



BRIGHAM YOUNG UNIVERSITY – IDAHO

ENVIRONMENTAL, HEALTH & SAFETY

SAFETY DEPARTMENT

ELECTRICAL SAFETY PROGRAM

EH-032-R00

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1.0 Overview

This policy is intended to establish safety requirements for University faculty, staff, students, and contractors who may work with or near electrically energized equipment during the course of normal activities, including the service and repair of electrical equipment. Separate lock out / tag out and confined space entry policies are already in place in connection with this policy.

2.0 Scope

All University employees and contractors will abide by all procedures set forth in this document. It is understood that an employee's failure to follow these policies and procedures may subject that employee to disciplinary action. Contractors that fail to follow these policies and procedures may be subject to removal from university property and cancellation of the contract.

3.0 Document Control

Maintenance / Revision

The Safety Office is responsible for the periodic review and updating of this policy.

Approvals:

The procedure as well as all Environmental, Health, and Safety (EH&S) procedures must be approved by the University Safety Officer and the University Resources Vice President.

Approved by: _____ Date: _____
University Safety Officer

Approved by: _____ Date: _____
University Resources Vice President

4.0 Roles & Responsibilities

By authority delegated from the University President, the University Resources Vice President is responsible for the safety of all University facilities. Under this authority, policies are developed to provide a safe teaching, service, housing and recreational environment.

4.1 BYU-I Safety Office

The Safety Office is responsible for the periodic review and updating of this policy. The Safety Office will also assist in electrical safety presentations when requested. Inspections to monitor compliance with this and other safety related policies will be performed by the Safety Office on a routine basis in addition to that performed by the Electrical Services Department.

4.2 University Departments

Each University department is responsible for the implementation of the policy within their respective departments. Training requirements associated with this policy will be the responsibility of the Department to provide, and may be scheduled through the Safety Office.

4.3 Supervisors

It is the supervisor's responsibility to enforce this policy. Supervisors are also responsible for the identification of and correction of potential electrical safety hazards. Supervisors are expected to identify employees requiring specialized training to safely complete their tasks relative to this policy.

4.4 Employees

All employees are required to comply with this policy. Any concerns related to electrical safety should be reported to supervisors.

5.0 Covered Work

5.1 Electrical safety work practices for all personnel working on, near or with the following installations:

- 5.1.1 Premises wiring. Installations of electric conductors and equipment within or on buildings or other structures, and on other premises such as yards, parking lots and substations.
- 5.1.2 Wiring for connection to supply. Installations of conductors that connect to the supply of electricity.
- 5.1.3 Other wiring. Installations of other outside conductors on the premises.
- 5.1.4 Optical fiber cable. Installations of optical fiber cable where such installations are made along with or next to electric conductors.
- 5.1.5 Installations in vehicles and/or other equipment.
- 5.1.6 Generation, transmission and distribution of electrical energy (including communication and metering) located in buildings used for such purposes or located outdoors.
- 5.1.7 All other electrical work as required.

6.0 Excluded Work

The provisions of 29 CFR 1910.331 through 1910.335 do not apply to work performed by qualified persons on or directly associated with the following installations:

- 6.1 Telecommunication installations. Installations of communication equipment to the extent that the work is covered by 29 CFR 1910.268.

7.0 ARC Flash Hazards

Following the guidance in the National Fire Protection Association (NFPA) 70E, 2012 Edition, safety-related work practices have been established to protect against arc flash hazards resulting from either direct or indirect electrical contacts of 50 volts or more when work is performed near or on equipment of circuits that are or may be energized

- 7.1 Approach boundaries to energized electrical conductors or circuit parts for shock protection (Please see Appendix C, or NFPA 70E, 2012 Edition Table 130.4(c)).

7.2 Arc Flash Protection Boundary

7.2.1 Voltage levels between 50 Volts and 600 Volts. In those cases where detailed arc flash hazard analysis calculations are not performed for systems that are between 50 volts and 600 volts, the Arc Flash Protection Boundary shall be 4.0 ft, based on the product clearing time of 2 cycles (0.033 seconds) and the available bolted fault current of 50 kA or any combination not exceeding 100 kA cycles (1667 ampere seconds). When the product of clearing times and bolted fault current exceeds 100 kA, the Arc Flash Protection Boundary shall be calculated.

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

- 7.2 Hazard/Risk Category Classifications and Use of Rubber Insulating Gloves and Insulated Hand Tools (Please see Appendix D, NFPA 70E, 2012 Edition, Table 130.7(c) (9))

7.3 Protective Clothing and Personal Protection Equipment Requirements and Characteristics:

7.3.1 Protective Clothing and Personal Protective Equipment Requirements for different Hazard/Risk Categories (Please see Appendix E, NFPA 70E, 2012 Edition, Table 130.7(c) (16)).

8.0 Work Practices

Safety-related work practices have been established to prevent electric shock or other injuries resulting from either direct or indirect electrical contacts, when work is performed near or on equipment or circuits that are or may be energized.

8.1 **Pre-job Briefing** A pre-job briefing on the type of work being performed and what is involved should always be done first. Items to be covered include:

- 8.1.1 Information needed to perform the job
- 8.1.2 Teamwork requirements
- 8.1.3 Safety items such as a review of the hazards involved
- 8.1.4 Personal protective equipment and clothing requirements
- 8.1.5 Lockout/tagout requirements
- 8.1.6 Hot work or other special issues
- 8.1.7 Expected outcomes
- 8.1.8 What to do if there is a problem or unexpected response
- 8.1.9 Emergency procedures
- 8.1.10 Emergency escape routes
- 8.1.11 Energized equipment / cable proximity permit

8.2 **10.2 De-energized Parts**

Live parts to which an employee may be exposed shall be de-energized before the employee works on or near them, unless de-energizing introduces additional or increased hazards or is infeasible due to equipment design or operational limitations. Live parts that operate at less than 50 volts to ground need not be energized if there will be no increased exposure to electrical burns or to explosion due to electric arcs.

- 8.2.1 Examples of increased or additional hazards include, but are not limited to, interruption of life support equipment, deactivation of emergency alarm systems, shut-down of hazardous location ventilation equipment, or removal of illumination for an area.
- 8.2.2 Examples of work that may be performed on or near exposed energized conductors or circuit parts because of infeasibility due to equipment design or operational limitations include performing diagnostics and testing (e.g., start-up or trouble-shooting) of electric circuits that can only be performed with the circuit energized and work on circuits that form an integral part of a continuous process that would otherwise need to be completely shut down in order to permit work on one circuit or piece of equipment.
- 8.2.3 Conductors and parts of electric equipment that have been de-energized but have not been locked out or tagged shall be treated as energized parts.

8.3 Control of Hazardous Energy Program (Lockout/Tagout)

While any employee is exposed to contact with parts of fixed electric equipment or circuits which have been de-energized, the circuits energizing the parts shall be locked out, tagged out, or both locked and tagged out in accordance with the University Control of Hazardous Energy Program (Lockout/Tagout).

8.3.1 As used in this section, fixed equipment refers to equipment fastened in place or connected by permanent wiring methods.

8.4 Vehicular and Mechanical Equipment

8.4.1 Any vehicle or mechanical equipment capable of having parts of its structure elevated near energized overhead lines shall be operated so that a clearance of 10 ft. (305 cm) is maintained. If the voltage is higher than 50kV, the clearance shall be increased 4 in. (10 cm) for every 10kV over that voltage. However, under any of the following conditions, the clearance may be reduced:

8.4.1.1 If the vehicle is in transit with its structure lowered, the clearance may be reduced to 4 ft. (122 cm). If the voltage is higher than 50kV, the clearance shall be increased 4 in. (10 cm) for every 10 kV over that voltage.

