time that the equipment and circuit can be verified for safe energization.

Test Instruments and Equipment

Only Qualified Persons may perform testing on electric circuits or equipment. All test equipment should be inspected prior to each use and, in the event damage or defect is noted, the damaged equipment should be tagged and removed from service. All test equipment should be properly rated for the circuits and equipment to which they will be connected.

Ground Fault Circuit Interrupters (GFCI's)

A GFCI is a protective device that compares the amount of current going into electrical equipment with the amount of current returning from the equipment. If the current deviation is exceeded by more than 5 ma, the circuit will be quickly broken in milliseconds.

All 125-volt single-phase, 15, 20, and 30-amp receptacle outlets that are not part of the permanent wiring of a building or structure shall have GFCI protection.

GFCI devices shall always be used for temporary circuits on all Construction projects.

In the event that GFCI protection is not feasible, an Engineered, assured, equipment grounding conductor program covering cord sets, receptacles that are not part of the building or structure, and equipment connected by cord and plug shall be implemented.

There are several types of GFCI's available. Although all types will provide ground-fault protection, the specific application may dictate one type over another.

- **Circuit-Breaker Type** - The circuit-breaker type includes the functions of a standard circuit breaker with the additional functions of a GFCI. It is installed in a panelboard and can protect an entire branch circuit with multiple outlets. It is a direct replacement for a standard circuit breaker of the same rating.
- **Receptacle Type** - The receptacle style GFCI incorporates within one device one or more receptacle outlets, protected by the GFCI.
- **Permanently Mounted Type** - Permanently mounted types are mounted in an enclosure and designed to be permanently wired to the supply.
- **Portable Type GFCI** - Portable types are designed to be easily transported from one location to another. They usually contain one or more integral receptacle outlets protected by the GFCI module. Some models are designed to plug into existing non-GFCI protected outlets, or in some cases, are connected with a cord and plug arrangement. The portable types also incorporate a non-voltage release, which will disconnect power to the outlets if any supply conductor is open.
- **Units approved for use outdoors** will be in enclosures suitable for the environment. If exposed to rain, they must be listed as rainproof.
- **Cord Connected Type** - The power supply cord type GFCI consists of an attachment plug which incorporates the GFCI module. It provides protection for the cord and any equipment attached to the cord. The attachment plug has a non-standard appearance and is equipped with test and reset buttons. Like the portable type, it incorporates a non-voltage release device which will disconnect power to the load if any supply conductor is open. **Always assure that these devices are connected to the outlet end of the circuit.**

Classes of GFCI

- Ground-Fault Circuit-Interrupters are divided into two classes: Class A and Class B. The Class A device is designed to trip when current flow, in other than the normal path, is 5 milliamperes or greater.
- The Class B device will trip when current flow, in other than the normal path, is 20mA or greater.

Testing GFCI Devices

Due to the complexity of a GFCI, it is necessary to test the device on a regular basis. For permanently wired devices, a monthly test is recommended. Portable type GFCI's should be tested each time before use. GFCI's have a built-in test circuit which imposes an artificial ground fault on the load circuit to assure that the ground-fault protection is still functioning. Test and reset buttons are provided for testing.

Overcurrent Protection Devices

The use of overcurrent protection devices such as circuit breakers is an effective way to reduce the damage done by a fault in the electric circuit. In the event of a fault, an overcurrent protection device will isolate the fault and prevent damage to equipment.

Overcurrent devices are to be used as a line of defense to protect equipment. They are not to be used to protect employees.

All overcurrent devices should be readily accessible and labeled and should clearly indicate their operating position (on or off). If an overcurrent protection device is installed vertically, the up position should indicate “On”.

Sufficient working space should be adjacent to protection devices and this space should not be used for storage and must remain clear at all times. Minimum clear working space when working with 600 V or less is indicated in Table 5.

	Minimum clear distance for condition					
	Condition A		*Condition B*		*Condition C*	
	M	Ft	M	Ft	M	Ft
0-150	0.9	3.0	0.9	3.0	0.9	3.0
151-600	0.9	3.0	1.0	3.5	1.2	4.0

Source: *29CFR1926.403(i)(1)(i)*

Table 5. Minimum clear distance when working with 600V or less.

Condition A

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 material.

Condition B

Exposed live parts on one side and grounded parts on the other side.

Condition C

Exposed live parts on one side and exposed live parts on the other side.

Primary Rule

Electrical equipment and lines must be considered energized until isolated, tested, locked out and/or tagged out, and grounded, where feasible. Until the circuit is locked and tried out and appropriate grounds are firmly placed, where feasible, these devices are to be considered energized!

Verification of De-Energized Condition

A qualified person verifies the equipment is properly isolated, locked out, and cannot be restarted or energized (tryout). They use appropriate test equipment to test circuit elements and electrical parts of equipment to which workers may be exposed and verify that all elements and parts are de-energized. A qualified person installs appropriate PPE grounding where feasible. The qualified person determines whether the potential for any induced voltage or unrelated voltage back-feed exists (even though specific parts of the circuit have been de-energized).

Test equipment is checked for proper operation with a known live source immediately before and immediately after the test.

- This is commonly described as the **Live-Dead-Live** verification for proper operation of electrical rated meters.

For High Voltage verification the same process should be employed to assure proper operation of High Voltage non-contact voltage detectors.

Safe Work Zone

Establishing protection boundaries is required. Identify and barricade work areas containing electrical hazards not normally encountered during routine operation of the equipment and/or conductors located therein. This happens normally during maintenance, renovations to existing installations, or additions to installations where high-voltage equipment and/or conductors are located and exposed. Appropriate identification warns workers of the hazards in their work areas.

Protection Boundary

Area access is restricted to Qualified workers only. Unqualified workers may only access the area if escorted by a Qualified worker.

The **Minimum Approach Distance (MAD)** is 3 feet without appropriate Electrical PPE and proper approach methods. The MAD must never be encroached by any conductive object or body part.

A flash hazard analysis is done before a person approaches an exposed electrical conductor or circuit part not placed in an **Electrically Safe Work Condition** (See Appendix Attachment C for documentation (the “LU Electrically Safe Work Procedure”) to be used for this purpose). This analysis establishes a **Flash Protection Boundary** used to define the level of PPE necessary to perform work safely. In cases where a flash hazard analysis has not been completed, the NFPA 70E Article 130 Tables must be used.

If the work exposes energized or moving parts normally protected, danger signs are displayed. Suitable barricades are erected to restrict other personnel from entering the area.

When working in a restricted section that adjoins other sections, a Qualified worker marks the work area and places barriers to prevent accidental contact with energized parts in adjacent sections.

A Qualified worker determines the size of the safe zone. The voltage applied and the available fault at the work location of exposed energized conductors is considered. The dimension is established by the use of the "10-foot rule." The calculation of the Flash Protection Boundary made in the Flash Hazard Analysis is compared with "10-foot rule" to identify which is greater and usable as the perimeter of the protection boundary.

Areas Accessible to Vehicular and Pedestrian Traffic

When vehicles and non-qualified pedestrian traffic pass adjacent to exposed energized electrical equipment under maintenance, in exposed operation, or where construction activity could compromise the safety of these vehicles and pedestrians, appropriate warning signs and/or barricades are used.

Use of Electrical Hazard Barricade Tape/Rope

Electrical hazard barricade tape/rope is intended as a temporary hazard warning. Temporary is defined as the duration of any work assignment where there is an active effort to complete a permanent installation and worker safety is not compromised.

