

Electrical Safety Program

50V-1000V

The purpose of Clemson University's (CU) Electrical Safety Program is to protect all staff, students, and faculty from electrical hazards. Clemson University complies with the most recent version of NFPA 70E & OSHA 1910 Subpart S, portions of the aforementioned documents may not be included in this program but are still considered part of this program. This Program will be executed through compliance with the work practices described in this program along with effective application of engineering controls, administrative controls and the use of Personal Protective Equipment (PPE).

Policy

Clemson University is committed to provide a workplace free of recognized hazards and to provide employees with the necessary tools and training to complete their tasks. It is the policy of Clemson University to avoid energized work unless it is absolutely necessary. Live parts will be de-energized before an employee works on or near them unless one of the following conditions apply:

1. Greater Hazard. Energized work shall be permitted where supervision can demonstrate that de-energizing introduces additional hazards or increased risk. A live work permit is required with a risk assessment in this case. Energized work shall be permitted where supervision can demonstrate that the task to be performed is infeasible in a de-energized state due to equipment design or operational limitations. Live work permit required with risk assessment.
2. Less Than 50 Volts. Energized electrical conductors and circuit parts that operate at less than 50 volts shall not be required to be de-energized where the capacity of the source and any overcurrent protection between the energy source and the worker are considered and it is determined that there will be no increased exposure to electrical burns or to explosion due to electrical arcs.

Scope

This program applies to all qualified workers authorized by management to install, modify, repair, or work on electrical conductors and equipment in or on University property. In addition, this program applies to unqualified workers who may be affected by electrical work. It also applies to electrical conductors and equipment operating at 50 volts nominal, or greater; and to live parts operating at less than 50 volts nominal, if there is an increased risk of exposure to electrical burns or to explosion due to electrical arcs.

Definitions

Arc Flash: An arc flash is a phenomenon where a flashover of electric current leaves its intended path and travels through the air from one conductor to another, or to ground. The results are often violent and when a human is in close proximity to the arc flash, serious injury and even death can occur. Arc flash can be caused by many things, including:

- Dust
- Dropping tools
- Accidental touching
- Condensation
- Material Failure
- Corrosion
- Faulty Installation

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

Arc Flash Protection Boundary: An approach limit at a distance from exposed live parts within which a person could receive a second-degree burn if an electrical arc flash were to occur.

Arc Flash Suit: A complete arc-rated clothing and equipment system that covers the entire body, except for the hands and feet. This includes pants, jacket, and balaclava.

Arc Rating: The maximum incident energy resistance demonstrated by a material (or layered system of materials) prior to "breaking open" or at the onset of a second-degree skin burn. This rating is assigned to electrical protective clothing and is normally expressed in calories per square centimeter (cal/cm²).

Balaclava (sock hood): An arc-rated AR hood that protects the neck and head except for facial area of the eyes and nose.

Bare Hand Work: A technique of performing work on energized electrical conductors or circuit parts, after the employee has been raised to the potential of the energized electrical conductors or circuit part.

Branch Circuit: The circuit conductors between the final overcurrent device protecting the circuit and other outlets.

Conductor, Bare: A conductor having no covering or electrical insulation whatsoever.

Conductor, Covered: A conductor encased within a material of composition and thickness that is not recognized by NFPA 70E or this policy as electrical insulation.

Conductor, Insulated: A conductor encased within material of composition and thickness that is recognized by NFPA 70E and this policy as electrical insulation.

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

EHS: Environmental Health and Safety, location 310 Klugh Drive Clemson, SC 29634. By phone 864-643-6130.

Energized: Electrically connected to or having a source of voltage.

Electrically Safe Working Condition: A state in which an electrical conductor or circuit part to be worked on or near has been disconnected from all sources of power including storage devices such as batteries and capacitors. In addition, the equipment disconnects have been locked/tagged out in accordance with CU Lockout/Tagout policy.

AR Apparel: Arc resistance apparel designed specifically to protect Qualified Workers from electrical arc events during the completion of energized tasks. Apparel is marked with cal/cm² rating.

Ground-fault circuit-interrupter (GFCI): is a protective device that compares the amount of current going into electrical equipment with the amount of current returning from the equipment and if a targeted deviation (0.005 amperes) is exceeded, the circuit is quickly broken, often within as little as 25 milliseconds.