8.4.1.2 If insulating barriers are installed to prevent contact with the lines, and if the barriers are rated for the voltage of the line being guarded and are not a part of or an attachment to the vehicle or its raised structure, the clearance may be reduced to a distance within the designed working dimensions of the insulating barrier.

8.4.1.3 If the equipment is an aerial lift insulated for the voltage involved, and if a qualified person performs the work, the clearance (between the uninsulated portion of the aerial lift and the power line) may be reduced to the distance given in the Approach Distances for Qualified Employees Table.

8.4.1.4 Employees standing on the ground may not contact the vehicle or mechanical equipment or any of its attachments, unless:

8.4.1.4.1 The employee is using protective equipment rated for the voltage; or

8.4.1.4.2 The equipment is located so that no uninsulated part of its structure (the portion of the structure that provides conductive path to employees on the ground) can come closer to the line than permitted in this section.

8.4.1.4.3 If any vehicle or mechanical equipment capable of having parts of its structure elevated near energized overhead lines is intentionally grounded, employees working on the ground near the point of grounding may not stand at the grounding location whenever there is a possibility of overhead line contact.

8.4.1.4.4 Additional precautions, such as the use of barricades or insulation, shall be taken to protect employees from hazardous ground potentials, depending on earth resistivity and fault currents, which can develop within the first few feet or more outward from the grounding point.

8.5 **Illumination**

8.5.1 Employees may not enter spaces containing exposed energized parts, unless illumination is provided that enables the employees to perform the work safely.

8.5.2 Where lack of illumination or an obstruction precludes observation of the work to be performed, employees may not perform tasks near exposed energized parts. Employees may not reach blindly into areas that may contain energized parts.

8.6 **Confined or Enclosed Work Spaces**

8.6.1 When an employee works in a confined or enclosed space (such as a manhole or vault) that contains exposed energized parts or high voltage cable, the employer shall provide, and the employee shall use, protective shields, protective barriers, or insulating materials as necessary to avoid inadvertent contact with these parts.

8.6.2 Doors, hinged panels, and the like shall be secured to prevent their swinging into an employee and causing the employee to contact exposed energized parts.

8.6.3 Refer to BYU-Idaho's Confined Space Program.

8.7 **Conductive Materials and Equipment**

8.7.1 Conductive materials and equipment that are in contact with any part of an employee's body shall be handled in a manner that will prevent them from contacting exposed energized conductors or circuit parts.

8.7.2 If an employee must handle long dimensional conductive objects (such as ducts and pipes) in areas with exposed live parts, work practices (such as

the use of insulation, guarding and material handling techniques) shall be used to minimize the hazard.

8.8 **Portable Ladders**

Portable ladders shall have nonconductive side rails if they are used where the employee or the ladder could contact exposed energized parts.

8.9 **Conductive Apparel**

8.9.1 Conductive articles of jewelry and clothing (such as watch bands, bracelets, rings, key chains, necklaces, metalized aprons, cloth with conductive thread, or metal headgear) may not be worn if they might contact exposed energized parts.

8.9.2 Such articles may be worn if they are rendered nonconductive by covering, wrapping or other insulating means.

8.10 **Housekeeping Duties**

8.10.1 Where live parts present an electrical contact hazard, employees may not perform housekeeping duties at such close distances to the parts that there is a possibility of contact, unless adequate safeguards (such as insulating equipment or barriers) are provided.

8.10.2 Electrically conductive cleaning materials (including conductive solids such as steel wool, metalized cloth, and silicon carbide, as well as conductive liquid solutions) may not be used in proximity to energized parts unless procedures are followed which will prevent electrical contact.

8.11 **Interlocks**

8.11.1 Only a qualified person following the requirements of this section may defeat an electrical safety interlock, and then only temporarily while he or she is working on the equipment.

8.11.2 The interlock system shall be returned to its operable condition when this work is completed.

9.0 **Protective Equipment**

Personal protective equipment requirements are contained in 29 CFR 1910.137, Electrical Protective Equipment

9.1.1 Employees working in areas where there are potential electrical hazards shall be provided with, and shall use, electrical protective equipment that

is appropriate for the specific parts of the body to be protected and for the work to be performed.

- 9.1.2 Protective equipment shall be maintained in a safe, reliable condition and shall be periodically inspected or tested.
- 9.1.3 If the insulating capability of protective equipment may be subject to damage during use, the insulating material shall be protected. (For example, an outer covering of leather is sometimes used for the protection of rubber insulating material.)
- 9.1.4 Employees shall wear nonconductive head protection wherever there is a danger of head injury from electric shock or burns due to contact with exposed energized parts.
- 9.1.5 Employees shall wear protective equipment for the eyes and face wherever there is danger of injury to the eyes or face from electric arcs or flashes or from flying objects resulting from electrical explosion.

9.2 General Protective Equipment and Tools

- 9.2.1 When working near exposed energized conductors or circuit parts, each qualified employee shall use insulated tools or handling equipment if the tools or handling equipment might make contact with such conductors or parts.
 - 9.2.1.1 If the insulating capability of insulated tools or handling equipment is subject to damage, the insulating material shall be protected.
- 9.2.2 Fuse handling equipment, insulated for the circuit voltage, shall be used to remove or install fuses when the fuse terminals are energized.
- 9.2.3 Ropes and hand lines used near exposed energized parts shall be nonconductive.

9.3 Protective shields, barriers, or insulating materials

- 9.3.1 Protective shields, barriers, or insulating materials shall be used to protect each qualified employee from shock, burns, or other electrically related injuries while that employee is working near exposed energized parts which might be accidentally contacted or where dangerous electric heating or arcing might occur.
- 9.3.2 When normally enclosed live parts are exposed for maintenance or repair, they shall be guarded to protect unqualified persons from contact with the live parts.

9.4 Alerting Techniques

9.4.1 The following alerting techniques shall be used to warn and protect employees from hazards that could cause injury due to electric shock, burns, or failure of electric equipment parts:

9.4.1.1 Safety signs, safety symbols, labels, or accident prevention tags shall be used where necessary to warn employees about electrical hazards that may endanger them, as required by 29 CFR 1910.145.

9.4.1.2 Barricades shall be used in conjunction with safety signs where it is necessary to prevent or limit employee access to work areas exposing employees to uninsulated energized conductors or circuit parts.

9.4.1.3 Conductive barricades may not be used where they might cause an electrical contact hazard.

9.4.1.4 If signs and barricades do not provide sufficient warning and protection from electrical hazards, an attendant shall be stationed to warn and protect employees.

10.0 Use of Equipment

The following Electrical Safety Related Work Practices have been adapted from 29 CFR 191.334, Use of equipment:

10.1 Portable Electric Equipment

10.1.1 Portable Electric Equipment applies to the use of cord and plug connected equipment, including flexible cord sets (extension cords).

10.1.2 Equipment must be handled in a way that will not cause damage. Electric cords connected to equipment may not be used for hoisting or lowering the equipment; may not be fastened with staples or hung in a manner that could damage the outer jacket or insulation.

10.1.3 A visual inspection shall be exercised before use on each shift for external defects and for evidence of possible internal damage. If a defect or evidence of damage is noted, remove the equipment from service and return it to the Department Supervisor.