- **The required color is red**. It is recommended the red tape be imprinted with wording such as "Danger - Electrical Shock Hazard."

Job Briefings

All Pre-Job Safety Briefings (See Appendix Attachment D) must be documented with acknowledgement of all personnel in attendance.

Emphasis here is on the term "Pre-job," meaning, always, before the job begins.

Before an electrical work operation begins where entry into the protection boundaries is required, personnel are briefed on the safety concerns, energy source controls, required personal protective equipment, and precautions regarding their assignments. A **Pre-job Safety Briefing** the **Liberty University JHA (Job Hazard Analysis) document** is used for this purpose (See Appendix Attachment D).

Whenever work conditions or methods change in a way that could potentially compromise personnel safety, additional briefings are held.

The job briefings are conducted by the Qualified task supervisor or Person-in-Charge.

If the work or operations during the day are repetitive, at least one job briefing is conducted before the start of the first job of the day. Additional job briefings are held if changes affecting the safety of workers occur during the course of the work. Workers reporting to the job site after the work has begun will receive a full job briefing before they begin work.

A job briefing is a brief discussion for the work tasks that are routine and familiar to the workers. If the task is more complicated or particularly hazardous, or if workers may not recognize the hazards involved, a more extensive discussion is conducted.

Personnel working alone are required to plan their respective work and utilize their own singular **Pre-job Safety Briefing (LU JHA)** to consider all potential hazards on the job and actions which will be taken in the event of an emergency.

Grounding

This section applies to the (PPE) grounding of all generation, transmission, distribution, and utilization lines and equipment. **These activities may require special coordination with the delivering Power/Utility company.**

- For workers to work on lines or equipment designated as de-energized, equipment isolation must occur, a lock-out/tag-out must be accomplished, and appropriate PPE grounds installed, wherever feasible.
- Before any PPE grounding equipment is installed, the lines or equipment are tested for absence of voltage unless a previously installed ground is present. The regimen of this test is followed. Before installation of the PPE grounds, the grounding equipment is visually inspected to confirm the equipment's integrity.
- Temporary PPE grounding equipment is placed at the work location.
- If installation of grounds at the work location is not feasible, grounds are installed on each side of the work location as close as possible.
- Single-point grounding is an acceptable means of PPE grounding, provided equal potential grounding principals are followed. Everything a worker can touch, reach, or stand upon must be tied to the same ground point.
- Protective grounding equipment is capable of conducting the maximum ground-fault current that could flow for the time necessary to clear the fault. This equipment has an amp capacity greater than or equal to number 2 AWG stranded copper. A larger conductor such as 2/0 AWG stranded copper is recommended.
- Protective grounds must have an impedance to ground low enough to guarantee prompt operation of protective devices in case of accidental energization of the lines or equipment.
- **Before grounding any previously energized part, the worker connects one end of the grounding device to an effective ground.** Grounding is accomplished with the use of HV gloves, live-line tools, appropriate clothing, and other necessary personal protective equipment (electrocution-related PPE and arc-flash-related PPE).
- After necessary equipment is gathered and set up, a test of the previously energized parts is performed for voltage level using the regimen as detailed in this section. If the parts are free from voltage, the grounding is completed. The grounding device is brought into contact with the previously energized part using live-line tools and securely attached.
- <u>If the test indicates the parts are not free from voltage, the grounds must not be attached to the part.</u>
- Determine the source of the voltage to ensure that the presence of voltage does not prohibit completion of the grounding.
- **When removing grounds, first remove the grounding devices from the de-energized parts**, using live-line tools. Then remove the connection to the ground. Take

extreme caution. **Never remove the connection to the ground prior to removing the connection to the de-energized part. Electric shock and injury may result.**

- Approved clothing, rubber insulating gloves with protectors, hard hat and eye protection, and necessary arc-flash-related PPE are worn when testing for voltage and placing/removing grounding devices.
- **Static capacitors are grounded (discharged for 5 minutes) before work is done on them. A five-minute waiting period is required between isolating the capacitor and applying the grounds to ensure total discharge**.
- If the employer can demonstrate that the installation of grounds is impractical or presents a greater hazard, the lines or equipment may be worked on but must be considered energized. **Liberty University personnel are not allowed to make direct contact with energized circuits. This is considered "live-line work."**
- Grounds may be removed temporarily for testing. During the test procedure, the previously grounded lines and equipment must be considered to be energized.

Equipotential Grounding

Equipotential groundings are techniques used in generation, transmission, and distribution lines and equipment. These temporary protective grounds are placed and arranged to prevent each employee from being exposed to hazardous differences in electrical potential. Everything a worker can touch, reach, or stand upon is tied to the same ground point. The following are the different methods:

- **Single-point grounding** for pole top is where the worker has connected all three phases together with jumpers to a cluster bar attached to the pole below the worker's feet. A jumper to the neutral, if available, connects the cluster bar. For all other applications, the conductors and everything a worker can touch, reach, or stand upon is tied to the same ground point. If a ground fault should occur, the worker is at the same voltage as the lines and current does not flow through their body.
- **Double-point grounding** is necessary if work at the pole or non-pole location involves breaking the circuit. It is necessary to ground faults that may come from either direction. On both sides of the worker (an "equi-potential zone" is established), the phases are connected to each other, to the cluster bar below the worker's feet, and to the neutral for pole top activities. For non-pole top everything a worker can touch, reach, or stand upon is tied to the same ground point.
- **Remote double-point grounding** allows the worker more movement between the jumper sets but offers less protection than other methods. The grounds are connected to structures such as towers on each side of the work location. Fault current would flow through the towers into the earth. With this method, it is still possible to have potentially fatal current flow into the worker's body. The conductors are treated as energized requiring appropriate PPE.

These grounding techniques require a certain degree of skill and experience. Hands-on training and qualifications are required before practicing these methods.

Mobile Equipment Grounding

To establish an equipment ground on a vehicle trailer or other portable equipment, a connection is made from a suitable ground plate or stud to the best ground available in the immediate work area. Examples of such equipment include cranes, line trucks, and aerial lifts.

On distribution circuits, the common neutral or ground grid system is used as the ground source. A driven ground rod is used only as a last alternative. Workers are instructed to stay clear of the driven ground location. Other protective measures such as barricades are used as necessary.

High-voltage rubber gloves are worn during the attaching and removal of the ground lead at the vehicle. The correct sequence calls for the lead to be attached to the best available ground source first and then to the vehicle. **When removing grounds, detach the ground lead first from the vehicle and then from the ground source**.

Grounding is done prior to raising a crane, derrick boom, or similar equipment.

The ground device is not removed until after the crane, derrick boom, or similar parts of the equipment have been returned to their cradle and lashed.

Only qualified personnel trained in the proper grounding technique and hazards associated with working around energized or potentially energized circuits are permitted to operate mechanical equipment where these hazards are present. The “10-foot rule” is followed at all times.

Grounding Equipment and Material

Safety ground leads are applied to mobile equipment as described in the previous subsection. It is required that safety ground leads are not less than 2/0 flexible stranded copper rubber-covered cable.

Ground leads are visually inspected for any type of damage or wear before first use of the day.

Operator Training

Mobile equipment operators are qualified in electrical work (29 CFR 1910.269) and have had live-line training if their equipment has the potential for coming closer than the “10-foot rule” to energized lines or equipment. Few, Liberty University employees will fit this description.