Hazard/Risk Categories (HRC): refers to categories of treated protective clothing which are determined by the minimum amount of calories per square centimeter (Arc Thermal Performance Value (ATPV) or Cal/cm²). Any treated garment must pass through with a 50% probability of a 2nd or 3rd degree burn occurring, which is how the protective level of the treated clothing is determined. The higher the ATPV, the higher the HRC level attained, the greater the protection that is needed.

Incident Energy: The amount of energy impressed on a surface, a certain distance from the source, generated during an electrical arc event. One of the units used to measure incident energy is calories per centimeter squared (cal/cm²).

Job Hazard Analysis (JHA): A technique that focuses on job tasks as a way to identify hazards before they occur. It focuses on the relationship between the worker, the task, the tools, and the work environment. See attachment F for a sample and attachment G for a blank form.

Limited Approach Boundary: An approach limit at a distance from an exposed energized electrical conductor or circuit part within which a shock hazard exists.

Lockout / Tagout: A procedure where equipment or machinery systems have had (1) all potential energy sources isolated (i.e., turned off); (2) all potential energy sources secured from reactivation (e.g. locked out); (3) all residual energy relieved from the system; and (4) all system controls activated, with safety verified. See the CU Policy, "Lock Out / Tag Out" for more details. `

Qualified Person: One who has demonstrated 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.

Note 1 to the definition of "qualified person:" Whether an employee is considered to be a "qualified person" will depend upon various circumstances in the workplace. For example, it is possible and, in fact, likely for an individual to be considered "qualified" with regard to certain equipment in the workplace, but "unqualified" as to other equipment.

Note 2 to the definition of "qualified person:" An employee who is undergoing on-the-job training and who, in the course of such training, has demonstrated an ability to perform duties safely at his or her level of training and who is under the direct supervision of a qualified person is considered to be a qualified person for the performance of those duties.

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

Unqualified Person: A person who has not been trained as a qualified individual.

*Additional definitions can be found in the most recent version NFPA 70E

Responsibilities

Environmental Health and Safety (EHS) is responsible for reviewing hazards associated with electrical safety during annual shop inspections. EHS is responsible for reviewing and updating the electrical safety Program. EHS will assist departments in implementing the provisions of this program and developing task specific safety training and procedures. EHS and Supervisors also work jointly in the development of Job Hazard Analysis (JHA) to document first-time procedures.

Supervisors are responsible for implementing the Electrical Safety Program within their areas and ensuring that employees comply with the program. Supervisors develop and maintain a list of all qualified employees in their areas. They must ensure employees are provided with and use appropriate protective equipment. They must also conduct the Electrical Safety Program Audit. Supervisors are responsible for administering progressive discipline in accordance with the SC State Personnel Manual and Clemson University guidelines when subordinate personnel repeatedly fail to comply with this procedure as required.

Qualified Employees must perform electrical work in accordance with this program. They must conduct a visual inspection of PPE, equipment and tools prior to each use to ensure good working condition. Employees must notify their supervisor if PPE, equipment or tools are found to be defective. They must also keep unqualified people outside of the qualified worker boundary (Limited Approach Boundary).

Contractors Safety programs used by contractors must meet or exceed all applicable guidelines of the CU Electrical Safety Program. Contractors may be required to submit copies of their program to the CU representative associated with the work. After the work is complete, contractors must notify CU in writing of any hazards created by the work.

Training Requirements

Training shall be conducted in the classroom, on-the-job, or a combination of the two. The degree of training provided shall be determined by the risk to the employee. Employees will be classified in one of two categories, qualified workers and unqualified workers. All training must be confirmed by Clemson University EHS Manager.