10.1.4 Attachment plugs that are to be connected to a receptacle shall be checked to ensure that they are of proper mating configuration.

10.1.5 A flexible cord used with grounding type equipment shall contain an equipment-grounding conductor.

- 10.1.6** Attachment plugs and receptacles may not be connected or altered in a manner that would prevent proper continuity of the equipment-grounding conductor at the point where plugs are attached to receptacles.
 - 10.1.6.1 Additionally, these devices may not be altered to allow the grounding pole of a plug to be inserted into slots intended for connection to the current carrying conductors.
 - 10.1.6.2 Adapters that interrupt the continuity of the equipment grounding connection may not be used.
- 10.1.7** Portable electric equipment and flexible cords used in highly conductive work locations (such as those inundated with water or other conductive liquids), or in job locations where employees are likely to contact water or conductive liquids, shall be approved for those locations and shall be ground fault protected (GFCI).
- 10.1.8** Employee's hands may not be wet when plugging and unplugging flexible cords and cord and plug connected equipment, if energized equipment is involved.
- 10.1.9** Energized plug and receptacle connections may be handled only with insulating protective equipment if the condition of the connection could provide a conducting path to the employee's hand (if, for example, a cord connector is wet from being immersed in water).
- 10.1.10** Locking type connectors shall be properly secured after connection.
- 10.1.11** Flexible electric cords (extension cords) are considered to be temporary and may not be used for more than 90 days consecutively.

10.2 **Electric Power and Lighting Circuits**

- 10.2.1** Load rated switches, circuit breakers, or other devices specifically designed as disconnecting means shall be used for the opening, reversing, or closing of circuits under load conditions.
- 10.2.2** Cable connectors not of the load break type, fuses, terminal lugs, and cable splice connections may not be used for such purposes, except in an emergency.
- 10.2.3** After a circuit is de-energized by a circuit protective device, the circuit may not be manually re-energized until it has been determined that the equipment and circuit can be safely energized.
- 10.2.4** Repetitive, manual re-closing of circuit breakers or reenergizing circuits through replaced fuses is prohibited.
 - 10.2.4.1 When it can be determined from the design of the circuit and the overcurrent devices involved that the automatic operation of a device was caused by an overload rather than a fault condition,

no examination of the circuit or connected equipment is needed before the circuit is re-energized.

- 10.3 Overcurrent protection of circuits and conductors may not be modified, even on a temporary basis, beyond that allowed by 29 CFR 1910.304(e).

10.4 Test Instruments and Equipment

10.4.1 Only qualified persons may perform testing work on electric circuits or equipment.

10.4.2 Test instruments and equipment and all associated test leads, cables, power cords, probes, and connectors shall be visually inspected for external defects and damage before the equipment is used.

10.4.2.1 If there is a defect or evidence of damage that might expose an employee to injury, the defective or damaged item shall be removed from service and forwarded to the employee's Supervisor.

10.4.2.2 No employee may use it until repairs and tests necessary to render the equipment safe have been made.

10.4.3 Test instruments and equipment and their accessories shall be rated with an overvoltage category of 3 or better for the circuits and equipment to which they will be connected and shall be designed for the environment in which they will be used.

10.5 Use of Flammable or Ignitable Materials

10.5.1 Where flammable materials are present, electric equipment capable of igniting them shall not be used, unless measures are taken to prevent hazardous conditions from developing.

10.5.2 Such materials include, but are not limited to: flammable gases, vapors or liquids; combustible dust; and ignitable fibers or filings.

10.5.3 Electrical installation requirements for locations where flammable materials are present on a regular basis are contained in 29 CFR 1910.307.

11.0 Training

11.1 General

The training requirements contained in this section shall apply to employees who face a risk of electrical hazard that is not reduced to a safe level by the applicable electrical installation and maintenance requirements. Such employees shall be trained to understand the specific hazards associated with electrical energy. They shall be trained in safety-related work practices and procedural requirements, as necessary, to provide protection from the electrical hazards associated with their

respective job or task assignments. Employees shall be trained to identify and understand the relationship between electrical hazards and possible injury.

11.2 Training

The training required by this policy shall be a combination of classroom and on-the-job. The degree of training provided shall be determined by the risk to the employee.

11.3 Retraining

Employee retraining, and auditing this safety program, shall take place at least every 3 years.

11.4 Contractors

The contract employer shall provide documentation that each of his or her employees is instructed in the hazards communicated to the contract employer by the university. This instruction shall be in addition to the basic training required by this policy.

The contract employer shall provide copies of the training records showing their effected employees meet the training requirements of this policy and that they understand the hazards.

11.5 Emergency Procedures

Employees exposed to shock hazards and those employees responsible for taking action in case of emergency shall be trained in methods of release of victims from contact with exposed energized electrical conductors or circuit parts. Employees shall be regularly instructed in methods of first aid, emergency procedures, and CPR / AED. Employees shall be certified in first aid and CPR / AED every 2 years with a review every year.

11.6 Employee Training

11.6.1 Qualified Person. A qualified person shall be trained and knowledgeable of the construction and operation of equipment or a specific work method and be trained to recognize and avoid the electrical hazards that might be present with respect to that equipment or work method.

(a) Such persons shall also be familiar with the proper use of the special precautionary techniques; personal protective equipment including arc flash clothing; insulating and shielding materials; and insulated tools and test equipment. A person can be considered qualified with respect to certain equipment and methods but still be unqualified for others.

(b) Such persons permitted to work within the limited approach boundary of exposed energized electrical conductors and circuit parts operating at 50 volts or more shall, at a minimum, be additionally trained in all of the following:

- (1) Skills and techniques necessary to distinguish exposed energized electrical conductors and circuit parts from other parts of electrical equipment
- (2) Skills and techniques necessary to determine the nominal voltage of exposed energized electrical conductors and circuit parts
- (3) Approach distances specified in Table 130.4(C)(a) and Table 130.4(C)(b) and the corresponding voltages to which the qualified person will be exposed (NFPA 70E-2012). (Appendix C)
- (4) Decision-making process necessary to determine the degree and extent of the hazard and the personal protective equipment and job planning necessary to perform the task safely

(c) An employee who is undergoing on-the-job training for the purpose of obtaining the skills and knowledge necessary to be considered a qualified person and who, in the course of such training, has demonstrated an ability to perform specific duties safely at his or her level of training, and who is under the direct supervision of a qualified person, shall be considered to be a qualified person for the performance of those specific duties for which trained.

(d) Tasks that are performed less often than once per year shall require retraining before the performance of the work practices involved.

(e) Employees shall be trained to select an appropriate voltage detector and shall demonstrate how to use a device to verify the absence of voltage, including interpreting indications provided by the device. The training shall include information that enables the employee to understand all limitations of each specific voltage detector that might be used.

(f) The employer shall determine, through regular supervision or through inspections conducted on at least an annual basis that each employee is complying with the Safety related work practices required by this standard.

11.6.2 Unqualified Persons. Unqualified persons shall be trained in, and be familiar with, any electrical safety related practices necessary for their safety.

11.6.3 Retraining. An employee shall receive additional training (or retraining) under any of the following conditions:

- (1) If the supervision or annual inspections indicate that the employee is not complying with the safety-related work practices
- (2) If new technology, new types of equipment, or changes in procedures necessitate the use of safety-related work practices that are different from those that the employee would normally use
- (3) If he or she must employ safety-related work practices that are not normally used during his or her regular job duties

11.7 Training Documentation

The university shall document that each employee has received the training required. This documentation shall be completed when the employee demonstrates proficiency in the work practices involved and shall be maintained for the duration of the employee's employment. The documentation shall contain the content of the training, each employee's name, and dates of training.