Potential Additional Training Requirements: Training in the potential electrical shock hazards associated with mobile equipment operation under these conditions is necessary.

Notification

Any mobile equipment operators who notice that operation of their equipment may place that equipment within the “10-foot rule” of energized or potentially energized lines or parts of electrical equipment must notify the appropriate location management and wait for further safety instructions.

Before the mobile equipment is moved to the job site, responsible engineering/location personnel must notify contractors and location workers of potential electrical hazards regarding mobile equipment operation (where this potential exposure can be reasonably anticipated before the job assignment starts).

Insulated Armored High-Voltage Cable

The “10-foot rule” does not apply to armored, insulated, high-voltage cable. Work activities can be performed adjacent to this type of cable while it is energized; however, this type of cable must not be disturbed or moved while it is energized.

Insulated Non-Armored High-Voltage Cable

In some cases, the “10-foot rule” does not apply to insulated non-armored high-voltage cable.

Because the integrity of this insulation is considered, a review by Qualified Persons is required before work activities are performed adjacent to this type of cable while it is energized. This type of cable must not be disturbed or moved while it is energized.

Enclosed Spaces

These requirements apply only to enclosed spaces, which are electrical in nature, such as manholes, un-vented vaults, tunnels, etc. that can be entered by workers. Refer to the Liberty University Confined Space Program for more specific information on this topic.

Underground Electrical Facilities

The following are additional requirements for work on underground electrical installations in manholes and/or vaults:

- Ladders or other climbing devices are used to enter or exit manholes or subsurface vaults exceeding four feet (122 cm) in depth. Workers must not use cables or hangers as steps to climb in or out of manholes and vaults.
- Equipment used to lower materials and tools are capable of supporting the weight and are checked for defects before use. Workers working in manholes and vaults must stand clear of the area directly underneath openings while tools or materials are being lowered or raised.
- While work is being performed in a manhole containing energized electrical equipment, a worker capable of rendering emergency assistance serving as the Attendant is on duty in the immediate vicinity of the manhole or vault opening. This worker must have received CPR/First Aid training and cannot enter the manhole or vault.
- When working in a manhole or vault with energized cable or equipment, all workers are in constant communication. This can consist of visual, voice, or signal-line communication.
- When multiple cables are present, exact identification is required by electric means unless identification is obvious. All other cables not being worked on are protected against damage.

Cables may be defective when any of the following abnormalities are observed:

- Oil or compound leaking from cable or joint
- Broken cable sheaths
- Broken joint sleeves
- Hot surface temperatures
- Joints swollen beyond normal tolerances

Sheath continuity is maintained while work is performed on buried cable or in cables in manholes, or the sheath is treated as energized.

Trenches and Excavation

All trenching and excavation projects are preceded by location notification to all power/utilities and others having underground installations in the affected location. This notice is given 24 hours prior to starting work unless local or state law requires a longer period.

Normal trenches or excavations less than four 4 feet deep do not require a protection system, if a Competent Person determines there is no cave-in potential.

All trenching and excavation operations must be supervised by a designated Competent Person for trenching and excavation, who must be trained to meet the requirements of 29 CFR 1926.650, 1926.651, and 1926.652. All trenching and excavation operations must comply with the Liberty University Excavation Safety Standard Operating Procedures located on the EHS website under Policies, Programs & SOP's.

Infrared Testing

Workers performing infrared testing on open high voltage systems located in or on structures wear at minimum an approved "Class E" hard hat, leather gloves (min 0.7mm thick), safety glasses with side shields, approved clothing, and leather safety shoes, and should identify the arc-flash hazard boundary requirements. If infrared testing brings the worker within the defined arc-flash boundary, the appropriate arc-flash-related PPE shall be worn.

When performing infrared testing on metal-clad, enclosed switchgear requiring the enclosure to be opened (exposing energized high or low voltage parts), workers must wear, in addition to the personal protective equipment listed above, leather gloves, a face shield, balaclava (sock-hood), and an Arc-rated coverall covering the torso to the feet, with leather work shoes.

While infrared testing is proceeding, no equipment, tools, or body parts should enter the Minimum Approach Distance. Strongly Emphasize this sentence.

VI. Live Work Procedure

Purpose of this Procedure

It is Liberty University general policy that **NO** work will be performed on any equipment, conductors, and/or exposed parts at 50 Volts and above while they are "live" (energized). In cases where exceptions are unavoidable, this procedure details the conditions and the minimum requirements for working with "live" (energized) equipment at 50 Volts or greater. Further, for verification of the presence of power (generally voltage-testing), where voltage of 50 Volts or greater may exist, **Qualified Electrical Personnel may not approach such energized equipment within (3) feet without proper electrical PPE, as defined in NFPA 70E, 130.4 (D)**

Critical note: Under **NO** circumstances are Unqualified Personnel permitted to open or operate any equipment which may be energized, or approach **within 3-Feet** of such equipment or within the established Arc-Flash Boundary.

Principles

i.) **Procedure Overview**

The significant threats to Liberty University employees performing electrical work on or near exposed, energized equipment are electrocution and the heat/blast effects of a catastrophic electrical arc failure in equipment. Liberty University personnel shall work on electrical equipment only when it is safely de-energized. However, when this is not possible, this

procedure establishes the conditions for performing “live work” and the minimum safety requirements for working on “live” equipment. This is termed **the (3) Foot Rule**, as defined in Purpose above.

ii.) **Electrically Safe Work Condition (See Appendix Attachment C)**

Equipment must be considered “live” (energized) until it is electrically isolated, locked-out, tested, and grounded, where feasible (the “**Electrically Safe Work Condition**”). Only Qualified Persons can establish an electrically safe condition.

Job Briefing (See NFPA 70E Article 110.1(H))

Prior to commencing work, Supervisors or the Qualified Person in Charge shall conduct a job briefing with all employees that have a potential for exposure to energized electrical parts. The briefing should cover the following:

- Hazards associated with the task. This includes identifying shock exposures and arc flash hazards.
- Work procedures to be safely employed
- Special precautions such as draining capacitors and gradient potential issues
- Energy source controls (LOTO points)
- PPE required for successful mitigation
- Emergency Response Procedures

The process of establishing an electrically safe work condition is inherently hazardous because it requires Qualified Persons to work around live conductors. Appropriate PPE must be worn and used when performing some of the steps listed below. Electrical conductors and equipment are considered energized until the process of establishing an **Electrically Safe Work Condition** is complete.

Process to Establish an Electrically Safe Work Condition (see NFPA 70E 120.1)

- Determine all sources of electrical supply to the specific equipment. Check applicable up-to-date drawings, diagrams, and identification tags.
  - Most electrical equipment has a single source of supply; however, there are instances where there are multiple sources, such as rooftop photovoltaic arrays or emergency generators, **always verify for BACKFEED!**
- After properly interrupting the load current, open the disconnecting device(s) for each source.
  - Fuses aren’t considered disconnecting means and a circuit cannot be de-energized by removing one or more fuses. However, a pullout block or safety switch with fuses can be considered a disconnect.
  - Attachment plugs of electric appliances are permitted to be used as disconnects as long as the plug end of the device is locked out.
- Wherever possible, visually verify that all blades of the disconnecting devices are fully open, or that draw-out-type circuit breakers are withdrawn to the fully disconnected position.
  - Sometimes it’s impossible to visually verify the presence of an air gap. In these cases, test for the presence of voltage to verify that the circuit has been fully disconnected.
- Apply LOTO devices in accordance with **Liberty University Energy Control** procedures.

- Use an adequately rated test instrument to test each phase conductor or circuit part to verify it is de-energized **(Using the required CAT Level meter is critical).**
  - Test each phase conductor or circuit part to both phase-to-phase, neutral-to-ground, and phase-to-ground.
  - Before and after each testing, determine that the test instrument is operating properly through verification on a known voltage source (Live-Dead-Live test).
- Discharge stored electrical energy and install safety grounds where feasible.

Once these steps have been completed, electrical energy has been removed from all conductors and equipment and cannot reappear unexpectedly. Only under these circumstances is PPE not needed and unqualified persons can perform work on or near electrical equipment.

If you are unable to complete these steps, you must treat the equipment as if it were energized at all times and subject to the "live work" conditions of this policy. "Live Work" requires the use of applicable protective equipment, prior management approval, and completion of a written live work justification on the **Pre-job Safety Briefing (LU JHA) (See Appendix Attachment D)**.

- All employees are required to know personally, at all times, the electrical state (energized or de-energized) of any equipment they are working around.

iii). Approach Boundaries to Live Parts

A shock risk assessment shall determine the voltage to which personnel have the potential to be exposed, the boundary requirements, and the PPE necessary to protect employees.

Shock protection boundaries are identified as *limited approach boundary* and *restricted approach boundary*. These boundaries are applicable where approaching personnel are exposed to energized electrical conductors or circuit parts.

Limited Approach Boundary

Approach by Unqualified Persons (NFPA 70E 130.4 (C))

- Unless permitted by (NFPA 70E 130.4(C)(3)) no unqualified person shall be permitted to approach nearer than the limited approach boundary of energized electrical conductors or live parts.

Unqualified Persons Working at or Close to the Limited Approach Boundary

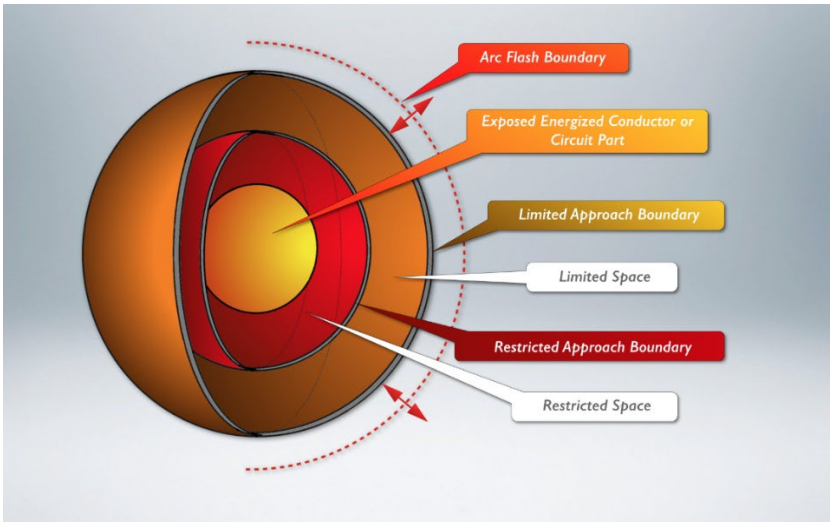
- It is the responsibility of the designated Person in Charge of the work space where the electrical hazard exists to advise the unqualified person(s) of the hazard and warn them to stay outside of the limited approach boundary. (See NFPA 70E 130.4 (C)(2))

Entering the Limited Approach Boundary (NFPA 70E 130.4(C)(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 (NFPA 70E 130.4 (D))

- No Qualified Person shall approach or take any conductive object closer to exposed energized electrical conductors or circuit parts operating at 50 volts or more than the restricted approach boundary set forth in Table 2 and Table 3 of this document (NFPA 70E Tables 130.4(D)(a) and 130.4(D)(b)), unless one of the following apply:
    - The qualified person is guarded or insulated from energized electrical conductors or circuit parts operating at 50 volts or more through adequate PPE
    - The energized electrical conductors or circuit part operating at 50 volts or more are electrically insulated from the Qualified Person and from any other conductive object at a different potential.
    - The Qualified Person is insulated from any other conductive object.



Source: *NFPA 70E (2015)*

Figure 1 – Approach Boundaries

Approach Boundaries for Shock Protection for Alternating Currents (AC)

Limited Approach Boundary			
Nominal Potential Difference	**Exposed Movable Conductor**	**Exposed Fixed Circuit Part**	**Restricted Approach Boundary**
<50V	Not specified	Not specified	Not Specified
50V-150V	10 ft 0 in.	3 ft 6 in.	Avoid contact
151V-750V	10 ft 0 in.	3 ft 6 in.	1 ft 0 in.
751V-15kV	10 ft 0 in.	5 ft 0 in.	2 ft 2 in.

15.1 kV- 36kV	10 ft 0 in.	6 ft 0 in.	2 ft 7 in.
36.1kV-46kV	10 ft 0 in.	8 ft 0 in.	2 ft 9 in.
46.1kV-72.5kV	10 ft 0 in.	8 ft 0 in.	3 ft 3 in.
72.6kV-121kV	10 ft 8 in.	8 ft 0 in.	3 ft 4 in.
138kV-145kV	11 ft 0 in.	10 ft 0 in.	3 ft 10 in.
161kV-169kV	11 ft 8 in.	11 ft 8 in.	4 ft 3 in.
230kV-242kV	13 ft 0 in.	13 ft 0 in.	5 ft 8 in.
345kV-362kV	15 ft 4 in.	15 ft 4 in.	9 ft 2 in.
500kV-550kV	19 ft 0 in.	19 ft 0 in.	11 ft 10 in.
765kV-800kV	23 ft 9 in.	23 ft 9 in.	15 ft 11 in.

Source: *NFPA 70E Table 130.4 D (a)*

Table 2 (All dimensions are distance from energized electrical conductor to employee).

Approach Boundaries for Shock Protection for Direct Currents (DC)

Limited Approach Boundary			
Nominal Potential Difference	**Exposed Movable Conductor**	**Exposed Fixed Circuit Part**	**Restricted Approach Boundary**
<100V	Not specified	Not specified	Not Specified
100V-300V	10 ft 0 in.	3 ft 6 in.	Avoid contact
301V-1kV	10 ft 0 in.	3 ft 6 in.	1 ft 0 in.
1.1kV-5kV	10 ft 0 in.	5 ft 0 in.	1 ft 5 in.
5kV- 15kV	10 ft 0 in.	5 ft 0 in.	2 ft 2 in.
15.1kV-45kV	10 ft 0 in.	8 ft 0 in.	2 ft 9 in.
45.1kV-75kV	10 ft 0 in.	8 ft 0 in.	3 ft 2 in.
75.1kV-150kV	10 ft 8 in.	10 ft 0 in.	4 ft 0 in.
150.1kV-250kV	11 ft 8 in.	11 ft 8 in.	5 ft 3 in.
250.1kV-500kV	20 ft 0 in.	20 ft 0 in.	11 ft 6 in.
500.1kV-800kV	26 ft 0 in.	26 ft 0 in.	16 ft 5 in.

Source: *NFPA 70E Table 130.4 D(b)*

Table 3 (All dimensions are distance from energized electrical conductor to employee).