APPENDIX A

Definitions

Affected employee: An employee whose job requires him/her to operate or use a machine or equipment on which servicing or maintenance is being performed under lockout / tagout, or whose job requires him/her to work in an area in which such servicing or maintenance is being performed.

Authorized employee: An authorized employee is one who locks out or tags out machines or equipment in order to perform servicing or maintenance on that machine or equipment. An affected employee becomes an authorized employee when that employee's duties include performing servicing or maintenance covered under this section.

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

BOUNDARIES

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

Limited Approach Boundary: A limited approach boundary is the distance from an exposed energized electrical conductor or circuit part within which a shock hazard exists.

Prohibited Approach Boundary: An approach limit is the distance from an exposed energized electrical conductor or circuit part within which work is considered the same as making contact with the electrical conductor or circuit part.

Restricted Approach Boundary: An approach limit at a distance from an exposed energized electrical conductor or circuit part within which there is an increased risk of shock, due to electrical arc over combined with inadvertent movement, for personnel working in close proximity to the energized electrical conductor or circuit part.

Capable of being locked out: An energized isolating device is capable of being locked out if it has a hasp or other means of attachment to which, or through which, a lock can be affixed, or it has a locking mechanism built into it.

Energized: Connected to an energy source or containing residual or stored energy.

Energy isolating device: A mechanical device that physically prevents the transmission or release of energy.

Energy source: Any source of electrical, mechanical, hydraulic, pneumatic, chemical, thermal, or other energy.

Lockout: the placement of a lockout device on an energy isolating device, in accordance with an established procedure, ensures that the energy isolating device and the equipment being controlled cannot be operated until the lockout device is removed.

Lockout device: A device that utilizes a positive means such as a lock, either key or combination type, to hold an energy isolating device in the safe position and prevent the energizing of a machine or equipment.

Lockout/Tagout Procedure Form: The document outlining the procedures identifying each isolation point and the method of isolating and locking out or tagging out each point.

Other employee: Employees whose work operations are or may be in an area where energy control procedures may be utilized. Other employees shall be instructed about the procedure and about the prohibition relating to an attempt to restart or re-energize machine and equipment, which are locked and/or tagged out.

Qualified person: One who has skills and knowledge related to the construction and operation of the electrical equipment and installations and has received safety training to recognize and avoid the hazards involved.

Servicing/Maintenance: Any activity, such as repairing, adjusting, lubricating or cleaning equipment where an employee may be exposed to unexpected energization or startup of equipment or unexpected release of hazardous energy.

Stored energy: Residual energy that could be potentially hazardous and released unexpectedly.

Tagout: The placement of a tagout device on an energy isolating device, in accordance with an established procedure, to indicate that the energy isolating device and the equipment being controlled may not be operated until the tagout device is removed.

Tagout device: A prominent warning device, such as a tag and a means of attachment, which can be securely fastened to an energy isolating device in accordance with an established procedure, to indicate that the energy isolating device and the equipment being controlled may be operated until the tagout device is removed.

Troubleshooting: Testing energized circuits. Troubleshooting is the method used to test energized electrical components with an approved metering or testing device to identify the presence of voltage, amperage, faults or lack thereof.


Unqualified person: A person who is not a qualified person. Any electrical system modification must be reviewed by and approved by an electrical supervisor from the appropriate University maintenance division.

Working On (energized electrical conductors or circuit parts): Coming in contact with energized electrical conductors or circuit parts with the hands, feet, or other body parts with tools, probes, or other test equipment, regardless of the personal protective equipment a person is wearing. There are two categories of “working on”:


Diagnostic (testing): Taking readings or measurements of electrical equipment with approved test equipment that does not require making any physical change to the equipment.

Repair: any physical alteration of electrical equipment (i.e. tightening connections, removing or replacing components, etc.).

APPENDIX B
Labels (Examples)
 [for Older Vaults]

 DANGER	
No Safe PPE Exists Energized Work Prohibited	
ARC FLASH PROTECTION Arc Flash Hazard Category _____ Incident Energy (cm/in ²) _____ @ Working Distance _____ Arc Flash Boundary _____	SHOCK PROTECTION Voltage Shock Hazard _____ Limited Approach Boundary _____ Restricted Approach Boundary _____ Prohibited Approach Boundary _____ Glove Class _____
Equipment ID: _____ Date Prepared: _____ By: _____	

[for Newer Vaults]

 WARNING	
Arc Flash & Shock Hazard Appropriate PPE Required	
ARC FLASH PROTECTION Arc Flash Hazard Category _____ Incident Energy (cm/in ²) _____ @ Working Distance _____ Arc Flash Boundary _____	SHOCK PROTECTION Voltage Shock Hazard _____ Limited Approach Boundary _____ Restricted Approach Boundary _____ Prohibited Approach Boundary _____ Glove Class _____
Equipment ID: _____ Date Prepared: _____ By: _____	

APPENDIX C

Approach Boundaries

NFPA 70E – 2012 Table 130.4(C)(a)

Table 130.4(C)(a) Approach Boundaries to Energized Electrical Conductors or Circuit Parts for Shock Protection for Alternating-Current Systems (All dimensions are distance from energized electrical conductor or circuit part to employee.)

(1)	(2)	(3)	(4)	(5)
Nominal System Voltage Range, Phase to Phase ^a	Limited Approach Boundary ^b		Restricted Approach Boundary ^b ; Includes Inadvertent Movement Adder	Prohibited Approach Boundary ^b
	Exposed Movable Conductor ^c	Exposed Fixed Circuit Part		
<50 V	Not specified	Not specified	Not specified	Not specified
50 V–300 V	3.0 m (10 ft 0 in.)	1.0 m (3 ft 6 in.)	Avoid contact	Avoid contact
301 V–750 V	3.0 m (10 ft 0 in.)	1.0 m (3 ft 6 in.)	0.3 m (1 ft 0 in.)	25 mm (0 ft 1 in.)
751 V–15 kV	3.0 m (10 ft 0 in.)	1.5 m (5 ft 0 in.)	0.7 m (2 ft 2 in.)	0.2 m (0 ft 7 in.)
15.1 kV–36 kV	3.0 m (10 ft 0 in.)	1.8 m (6 ft 0 in.)	0.8 m (2 ft 7 in.)	0.3 m (0 ft 10 in.)
36.1 kV–46 kV	3.0 m (10 ft 0 in.)	2.5 m (8 ft 0 in.)	0.8 m (2 ft 9 in.)	0.4 m (1 ft 5 in.)
46.1 kV–72.5 kV	3.0 m (10 ft 0 in.)	2.5 m (8 ft 0 in.)	1.0 m (3 ft 3 in.)	0.7 m (2 ft 2 in.)
72.6 kV–121 kV	3.3 m (10 ft 8 in.)	2.5 m (8 ft 0 in.)	1.0 m (3 ft 4 in.)	0.8 m (2 ft 9 in.)
138 kV–145 kV	3.4 m (11 ft 0 in.)	3.0 m (10 ft 0 in.)	1.2 m (3 ft 10 in.)	1.0 m (3 ft 4 in.)
161 kV–169 kV	3.6 m (11 ft 8 in.)	3.6 m (11 ft 8 in.)	1.3 m (4 ft 3 in.)	1.1 m (3 ft 9 in.)
230 kV–242 kV	4.0 m (13 ft 0 in.)	4.0 m (13 ft 0 in.)	1.7 m (5 ft 8 in.)	1.6 m (5 ft 2 in.)
345 kV–362 kV	4.7 m (15 ft 4 in.)	4.7 m (15 ft 4 in.)	2.8 m (9 ft 2 in.)	2.6 m (8 ft 8 in.)
500 kV–550 kV	5.8 m (19 ft 0 in.)	5.8 m (19 ft 0 in.)	3.6 m (11 ft 10 in.)	3.5 m (11 ft 4 in.)
765 kV–800 kV	7.2 m (23 ft 9 in.)	7.2 m (23 ft 9 in.)	4.9 m (15 ft 11 in.)	4.7 m (15 ft 5 in.)