Arc Flash

Arc flash is a phenomenon that is the result of an electric current leaving its intended path and travelling through the air from one conductor to another, or to ground. The results of an arc flash are often violent and when workers are in close proximity to the arc flash, serious injury or death can occur. Workers must be protected from the extreme heat of an arc flash, approaching 35,000 degrees F with extreme noise and blinding light, and the physical risk of third degree burns.

Arc Flash Risk Assessment

An arc flash risk assessment should be done before a person approaches any exposed electrical conductor or circuit part not placed in an **Electrically Safe Work Condition**. This arc flash risk assessment will determine whether an arc flash hazard exists and, if so, the risk assessment shall determine:

- Appropriate safety-related work practices
- The arc flash boundary
- Required PPE to be used within the Arc Flash Boundary

Arc flash risk assessments shall be updated when a major system modification occurs. The interval between document reviews is not to exceed a period of 5 years. The results of an Arc flash risk assessment must be documented and maintained.

Arc Flash Boundary

A major premise of the NFPA 70E Standard is to provide protection for electrical workers from the onset of third degree burns equating to **~1.2 cal/cm2 or greater**.

The **Arc Flash Boundary** is the furthest established boundary from an energy source where, if an arc flash occurred, a worker would be exposed to a curable second degree burn. Employees crossing into the arc flash boundary are required to wear the appropriate PPE as determined by the *Incident Energy Analysis Method* as published in *NFPA 70E,* or the *Arc Flash PPE Categories Method* which utilize Table 130.7 (C)(15)(A)(a) in *NFPA 70E*.

Notes: Unqualified Personnel, regardless of experience, are not considered “Qualified” electrical workers per OSHA unless they meet the definition of Qualified. Unqualified Personnel must always work outside OSHA’s Minimum Approach Distance (see Table R-6 below), and only perform visual inspections without any equipment interaction by touch, tools, or devices. **Unqualified Personnel are not permitted to open doors or panels at 50 Volts or greater under any circumstances**. If such Personnel require access to complete field surveys, they must obtain assistance from a "Qualified" electrical worker.

Lock-Out/Tag-Out. Qualified persons (as defined by 29 CFR 1910.269) shall perform Lock-Out/Tag-Out activities and other actions required to de-energize equipment. Qualified persons working with a hot stick (when required) outside OSHA’s minimum approach distance shall:

- Use tic-tracers or other non-contact voltage detectors
- Perform Lock-Out/Tag-Out activities
- Attach grounds

Installation, Maintenance, Troubleshooting, and Testing. Qualified persons may also perform electrical equipment installation, maintenance, troubleshooting, and testing activities. These may include:

- Parameter testing or readings (voltage, amperage, high-pot tests, etc.)
- Use of meters, oscilloscopes, or other test instruments
- Voltage phasing
- Preventive maintenance observations and meter checks
- System component adjustment
- Troubleshooting
- Re-setting device overloads

FOR HIGH VOLTAGE WORK

- **Note: Liberty University applies the 3-Foot rule for voltages up to 46 KV**

Table R-6 from 29 CFR 1910.269

(Minimum Approach Distances)

Voltage (Phase to Phase)	**Feet (or Inches)**
Up to 1 kV	*See note differs from OSHA
1 kV – 15 kV	*See note
15 kV – 36 kV	*See note
36 kV – 46 kV	*See Note
46 kV – 72.5 kV	3'-6" (42")
72.5 kV – 121 kV	4'-3" (51")

Requirements for Live Work

With the exception of "Inspection" work (as described above), all live work must follow the remaining requirements of this procedure.

- NFPA 70E (130.1) requires a written justification documenting why work must be completed live, this is called the **Liberty University Energized Electrical Work Permit (See Appendix Attachment B)**. Before starting any live work, you must briefly explain why the work must be completed live on the **Pre-job Safety Briefing (LU JHA).** If Lock-Out/Tag-Out activities are the only live work to be performed, then simply "LOTO Only" shall be noted in the Briefing document.
- Working on or operating equipment, which is known or suspected to be faulty, in poor condition, has no evidence of routine maintenance, or which (in the opinion of a Qualified - employee) presents any other significantly increased safety risk, shall be undertaken only in a de-energized state.

OSHA ***requires*** the presence of two persons, both of whom are "Qualified" under 29 CFR 1910.269, in order for **work to be performed on equipment energized greater than 600V.** At least one of the two individuals shall have current First-Aid and CPR training in accordance with NFPA 70E requirements. **Although not required by OSHA, it is recommended by NFPA 70E that two persons be present whenever live work is required on equipment energized above 50V, up to and including 600V**.

Individuals performing live work must establish a 10-foot perimeter around their work area (OSHA's 10-ft. Rule—see 29 CFR 1910.269). Only "Qualified" persons may enter this perimeter during work activities. Caution tape or other barricade measures shall be placed to alert non-essential personnel to stay out of the work area.

Individuals performing live work must participate in a pre-job or project-site safety meeting in accordance with the **Pre-Work Safety Briefing (LU JHA).**

Individuals performing live work must use personal protective equipment in accordance with the **LU Electrical Safety Program** above.

Individuals working on or around energized equipment must follow one of two methods for determining the arc-flash hazard and protective clothing requirements:

- They shall rely on the **Arc-flash Label categories** posted on electrical equipment, or
- They may follow the recommendations outlined in NFPA 70E (NFPA 70E PPE Selection Tables). **Note:** Requirements of these tables must be satisfied for work to proceed. Each employee must know how to gain access to the current NFPA 70E Standard. LU Departments are responsible for assuring that affected personnel have access to the latest version of the NFPA 70E Standard, whether hard-copy or electronic version, and for training the affected employees on how to obtain the information they need.

Energized Electrical Work Permit (NFPA 70E, 130.2(B)) (See Appendix Attachment B for the LU Energized Electrical Work Permit)

A work permit must be obtained when the following conditions apply, (except when the specific exemptions listed in NFPA 70E 130.2 are applicable):

- When work (other than delineated) is performed within the restricted approach boundary of energized circuits or parts.
- When the employee interacts with the equipment where conductors or circuit parts are exposed or not exposed, but an increased likelihood of injury from an exposure to arc flash hazards exist.

Elements of the Energized Work Permit (NFPA 70E, 130.2(B)(2)) (Appendix Attachment B)

In those instances where it is necessary to work on energized conductors or circuit parts, it is necessary for employees to obtain an **Energized Electrical Work Permit**. Information in this permit includes, but is not limited to the following items (see Appendix Attachment B for the permit):

- Description of the circuit and equipment to be worked on and their location;
- Justification for why the work must be performed in an energized condition;
- Description of the safe work practices to be performed;
- Results of the **Shock Risk Assessment**;

- Voltage to which personnel will be exposed;
- Limited approach boundary;
- Restricted approach boundary;
- Necessary PPE and other protective equipment to safely perform the task;

- Results of the **Arc Flash Risk Assessment**
  - Available incident energy at the working distance or arc flash PPE category;
  - Necessary PPE to protect against the hazard
- Means employed to restrict access of unqualified personnel from the work area;
- Evidence of completion of a JHA describing the hazards present;
- Evidence of completed Pre-job Safety Briefing (LU JHA) by a Qualified Person in Charge;
- Energized work approval
- Reviewed for completeness and clarity before work begins

Equipment Labeling (see NFPA 70E, 130.5 (D))

Each piece of equipment operating at 50 volts or more and not put into a de-energized state must be evaluated for arc flash and shock protection before completing an energized electrical work permit. **This evaluation will determine the Limited, Restricted, and Arc Flash Boundaries** and will inform the worker of what PPE is required. Once an evaluation of a piece of equipment is complete, an Arc Flash Hazard warning label must be affixed to any equipment which is likely to require examination, adjustment, servicing, or maintenance while energized and shall be visible to employees who may work on the equipment while energized.