Note: For arc flash boundary, see 130.5(A).

^a For single-phase systems, select the range that is equal to the system's maximum phase-to-ground voltage multiplied by 1.732.

^b See definition in Article 100 and text in 130.4(D)(2) and Annex C for elaboration.

^cThis term describes a condition in which the distance between the conductor and a person is not under the control of the person. The term is normally applied to overhead line conductors supported by poles.

Table 130.4(C)(D) Approach Boundaries^a to Energized Electrical Conductors or Circuit Parts for Shock Protection, Direct-Current Voltage Systems

(1)	(2)	(3)	(4)	(5)
Nominal Potential Difference	Limited Approach Boundary		Restricted Approach Boundary; Includes Inadvertent Movement Adder	Prohibited Approach Boundary
	Exposed Movable Conductor ^b	Exposed Fixed Circuit Part		
<100 V	Not specified	Not specified	Not specified	Not specified
100 V–300 V	3.0 m (10 ft 0 in.)	1.0 m (3 ft 6 in.)	Avoid contact	Avoid contact
301 V–1 kV	3.0 m (10 ft 0 in.)	1.0 m (3 ft 6 in.)	0.3 m (1 ft 0 in.)	25 mm (0 ft 1 in.)
1.1 kV–5 kV	3.0 m (10 ft 0 in.)	1.5 m (5 ft 0 in.)	0.5 m (1 ft 5 in.)	0.1 m (0 ft 4 in.)
5 kV–15 kV	3.0 m (10 ft 0 in.)	1.5 m (5 ft 0 in.)	0.7 m (2 ft 2 in.)	0.2 m (0 ft 7 in.)
15.1 kV–45 kV	3.0 m (10 ft 0 in.)	2.5 m (8 ft 0 in.)	0.8 m (2 ft 9 in.)	0.4 m (1 ft 5 in.)
45.1 kV– 75 kV	3.0 m (10 ft 0 in.)	2.5 m (8 ft 0 in.)	1.0 m (3 ft 2 in.)	0.7 m (2 ft 1 in.)
75.1 kV–150 kV	3.3 m (10 ft 8 in.)	3.0 m (10 ft 0 in.)	1.2 m (4 ft 0 in.)	1.0 m (3 ft 2 in.)
150.1 kV–250 kV	3.6 m (11 ft 8 in.)	3.6 m (11 ft 8 in.)	1.6 m (5 ft 3 in.)	1.5 m (5 ft 0 in.)
250.1 kV–500 kV	6.0 m (20 ft 0 in.)	6.0 m (20 ft 0 in.)	3.5 m (11 ft 6 in.)	3.3 m (10 ft 10 in.)
500.1 kV–800 kV	8.0 m (26 ft 0 in.)	8.0 m (26 ft 0 in.)	5.0 m (16 ft 5 in.)	5.0 m (16 ft 5 in.)

^aAll dimensions are distance from exposed energized electrical conductors or circuit parts to worker.

^bThis term describes a condition in which the distance between the conductor and a person is not under the control of the person. The term is normally applied to overhead line conductors supported by poles.

APPENDIX D

Hazard / Risk Category Table

**Table 130.7(C)(15)(a) Hazard/Risk Category Classifications and Use of Rubber Insulating Gloves and Insulated and Insulating Hand Tools-Alternating Current Equipment
 (Formerly Table 130.7(C)(9))**

Tasks Performed on Energized Equipment	Hazard / Risk Category	Rubber Insulating Gloves	Insulated and Insulating Hand Tools
Panelboards or other equipment rated 240 V and below Parameters: Maximum of 25 kA short circuit current available; maximum of 0.03 sec (2 cycle) fault clearing time; minimum 18 in. working distance Potential arc flash boundary with exposed energized conductors or circuit parts using above parameters: 19 in.			
Perform infrared thermography and other non-contact inspections outside the restricted approach boundary	0	N	N
Circuit breaker (CB) or fused switch operation with covers on	0	N	N
CB or fused switch operation with covers off	0	N	N
Work on energized electrical conductors and circuit parts, including voltage testing	1	Y	Y
Remove/install CBs or fused switches	1	Y	Y
Removal of bolted covers (to expose bare, energized electrical conductors and circuit parts)	1	N	N
Opening hinged covers (to expose bare, energized electrical conductors and circuit parts)	0	N	N
Work on energized electrical conductors and circuit parts of utilization equipment fed directly by a branch circuit of the panel board	1	Y	Y
Panelboards or other equipment rated > 240 V and up to 600 V Parameters: Maximum of 25 kA short circuit current available; maximum of 0.03 sec (2 cycle) fault clearing time; minimum 18 in. working distance Potential arc flash boundary with exposed energized conductors or circuit parts using above parameters: 30 in.			
Perform infrared thermography and other non-contact inspections outside the restricted approach boundary	1	N	N
Circuit breaker (CB) or fused switch operation with covers on	0	N	N
CB or fused switch operation with covers off	1	Y	Y
Work on energized electrical conductors and circuit parts, including voltage testing	2	Y	Y
Remove/install CBs or fused switches	2	Y	Y
Removal of bolted covers (to expose bare, energized electrical conductors and circuit parts)	1	N	N
Opening hinged covers (to expose bare, energized electrical conductors and circuit parts)	0	N	N
Work on energized electrical conductors and circuit parts of utilization equipment fed directly by a branch circuit of the panelboard	2	Y	Y

Tasks Performed on Energized Equipment	Hazard / Risk Category	Rubber Insulating Gloves	Insulated and Insulating Hand Tools
600 V class motor control centers (MCCs) Parameters: Maximum of 65 kA short circuit current available; maximum of 0.03 sec (2 cycle) fault clearing time; minimum 18 in. working distance Potential arc flash boundary with exposed energized conductors or circuit parts using above parameters: 53 in.			
Perform infrared thermography and other non-contact inspections outside the restricted approach boundary	1	N	N
CB or fused switch or starter operation with enclosure doors closed	0	N	N
Reading a panel meter while operating a meter switch	0	N	N
CB or fused switch or starter operation with enclosure doors open	1	N	N
Work on energized electrical conductors and circuit parts, including voltage testing	2	Y	Y
Work on control circuits with energized electrical conductors and circuit parts 120 V or below, exposed	0	Y	Y
Work on control circuits with energized electrical conductors and circuit parts >120 V, exposed	2	Y	Y
Application of temporary protective grounding equipment, after voltage test	2	Y	N
Work on energized electrical conductors and circuit parts of utilization equipment fed directly by a branch circuit of the motor control center	2	Y	Y
600 V class motor control centers (MCCs) Parameters: Maximum of 42 kA short circuit current available; maximum of 0.33 sec (20 cycle) fault clearing time; minimum 18 in. working distance Potential arc flash boundary with exposed energized conductors or circuit parts using above parameters: 165 in.			
Insertion or removal of individual starter "buckets" from MCC	4	Y	N
Removal of bolted covers (to expose bare, energized electrical conductors and circuit parts)	4	N	N
Opening hinged covers (to expose bare, energized electrical conductors and circuit parts)	1	N	N
600 V class switchgear (with power circuit breakers or fused switches) and 600 V class switchboards Parameters: Maximum of 35 kA short circuit current available; maximum of up to 0.5 sec (30 cycle) fault clearing time; minimum 18 in. working distance Potential arc flash boundary with exposed energized conductors or circuit parts using above parameters: 233 in.			
Perform infrared thermography and other non-contact inspections outside the restricted approach boundary	2	N	N
CB or fused switch operation with enclosure doors closed	0	N	N
Reading a panel meter while operating a meter switch	0	N	N
CB or fused switch operation with enclosure doors open	1	N	N
Work on energized electrical conductors and circuit parts, including voltage testing	2	Y	Y
Work on control circuits with energized electrical conductors and circuit parts 120 V or below, exposed	0	Y	Y

Tasks Performed on Energized Equipment	Hazard / Risk Category	Rubber Insulating Gloves	Insulated and Insulating Hand Tools
Work on control circuits with energized electrical conductors and circuit parts >120 V, exposed	2	Y	Y
Insertion or removal (racking) of CBs from cubicles, doors open or closed 4 N	4	N	N
Application of temporary protective grounding equipment after voltage test	2	Y	N
Removal of bolted covers (to expose bare, energized electrical conductors and circuit parts)	4	N	N
Opening hinged covers (to expose bare, energized electrical conductors and circuit parts)	2	N	N
Other 600 V class (277 V through 600 V, nominal) equipment Parameters: Maximum of 65 kA short circuit current available; maximum of 0.03 sec (2 cycle) fault clearing time; minimum 18 in. working distance (except as indicated) Potential arc flash boundary with exposed energized conductors or circuit parts using above parameters: 53 in.			
Lighting or small power transformers (600 V, maximum) Removal of bolted covers (to expose bare, energized electrical conductors and circuit parts)	2	N	N
Opening hinged covers (to expose bare, energized electrical conductors and circuit parts)	1	N	N
Work on energized electrical conductors and circuit parts, including voltage testing	2	Y	Y
Application of temporary protective grounding equipment, after voltage test	2	Y	N
Revenue meters (kW-hour, at primary voltage and current)—insertion or removal	2	Y	N
Cable trough or tray cover removal or installation	1	N	N
Miscellaneous equipment cover removal or installation	1	N	N
Work on energized electrical conductors and circuit parts, including voltage testing	2	Y	Y
Application of temporary protective grounding equipment, after voltage test	2	Y	N
Insertion or removal of plug-in devices into or from busways	2	Y	N
NEMA E2 (fused contactor) motor starters, 2.3 kV through 7.2 kV Parameters: Maximum of 35 kA short circuit current available; maximum of up to 0.2 sec (12 cycle) fault clearing time; minimum 36 in. working distance Potential arc flash boundary with exposed energized conductors or circuit parts using above parameters: 422 in.			
Perform infrared thermography and other non-contact inspections outside the restricted approach boundary	3	N	N
Contactor operation with enclosure doors closed	0	N	N
Reading a panel meter while operating a meter switch	0	N	N
Contactor operation with enclosure doors open	2	N	N
Work on energized electrical conductors and circuit parts, including voltage testing	4	Y	Y
Work on control circuits with energized electrical conductors and circuit parts 120 V or below, exposed	0	Y	Y

Tasks Performed on Energized Equipment	Hazard / Risk Category	Rubber Insulating Gloves	Insulated and Insulating Hand Tools
Work on control circuits with energized electrical conductors and circuit parts >120 V, exposed	3	Y	Y
Insertion or removal (racking) of starters from cubicles, doors open or closed	4	N	N
Application of temporary protective grounding equipment, after voltage test	3	Y	N
Removal of bolted covers (to expose bare, energized electrical conductors and circuit parts)	4	N	N
Opening hinged covers (to expose bare, energized electrical conductors and circuit parts)	3	N	N
Insertion or removal (racking) of starters from cubicles of arc-resistant construction, tested in accordance with IEEE C37.20.7, doors closed only	0	N	N
Metal clad switchgear, 1 kV through 38 kV Parameters: Maximum of 35 kA short circuit current available; maximum of up to 0.2 sec (12 cycle) fault clearing time; minimum 36 in. working distance Potential arc flash boundary with exposed energized conductors or circuit parts using above parameters: 422 in.			
Perform infrared thermography and other non-contact inspections outside the restricted approach boundary	3	N	N
CB operation with enclosure doors closed	2	N	N
Reading a panel meter while operating a meter switch	0	N	N
CB operation with enclosure doors open	4	N	N
Work on energized electrical conductors and circuit parts, including voltage testing	4	Y	Y
Work on control circuits with energized electrical conductors and circuit parts 120 V or below, exposed	2	Y	Y
Work on control circuits with energized electrical conductors and circuit parts >120 V, exposed	4	Y	Y
Insertion or removal (racking) of CBs from cubicles, doors open or closed	4	N	N
Application of temporary protective grounding equipment, after voltage test	4	Y	N
Removal of bolted covers (to expose bare, energized electrical conductors and circuit parts)	4	N	N
Opening hinged covers (to expose bare, energized electrical conductors and circuit parts)	3	N	N
Opening voltage transformer or control power transformer compartments	4	N	N
Arc-resistant switchgear Type 1 or 2 (for clearing times of < 0.5 sec with a perspective fault current not to exceed the arc-resistant rating of the equipment) Parameters: Maximum of 35 kA short circuit current available; maximum of up to 0.2 sec (12 cycle) fault clearing time; minimum 36 in. working distance Potential arc flash boundary with exposed energized conductors or circuit parts using above parameters: 422 in.			
CB operation with enclosure door closed	0	N	N
Insertion or removal (racking) of CBs from cubicles, doors closed	0	N	N