It is the responsibility of the employee to follow the requirements of the Arc Flash Hazard label by wearing the proper PPE and using the proper insulated tools and other safety related equipment. This includes not working on or near the circuit unless that worker is a Qualified person.

Arc flash labels shall include:

- Equipment name
- Nominal system voltage
- Limited approach boundary
- Restricted approach boundary
- Arc flash boundary
- Incident energy values in cal/cm^2 and the corresponding working distance

Special Electrical Work Safety Considerations

Maintenance

Proper maintenance of electrical equipment is vital to ensure the safety of workers who may be exposed to electrical equipment in an energized or de-energized state. Additionally, proper maintenance can help to ensure continuity of operations of a given system, increase equipment and system reliability, and reduce the risk of fire. General maintenance requirements for Liberty University employees and equipment are as follows (per OSHA 29 CFR 1910.305-333 and NFPA 70E standard Article 110.4-6 and 26 requirements):

- Employees who perform maintenance on electrical equipment and installations shall be Qualified persons and shall be trained in, and familiar with, the specific maintenance procedures and tests required.
- A single line diagram, where provided for the electrical system, shall be maintained.
- All working space and clearances shall be maintained in accordance with requirements delineated in NFPA 70 (NEC).
- Equipment, raceway, cable tray, and enclosure bonding and grounding shall be maintained to ensure electrical continuity.
- Enclosures shall be maintained to guard against accidental contact with energized conductors and circuit parts and other electrical hazards.
- Locks, interlocks, and other safety equipment shall be maintained in proper working condition to accomplish the control purpose.
- Identification of components, where required, and safety-related instructions (operating and maintenance), if posted, shall be securely attached and maintained in legible condition.
- Warning signs, where required, shall be visible, securely attached, and maintained in legible condition.
- Circuit or voltage identification shall be securely affixed and maintained in updated and legible condition.
- Electrical cables and single and multiple conductors shall be maintained free of damage, shorts, and ground that would present a hazard to employees.
- Flexible cords and cables shall be maintained to avoid strain and damage.
    - Cords and cables shall not have worn, frayed, or damaged areas that present and electrical hazard to employees.

- Strain relief of cords and cables shall be maintained to prevent pull from being transmitted directly to joints or terminals.

Batteries

Prior to any work on a battery system, a **Risk Assessment** is to be performed to identify the following characteristics of batteries and associated systems:

- Chemical properties
- Electrical shock hazards
- Arc flash hazards

Single-Line Diagram

A single-line diagram allows workers to identify the main components of an electrical system and how they are connected, including redundant equipment. It will show a power distribution path from the incoming power source to each downstream load and will indicate the ratings of each piece of electrical equipment, their circuit conductors, and their protective devices.

A single-line diagram is required in order to perform effective maintenance and to implement effective electrical safety procedures.

Blind Reaching

The practice of blind reaching, or reaching into equipment without a clear line of sight, is prohibited. OSHA requires that employees "Test Before Touch" in order to avoid the risk of unintentional electric shock as a result of blind reaching.

Confined or Enclosed Workspaces

Confined spaces with live, exposed electrical parts are considered permit-required confined spaces. Work inside these spaces must be conducted in accordance with the **LU Confined Space Program**.

Overhead Lines

All equipment should be kept well away from overhead lines. The exact distance depends on the voltage in the overhead lines and can be determined by consulting Table 3 of this document. An employee other than the equipment operator shall watch during equipment movement to ensure the appropriate safe approach distance is maintained.

All work zones near overhead power lines are to be identified through demarcating boundaries (flags, cones, other barriers) or by defining the work zone as the area 360 degrees around equipment, up to the equipment's maximum working radius.

If any part of the equipment, load line or load could get closer than 20 feet to a power line when operated at its maximum working radius in the work zone, then one of the following options must be chosen:

- Confirm from the utility operator/owner that the power line has been de-energized and visibly grounded at the worksite;
- Ensure that no part of the equipment, load line, or load gets closer than 20 feet to the power line;
- Use Table 4 clearance.

All employees are required to be aware of the procedures to be followed in the event of electrical contact with a power line. These procedures must include:

- The importance of the operator to not touch equipment and the ground;
- The importance of the operator to remain inside the equipment cab unless there is imminent danger of fire or explosion or other emergency that necessitates leaving the cab;
- The safest means of evacuating equipment that may be energized;
- The danger of the potentially energized zone around equipment;
- The need for employees in the area to avoid approaching or touching equipment;

Identification of Disconnecting Means and Circuits

When working with electrical motors, extra caution should be given to the disconnection means. The disconnecting means for the motor shall be within sight of the motor, or not more than 50 ft. The disconnecting means should be readily accessible and plainly indicate whether it is in the "Off" or "On" position. If there is more than one disconnect, only one disconnect means need be readily accessible.

Each service, feeder, and branch circuit, at its disconnecting means or overcurrent device, should be legibly marked to indicate its purpose unless it is located and arranged so that the purpose is evident.

Guarding of Live Parts

Generally, guarding of live parts is intended to protect those employees that are not Qualified or trained to be in close proximity to live parts. Except as required, live parts of electric equipment operating at 50 volts or more shall be guarded against accidental contact by approved cabinets or other forms of approved enclosures, or by any of the following means:

- By location in a room, vault, or similar enclosure that is accessible only to qualified persons;
- By suitable permanent and substantial partitions that are so arranged to allow only qualified persons access to the space within reach of the live parts;
- By location on a suitable balcony or platform;
- By elevation of 8 feet or more above the floor or other working surface.

Entrances to rooms and other guarded locations containing live exposed parts shall be marked with warning signs forbidding unqualified persons to enter.

One of the most common jobs for LU employees engaged in Electrical Work involves

- **VAV/PIU (air-handling) boxes**, the following Special Rules shall apply for this type of equipment:

  - The **3-Foot Approach rule** applies, when potentially energized and exposed voltages are identified above 50 Volts AC or DC. The presence of such voltage shall be identified by use of a non-contact voltage detector before the equipment is opened. Once the presence of voltage is identified, minimum Class "0" electrical rubber-gloves shall be donned before approaching within 3-feet. Electrical Rubber-Gloves may not be removed until the circuit has been verified as de-energized by means of a calibrated multi-meter using the test-verify-test method.

- Additionally, work on **VFD (Variable Frequency Drives)** will follow the same preceding process, therefore:

  - All VFD equipment which has the potential to be energized (power on) shall be verified before making contact with the equipment by means of a non-contact voltage detector or similar device, and if the presence of voltage is indicated, then Class "0" Electrical Rubber-gloves shall be donned before approaching within 3-feet of the equipment and performing further verification with a multi-meter. This typically will apply with regards to the incoming 480 or 277/240 Volt molded-case circuit breaker terminals.

VII. Annual Review Process

EHS, in conjunction with LU Supervisors and designated LU Departmental Managers, will conduct an annual review of each work group that performs Electrical work activities within the scope of this Program and Procedure to correct any areas of concern that have been identified. Annual reviews shall be performed on written Electrical Work Procedures for employees using such procedures during their annual job performance evaluation. Information from such reviews should be retained for a period of not less than five years.