Tasks Performed on Energized Equipment	Hazard / Risk Category	Rubber Insulating Gloves	Insulated and Insulating Hand Tools
Insertion or removal of CBs from cubicles with door open	4	N	N
Work on control circuits with energized electrical conductors and circuit parts 120 V or below, exposed	2	Y	Y
Insertion or removal (racking) of ground and test device with door closed	0	N	N
Insertion or removal (racking) of voltage transformers on or off the bus door closed	0	N	N
Other equipment 1 kV through 38 kV Parameters: Maximum of 35 kA short circuit current available; maximum of up to 0.2 sec (12 cycle) fault clearing time; minimum 36 in. working distance Potential arc flash boundary with exposed energized conductors or circuit parts using above parameters: 422 in.			
Metal-enclosed interrupter switchgear, fused or unfused Switch operation of arc-resistant-type construction, tested in accordance with IEEE C37.20.7, doors closed only	0	N	N
Switch operation, doors closed	2	N	N
Work on energized electrical conductors and circuit parts, including voltage testing	4	Y	Y
Removal of bolted covers (to expose bare, energized electrical conductors and circuit parts)	4	N	N
Opening hinged covers (to expose bare, energized electrical conductors and circuit parts)	3	N	N
Outdoor disconnect switch operation (hookstick operated)	3	Y	Y
Outdoor disconnect switch operation (gang-operated, from grade)	2	Y	N
Insulated cable examination, in manhole or other confined space	4	Y	N
Insulated cable examination, in open area	2	Y	N
Y = Yes (required). N: No (not required). Notes: (1) Rubber insulating gloves are gloves rated for the maximum line-to-line voltage upon which work will be done. (2) Insulated and insulating hand tools are tools rated and tested for the maximum line-to-line voltage upon which work will be done, and are manufactured and tested in accordance with ASTM F 1505, <i>Standard Specification for Insulated and Insulating Hand Tools</i> . (3) The use of "N" does not indicate that rubber insulating gloves and insulated and insulating hand tools are not required in all cases. Rubber insulating gloves and insulated and insulating hand tools may be required by 130.4, 130.7 (C) (7)(a), and 130.7(D)(1). (4) For equipment protected by upstream current limiting fuses with arcing fault current in their current limiting range ($\frac{1}{2}$ cycle fault clearing time or less), the hazard/risk category required may be reduced by one number. (5) For power systems up to 600 V the arc flash boundary was determined by using the following information: When 0.03 second trip time was used, that indicated MCC or panelboard equipment protected by a molded-case circuit breaker. Working distance used was 18 in. (455 mm). Arc gap used was 32 mm for switchgear and 25 mm for MCC and protective device type 0 for all. When 0.33 or 0.5 second trip time was used, that indicated a LVPCB (drawout circuit breaker) in switchgear. Working distance was 18 in. (455 mm). Arc gap used was 32 mm and protective device type 0 for all. All numbers were rounded up or down depending on closest multiple of 5. (6) For power systems from 1 kV to 38 kV the arc flash boundary was determined by using the following information: No maximum values were given in the 2009 edition of NFPA 70E for short-circuit current or operating time. Two sets of equations were performed: 35 kA AIC and 0.2 second operating time and 26 kA AIC and 0.2 second operating time. 0.2 seconds was used by adding the typical maximum total clearing time of the circuit breaker to an estimated value for relay operation. This coincides with the IEEE 1584 values of 0.18 second operating time and 0.08 tripping time rounded off. A short-circuit current of 35 kA was used as a maximum (HRC-4 @ ~ 40 cal/cm ²) and 26 kA was used to compare the effects of lowering the short circuit current (HRC-4 @ ~ 30 cal/cm ²). Working distance used was 36 in. (909 mm), arc gap was 6 in. (455 mm), and protective device type 0 for all.			

Tasks Performed on Energized Equipment	Hazard / Risk Category	Rubber Insulating Gloves	Insulated and Insulating Hand Tools
Table 130.7(C)(15)(b) Hazard/Risk Category Classifications and Use of Rubber Insulating Gloves and Insulated and Insulating Hand Tools — Direct Current Equipment			
Storage batteries, direct-current switchboards and other direct-current supply sources >100 V <250 V			
Parameters: Voltage: 250 V Maximum arc duration and working distance: 2 sec @ 18 in.			
Work on energized electrical conductors and circuit parts, including voltage testing where arcing current is ≤ 1 kA and < 4 kA Potential arc flash boundary using above parameters at 4 kA: 36 in.	1	Y	Y
Work on energized electrical conductors and circuit parts, including voltage testing where arcing current is ≥ 4 kA and < 7 kA Potential arc flash boundary using above parameters at 7 kA: 48 in.	2	Y	Y
Work on energized electrical conductors and circuit parts, including voltage testing where arcing current is ≥ 7 kA and < 15 kA Potential arc flash boundary using above parameters at 15 kA: 72 in.	3	y	y
Storage batteries, direct-current switchboards and other direct-current supply sources ≥ 250 V ≤ 600 V			
Parameters: Voltage: 600 V Maximum arc duration and working distance: 2 sec @ 18 in.			
Work on energized electrical conductors and circuit parts, including voltage testing where arcing current is ≥ 1 kA and < 1.5 kA Potential arc flash boundary using above parameters at 1.5 kA: 36 in.	1	Y	Y
Work on energized electrical conductors and circuit parts, including voltage testing where arcing current is ≥ 1.5 kA and < 3 kA Potential arc flash boundary using above parameters at 3 kA: 48 in.	2	Y	Y
Work on energized electrical conductors and circuit parts, including voltage testing where arcing current is ≥ 3 kA and < 7 kA Potential arc flash boundary using above parameters at 7 kA: 72 in.	3	Y	Y
Work on energized electrical conductors and circuit parts, including voltage testing where arcing current is ≥ 7 kA and < 10 kA Potential arc flash boundary using above parameters at 10 kA: 96 in.	4	Y	Y
Y: Yes (required). aIf acid exposure is possible, the clothing is required to be protected from acid and arc rated to the hazard according to ASTM F 1891 or equivalent and evaluated by ASTM F 1296 for acid protection. bIn clean rooms or other electrical installations, that do not permit leather protectors for arc flash exposure, ASTM F 496 is required to be followed for use of rubber insulating gloves without leather protectors.			

APPENDIX E
Protective Clothing and Personal Protective Equipment Table
NFPA 70E 2012 Edition, Table 130.7(C)(16)

Hazard / Risk Category	Protective Clothing & Personal Protective Equipment
0	<p>Protective Clothing, Non-melting or Untreated Natural Fiber (i.e., untreated cotton, wool, rayon, or silk, or blends of these materials) with a Fabric Weight of at Least 4.5 oz/yd² Shirt (long sleeve) Pants (long)</p> <p>Protective Equipment Safety glasses or safety goggles (SR) Hearing protection (ear canal inserts) Heavy duty leather gloves (AN) <i>(See Note 1.)</i></p>
1	<p>Arc-Rated Clothing, Minimum Arc Rating of 4 cal/cm² (See Note 3.) Arc-rated long-sleeve shirt and pants or arc-rated coverall Arc-rated face shield <i>(see Note 2)</i> or arc flash suit hood Arc-rated jacket, parka, rainwear, or hard hat liner (AN)</p> <p>Protective Equipment Hard hat Safety glasses or safety goggles (SR) Hearing protection (ear canal inserts) Heavy duty leather gloves <i>(See Note 1.)</i> Leather work shoes (AN)</p>
2	<p>Arc-Rated Clothing, Minimum Arc Rating of 8 cal/cm² (See Note 3.) Arc-rated long-sleeve shirt and pants or arc-rated coverall Arc-rated flash suit hood or arc-rated face shield <i>(See Note 2)</i> and arc-rated balaclava Arc-rated jacket, parka, rainwear, or hard hat liner (AN)</p> <p>Protective Equipment Hard hat Safety glasses or safety goggles (SR) Hearing protection (ear canal inserts) Heavy duty leather gloves <i>(See Note 1.)</i> Leather work shoes</p>
3	<p>Arc-Rated Clothing Selected so That the System Arc Rating Meets the Required Minimum Arc Rating of 25 cal/cm² (See Note 3.) Arc-rated long-sleeve shirt (AR) Arc-rated pants (AR) Arc-rated coverall (AR) Arc-rated arc flash suit jacket (AR) Arc-rated arc flash suit pants (AR) Arc-rated arc flash suit hood Arc-rated gloves <i>(See Note 1.)</i> Arc-rated jacket, parka, rainwear, or hard hat liner (AN)</p> <p>Protective Equipment Hard hat Safety glasses or safety goggles (SR) Hearing protection (ear canal inserts) Leather work shoes</p>

Hazard / Risk Category	Protective Clothing & Personal Protective Equipment
4	<p>Arc-Rated Clothing Selected so That the System Arc Rating Meets the Required Minimum Arc Rating of 40 cal/cm² (See Note 3.) Arc-rated long-sleeve shirt (AR) Arc-rated pants (AR) Arc-rated coverall (AR) Arc-rated arc flash suit jacket (AR) Arc-rated arc flash suit pants (AR) Arc-rated arc flash suit hood Arc-rated gloves (See Note 1.) Arc-rated jacket, parka, rainwear, or hard hat liner (AN)</p> <p>Protective Equipment Hard hat Safety glasses or safety goggles (SR) Hearing protection (ear canal inserts) Leather work shoes</p>
Notes:	<p>AN: as needed (optional). AR: as required. SR: selection required.</p> <p>(1) If rubber insulating gloves with leather protectors are required by Table 130.7(C)(15)(a) and Table 130.7(C)(15)(b), additional leather or arc-rated gloves are not required. The combination of rubber insulating gloves with leather protectors satisfies the arc flash protection requirement.</p> <p>(2) Face shields are to have wrap-around guarding to protect not only the face but also the forehead, ears, and neck, or, alternatively, an arc-rated arc flash suit hood is required to be worn.</p> <p>(3) <i>Arc rating</i> is defined in Article 100 and can be either the arc thermal performance value (ATPV) or energy of break open threshold (EBT). ATPV is defined in ASTM F 1959, <i>Standard Test Method for Determining the Arc Thermal Performance Value of Materials for Clothing</i>, as the incident energy on a material, or a multilayer system of materials, that results in a 50 percent probability that sufficient heat transfer through the tested specimen is predicted to cause the onset of a second-degree skin burn injury based on the Stoll curve, in cal/cm². EBT is defined in ASTM F 1959 as the incident energy on a material or material system that results in a 50 percent probability of break open. Arc rating is reported as either ATPV or EBT, whichever is the lower value.</p>

APPENDIX F Electrical Hazard Form

ELECTRICAL HAZARD ANALYSIS / WORK PERMIT

For Selected Work Activities on the AC Power Distribution System or Electrical Utilization Equipment

JOB NAME & LOCATION: _____

EFFECTIVE DATES OF PERMIT: Start: _____ End: _____

WORK TO BE PERFORMED BY: _____

QUALIFIED PERSON IN CHARGE: _____ PHONE: _____

Does the Work Involve Diagnostic Energized Work? Yes No (Includes LOTO Verification)

Does the Work Involve Manipulative Energized Work? Yes No (Justification Required)

Is an Inspection Required After Work is Completed? Yes No (Reqd. for New AC Pwr. Installs)

If the Work Activity Involves Manipulative Energized Work, State the Justification Here:

DESCRIPTION OF WORK: _____

ASSOCIATED HAZARDS: _____

HAZARD MITIGATION: [Indicate Hazard/Risk Category (0, 1, 2, 2*, 3 or 4)]:

SHOCK PROTECTION BOUNDARIES for ENERGIZED WORK

NFPA 70E Table 130.2(C) for Fixed Circuit Parts and Article 130.3(A).

For 120/208 VAC: **Shock Protection: Limited Approach: 3' 6". Restricted & Prohibited Approach: Avoid Contact**
For 480/277 VAC: **Shock Protection: Limited Approach: 3' 6". Restricted Approach: 1 Ft. Prohibited Approach: 1"**

Class Voltage-Rated Gloves and Leather Protectors Required for Subject Work Activity

ARC-FLASH PROTECTION BOUNDARY and REQUIRED PPE for ENERGIZED WORK

PPE Requirements for Shock & Arc Flash Protection are Fully Described in NFPA 70E, Article 130.7. Indicate if Otherwise.

Clothing Must be Non-Melting or Untreated Natural Fiber, Unless Specified as Flame-Resistant (FR).

The Default Flash Protection Boundary is 4 Feet (as Qualified by Article 130.3(A) at 100 kA Cycles)

If Calculated, Indicate Flash Protection Boundary: feet and/or inches

If Calculated, Indicate Incident Energy Level for Arc Flash Protection: cal/cm²

- HRC 0** Long-Sleeve Cotton Shirt, Long Cotton Pants, Safety Glasses, Hearing Protection, Leather Gloves (0 to 1.2 cal/cm²)
- HRC 1** FR Coverall, Safety Glasses, Hard Hat, Arc-rated Face Shield, Hearing Protection, Leather Protectors or Gloves, Leather Work Shoes (>1.2 to 4 cal/cm²)
- HRC 2** Cotton Clothing under FR Coverall, Safety Glasses, Hard Hat, Arc-Rated Face Shield, Hearing Protection, Leather Protectors or Gloves, Leather Work Shoes (>4 to 8 cal/cm²)
- HRC 2*** Cotton Clothing under FR Coverall, Safety Glasses, Hard Hat, Double-Layer Switching Hood, Hearing Protection, Leather Protectors or Gloves, Leather Work Shoes (>4 to 8 cal/cm²)
- HRC 3** Cotton Clothing under 2 FR Coveralls (25 cal/cm²), Safety Glasses, Hard Hat, Hard Hat Liner, Flash Suit Hood, Hearing Protection, Leather Protectors or Gloves, Leather Work Shoes (>8 to 25 cal/cm²)
- HRC 4** Cotton Clothing under Multilayer FR Flash Suit Jacket and Pants (40 cal/cm²), Safety Glasses, Hard Hat, Hard Hat Liner, Flash Suit Hood, Hearing Protection, Leather Protectors or Gloves, Leather Work Shoes (>25 to 40 cal/cm²)

PREPARED BY: _____ **DATE:** _____

APPROVED BY: _____ **DATE:** _____

Job Briefing Signature Sheet

Person(s) Conducting Briefing: _____ **Date:** _____

Personnel Present at the Job Briefing will sign below, indicating their understanding of the Scope of Work and Associated Hazards Mitigation Requirements.

PRINT NAME: _____ **SIGNATURE:** _____

Hazard Risk Assessment (OPTIONAL)

TASK: _____

Safety Concern	Exposure	Existing Controls	F	L	S	R (F*L*S)

 Completed by (Print)

 Signature

 Date

To perform a hazard risk assessment, use the instructions and risk rating scale (Table D.1):

1. List the task.
2. State the safety concerns, which are the possible hazards of the task.
3. If performing an assessment for an area like a shop or zone, state the number of employees performing the task. If you are filling the form out individually, leave space blank. (REM will compile cumulative results).
4. List what existing controls are used to decrease or eliminate the hazard.
5. Then rate on a scale from 1-5 the frequency (F), how often you perform the task; likelihood of the hazard occurring (L); and the severity (S) of possible harm from the hazard. Multiply the three parameters to find the Risk rating (R).

Table D.1 – Risk Rating Scale

Rating	Exposure Opportunity (Frequency)	Chance of Occurrence (Likelihood)	Degree of Harm (Severity)
1	Less than 1x per month	Highly Unlikely	First Aid
2	Less than 1x per week	Unlikely	Medical Treatment
3	Less than 1x per shift	Possible	Lost Time, full recovery
4	Greater than 1x per shift	Probable	Some permanent impairment
5	At all times	Highly Probable	Major Permanent impairment or death