VIII. Training

Training shall be provided to all employees who perform work on or near equipment which has the potential to produce Hazardous Energy. Training is provided by the Environmental Health & Safety Department. The training program should enable employees to recognize the hazards associated with working near Hazardous Energy and provide the requirements to be followed to minimize these hazards. Training must be completed and documented prior to employees working in areas where such hazards exist.

Training and certification of employees and supervisors must be documented. The trainer prepares a written training log complete with student printed names, date, signatures, and a summary of the training completed.

If the training is used to establish the employee as Qualified under 29 CFR 1910.269, it must be followed by proof of knowledge level such as a passing grade on a written exam or quiz and hands-on evaluation, and there must be some type of document acknowledging satisfactory completion.

All Qualified personnel are fully trained in the practices and requirements covered in an OSHA Electrical and NFPA 70E Safety Training Course. A worker has training in the following areas to be considered qualified:

- Safety-related work practices, safety procedures, and other safety requirements relating to their job assignments.
- Any other safety practices, including applicable emergency procedures, related to their work and necessary for their safety.
- Sufficient practical electrical work experience to demonstrate knowledge (such as interpreting schematic diagrams and identifying backfeed) and competency, especially regarding safety.

When workers are performing electrical work near potentially energized circuits, Cardiopulmonary resuscitation (CPR), First Aid, and blood borne pathogens (BBP) training is required.

- OSHA requires that a trained responder be located within 4 minutes of the potentially energized electrical work above 50 Volts.
- To be considered as trained, Employees must have received training in accordance with minimum retraining requirements of the CPR, First Aid, and BBP certifying entity (i.e., Red Cross, AHA, etc.).
- Such trained Employees Should also demonstrate training in rescue for shock at least every three years.

A **"Qualified Electrical Worker"** must have:

- Skills and techniques necessary to distinguish exposed energized parts from the other parts of electrical equipment, machines, and processes.
- Skills and techniques necessary to determine the nominal voltage of exposed parts.
- Knowledge and understanding of the clearance and minimum approach distances required when working with equipment energized or potentially energized and to which workers are exposed.
- Understanding regarding the proper use of the special precautionary techniques, personal protective equipment, insulating and shielding materials, and insulating tools when required.
- Skills and techniques necessary for the understanding of switching transients, induced and static voltages, grounding integrity, condition of poles and structures, and circuit and equipment location.
- Satisfactory completion (including comprehension testing) of an OSHA Electrical and NFPA 70E Safety Training Course, taught by a Qualified Competent Instructor.

Retraining

If seldom-used safety-related work practices are employed (OSHA considers these to be tasks that are performed less than once a year), training or retraining precedes performance of the task. **Minimum 3-year refresher training (per NFPA 70E Article 110.6)** shall be required for the electrical concepts of this Program and Procedure. All new-hire employees shall be trained within 90 days of employment unless previous training within the preceding three-years can be validated by documentation.

IX. Recordkeeping

It is the responsibility of each LU department to maintain applicable records for employees regarding issuance and maintenance of Electrical tools and devices.

- Employee training must be maintained for all employees exposed to Hazardous Electrical Energy.
- All inspection and certification records must be maintained for Electrical tools and devices.
- An Inventory of Electrical tools and devices should be maintained.

X. Periodic Program and Procedure Review

At least annually, the Environmental Health and Safety Program Administrator will conduct a review to assess the Program's effectiveness. The annual review will be evaluated, and the Program will be updated as necessary to include regulations and standards updates.

XI. Enforcement

Failure to follow the **Liberty University Electrical Safety Program and Live Work Procedure** can result in life threatening or serious injury situations for staff, facility, students, and visitors. Failure to comply with the Program and/or Procedure requirements can result in disciplinary action up to and including discharge of employment.

Appendix Attachments

Attachment A: Standards for Personal Protective Equipment (PPE)

Subject	Number and Title
Head protection	ANSI Z89.1, *Requirements for Protective Headwear for Industrial Workers*, 2009
Eye and face protection	ANSI Z87.1, *Practice for Occupational and Educational Eye and Face Protection,* 2003
Gloves	ASTM D 120, *Standard Specification for Rubber Insulating Gloves,* 2009
Sleeves	ASTM D 1051, *Standard Specification for Rubber Insulating Sleeves,* 2008
Gloves and sleeves	ASTM F 496, *Standard Specification for In-Service Care of Insulating Gloves and Sleeves*, 2008
Leather protectors	ASTM F 696, *Standard Specification for Leather Protectors for Rubber Insulating Gloves and Mittens*, 2006
Footwear	ASTM F 1117, *Standard Specification for Dielectric Overshoe Footwear,* 2008 ANSI Z41, *Standard for Personnel Protection, Protective Footwear,* 2006
Visual inspection	ASTM F 1236, *Standard Guide for Visual Inspection of Electrical Protective Rubber Products,* 2007
Apparel	ASTM F 1506, *Standard Specification for Protective Wearing Apparel for Use by Electrical Workers When Exposed to Momentary Electric Arc and Related Thermal Hazards,* 2010

ANSI – American National Standards Institute

ASTM – American Society for Testing and Materials

ATTACHMENT B

ENERGIZED ELECTRICAL WORK PERMIT

PART II: TO BE COMPLETED BY THE ELECTRICALLY QUALIFIED PERSONS DOING THE WORK:

Check when complete

(1) Detailed job description procedure to be used in performing the above detailed work: ☐

(2) Description of the safe work practices to be employed: ☐

(3) Results of the shock risk assessment:
- (a) Voltage to which personnel will be exposed ☐
- (b) Limited approach boundary ☐
- (c) Restricted approach boundary ☐
- (d) Necessary shock, personal and other protective equipment to safely perform assigned task ☐

(4) Results of the arc flash risk assessment:
- (a) Available incident energy at the working distance or Arc Rated PPE Category ☐
- (b) Necessary arc flash personal and other protective equipment to safely perform the assigned task ☐
- (c) Arc flash boundary ☐

(5) Means employed to restrict the access of unqualified persons from the work area: ☐

☐ Barricade ☐ Attendants ☐ Other(specify)

(6) Evidence of completion of a job briefing, including discussion of any job-related hazards: ☐

(7) Do you agree the above-described work can be done safely? ☐ Yes ☐ No (If *no*, return to requester.)

_____ _____

Electrically Qualified Person(s) Date

_____ _____

Electrically Qualified Person(s) Date

PART III: APPROVAL(S) TO PERFORM THE WORK WHILE ELECTRICALLY ENERGIZED

_____ _____

Department Manager Engineering Manager (if Applicable)

_____ _____

EHS Manager	Electrically Knowledgeable Person
_____	_____
Department Supervisor	Date

Note: Once the work is complete, forward this form to your Department and LU EHS for review and retention.

If you customize, you must maintain key signatures:

1. Person doing the work agreeing it can be done safely.
2. Justification for WHY it is being done energized.
3. Steps taken to assure it is done safely for electrical and all staff.
4. Management level approval.
5. Another electrically knowledgeable person other than the one doing the work
6. Any other NFPA 70E requirements in the current standard for EEWP.

Electrically Safe Work Procedure (ESWP)

This Electrically Safe Work Procedure defines the steps to be taken by an **Authorized Qualified Electrical Worker** before any maintenance is performed on the machine/s or equipment identified below. Use additional rows or pages as needed.

Description of Machine/Equipment/Circuit:	**Machine/Equipment/ Circuit ID#:**
All Affected personnel notified that service or maintenance is required?	**Check** ☐
Machine or equipment safely shut down by the Authorized Qualified Electrical Worker?	**Check** ☐

Steps to isolate and lockout/tagout energy source

Voltage Level AC or DC?	Energy Isolation Device (Circuit-breaker, switch, etc.)	Device ID # or location	Action required on energy isolation device, (e.g., open and lock)	Lock ID/ Tag Properly Completed	Installed By	Verified By	Removed By

Steps to render stored or residual energy safe and maintain safe

Type of Energy	Energy Control Device (Disconnect device, valve, etc.)	Device ID # or location	Method to dissipate or restrain stored energy MAY INCLUDE GROUNDING	Lock/Bleed/Blind ID	Installed By	Verified By	Removed By

Steps to verify zero energy state (e.g., Attempt to Start Machine, VERIFY ZERO VOLTAGE by LIVE-DEAD-LIVE Method	
	Check ☐
	Check ☐
	Check ☐

Steps to restore equipment to service	
Machine/Equipment inspected to ensure that nonessential items are removed, components are operational, system checks completed as necessary, and all personnel are clear? (Grounds removed)	**Check** ☐
Lockout/tagout devices removed from energy isolation/control devices listed above?	**Check** ☐
Affected employees notified that service or maintenance is complete and machine/equipment ready for use?	**Check** ☐
Authorized Qualified Electrical Worker verifies adequacy of ESWP and that any discrepancies are corrected?	**Check** ☐

Authorization		
	Name	**Date**
ESWP Written By:		
ESWP Approved By:		

Energy Type:

E - Electrical	P - Pneumatic	S - Steam	H - Hydraulic	G - Gravity	M - Mechanical	PR – Pressure

Note: The Electrically Safe Work Procedure must be attached to the JHA or Safety Briefing, Hazardous Work Permit, or Confined Space Entry Permit when a lockout/tagout is required.

ATTACHMENT D

LIBERTY UNIVERSITY
ENVIRONMENTAL HEALTH & SAFETY

Job Hazard Analysis Form

3552 Young Place, Lynchburg VA 24501
434-582-3389 / lusafety@liberty.edu

Picture of task/equipment:	Task:	
	Project:	
	Name of Shop or Dept.:	
	Job Title(s):	
	Analyzed by:	
	Date:	

Required PPE:

Safety Toed boots 

Safety glasses 

Gloves 

Required/Recommended Trainings:

Videos/Reference Materials:

TASK	HAZARDS	CONTROLS

Sign in Sheet

Project Name:				
Date:				
Employee Name (Print)	**Employee Signature**	**LU ID #**	**Date**	**Department**

By signing this form, you agree that your supervisor or lead has reviewed the hazards associated with the job tasks and has explained the controls that are required to reduce the potential for injury. If there is something you don't understand, it is your responsibility to ask your supervisor or lead to clarify what you need to do to maintain a safe work environment. If your supervisor does not have an answer contact Environmental Health and Safety at 434-582-3389 to have the work task evaluated.

Power Cord and Extension Cord Guidance

While cordless power tools are quickly replacing corded tools in the workplace, there are still many situations that require the use of a corded tool or electrical extension cord. Used properly, these tools make the job quicker and easier, but used improperly, electrical cords can be very dangerous. The key to keeping employees safe when using electrical cords is to ensure the proper cords are selected and used, and that they are kept in good condition. The guidelines below represent the minimum requirements for safe operation of power cords and extension cords.

Tool and Equipment Power Cord - Flexible power cords are used to minimize the likely hood of damage or wear from repeated movement or vibration of the equipment it's attached to, or when a tool or piece of equipment needs to be portable. Tools are typically designed with power cords that will safely handle the amount of current the tool requires without heating or shorting. When using a tool or piece of equipment with a power cord, make sure that the power source is properly rated for the tool or equipment to be used.

A power cord will be made of two or more inner conductive wires with rubberized insulation around each wire, covered by an outer casing or jacket of rubberized plastic that protects the inner insulation. Depending on the type of equipment, the cord may or may not have a ground conductor. Hand-held tools that are manufactured with non-metallic cases are called "double-insulated". If approved by nationally recognized testing laboratory (NRTL) such as Underwriter's Laboratory (UL Approved), they do not require grounding under the National Electrical Code. Although this design method reduces the risk of grounding deficiencies, a shock hazard can still exist. Other equipment that has metal as part of its housing is required to have a ground wire and grounding pin on the plug of the cord. This grounding pin cannot be removed, and a 3-to-1 plug adaptor cannot be used with the equipment.

Extension Cords - These cords, also called "temporary flexible cables", are used when power is needed at a location that does not have an outlet within reach of a tool or light power cord. The key word to remember about extension cords is "temporary". These cords are to be used for temporary purposes such as maintenance or repair work, or during construction activities. These cords are not designed or allowed to be used as permanent wiring. In workplace settings, all extension cords must be grounding cords. This means that they have to have a power (or Hot) wire, a neutral wire, and a ground wire. Usually the power wire is black, the neutral wire is white, and the ground wire is green, but this might not be the case in all pieces of equipment.

Care should be given when using extension cords so that the cords do not create tripping hazards. Extension cords should not be run across walkways or aisle ways where they could cause a hazard or where they could be damaged by vehicles or material handling equipment such as forklifts.

Both power cords and extension cords should be free of any visible damage including:

- cut or torn outer insulation jacket or inner insulation,
- dry rot,
- cracked, or worn outer insulation jackets,
- exposed inner insulation,
- outer jacket pulled from the cord end,
- missing ground pin,
- Spring-liked or coiled appearance (caused by repeated overheating of the conductors)

If repairs become necessary on equipment power cords or extension cords, the repaired cord must have the same protective rating as the original cord. This means that an "electrical tape repair" is not allowed since it does not provide the same level of protection as the original out jacket insulation. If a power cord's outer jacket is compromised, the cord/tool should be removed from service and the entire cord should be replaced. If the rubber strain relief provided where the cord enters the tool becomes damaged or is missing, the tools should be removed from service until the strain relief can be replaced. If the plug of a cord becomes damaged, either by having the outer jacket insulation pulled out of the plug, or the grounding pin is loose or missing, the tool should be taken out of service until the plug can be replaced. Any repairs to power cords should be done by a competent person that has been trained on how to select the correct replacement parts and how to properly install them. If a tool or cord needs repair replace or contact facilities management electrical department for repair.

Revision Tracking

Revision Number	Revision Description	Revision Location	Date Originated/Revised	Policy Author/Reviser:	Policy Approvers
01	Original		March 2022	Bob Drane Greg Bennett	Ronald Sloan John Peterson Greg Bennett
02	Attachment and language clarifications		March 2022	Bob Drane	Ronald Sloan John Peterson Greg Bennett

Document Approval Sheet

Liberty University Electrical Safety Program and Live Work Procedure

_____ Date: _____

Greg Bennett
Director
Environmental Health & Safety
Security & Public Safety

_____ Date: _____

John Peterson
Employee Leave and Welfare Administrator
Human Resources

_____ Date: _____

Ronald T. Sloan
Vice President
Office of Security & Public Safety