1. Qualified persons: Employees who face a risk of electrical hazard that is not reduced to a safe level 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. For a person to be considered qualified, the employee must receive general electrical safety training as stated above and in accordance with the most recent publication of NFPA 70E as well as training listed in this section:
 - Skills and techniques necessary to distinguish exposed energized electrical parts from other parts of electrical equipment
 - Skills and techniques necessary to determine the nominal voltage of exposed energized electrical parts
 - Approach distances and the corresponding voltages to which the qualified person will be exposed

- Decision-making process necessary to determine the degree and extent of the hazard and job planning to perform the task safely
 - In the selection of PPE and tools, including a dry run practice to ensure PPE does not limit the person's dexterity or vision.
 - NOTE: A person can be considered qualified with respect to certain equipment and methods but still unqualified for others.
 - In the selection of appropriate voltage detector and shall demonstrate how to use the device to verify the absence of voltage. The employee should also understand the limitations of each detector.
 - Employees undergoing training to become a qualified worker are considered qualified if he or she is under the direct supervision of a qualified worker.
 - Supervisors shall determine, through regular supervision or through inspections conducted on at least an annual basis that each employee is complying with safety-related work practices.
2. Unqualified persons shall be trained in and familiar with any electrical safety-related practices necessary for their safety.
 3. Retraining: An employee shall receive additional training (or retraining) under any of the following conditions:
 - a. If the supervision or annual inspections indicate that the employee is not complying with the safety-related work practices.
 - b. 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.
 - c. If he or she must employ safety-related work practices that are not normally used during his or her regular job duties.
 - d. If there are changes to the Electrical Safety Program/Policy.
 - e. If an employee is required to perform tasks less often than once per year, they shall be retrained before beginning the work.
 - f. Retraining shall be performed at intervals not to exceed 3 years.
 4. Emergency Procedures First Aid/CPR: Employees exposed to shock hazards and those employees responsible for taking action in case of emergency shall be regularly instructed in methods of first aid/CPR and emergency procedures, such as approved methods of resuscitation. Training of employees in approved methods of resuscitation, including cardiopulmonary resuscitation, shall be

certified by CU annually. In the event of an electrical shock CU will advise the victim of the incident to seek medical evaluation at no expense to the employee, in a situation where an employee suffered no visual injuries medical evaluation is still necessary.

5. Training Documentation: The Supervisor, the Training Office and EHS shall maintain a record of all electrical training provided to employees along with a list of all employees classified as qualified workers. The documentation shall contain the content of the training, the employee's name, instructor name, and dates of training. Per state guidelines, employee training records must be kept for five years after termination.

Procedures

CU employees shall use the written safe electrical work procedures, reviewed and approved by individual department management, which describe the specific safety procedures for working within the Limited Approach Boundary of energized electrical conductors and circuit parts operating at 50 volts or more or where an electrical hazard exists before work is started. Every electrical conductor or circuit part shall be considered energized until proven otherwise.

The most current edition of the referenced standards shall be used.

- NFPA 70E, Standard for Electrical Safety in the Workplace;
- IEEE Standard C2-2007 – National Electrical Safety Code;
- 29 CFR 1910.301 thru 29 CFR 1910.399 Occupational Safety & Health Standard
- Subpart S - Electrical; 29 CFR 1910.269
- 29 CFR 1910.147 Occupational Safety & Health Standard - Control of Hazardous Energy (Lockout/Tagout);
- CU Policy on Lockout/Tagout;
- CU Policy General Safety - Personal Protective Equipment (PPE)

Job Briefing (JHA/RA/JSA)

1. General: Before starting each job, the employee in charge shall conduct a job briefing with the employees involved. The briefing shall cover such subjects as hazards associated with the job, work procedures involved, special precautions, energy source controls, PPE requirements, and the information on the energized electrical work permit, if required. Additional job briefings shall be held if changes that might affect the safety of employees occur during the course of the work. In addition to a job briefing a JHA shall be conducted and be formally documented with hazards and control measures and all participating parties will sign and date an attendance sheet (see attachment D-G for examples).

- a. Repetitive or Similar Tasks. If the work or operations to be performed during the day or shift are repetitive and similar, at least one job briefing and JHA shall be conducted before the start of the day or shift. Additional job briefings shall be held if significant changes occur during the course of the work.
- b. Routine Work. Prior to starting work, a brief discussion shall be satisfactory if the work involved is routine and if the employee is qualified for the task. A more extensive discussion shall be conducted if the work is more complicated than usual or is particularly hazardous. See Attachment A for the Job Briefing and Planning Checklist.

Establishing an Electrically Safe Work Condition

An electrically safe work condition shall be achieved when performed in accordance with the CU Policy "Lock Out / Tag Out" and verified by the following process:

1. Determine all possible sources of electrical supply to the specific equipment. Check applicable up to date drawings, diagrams and identification tags.
2. After properly interrupting the load current, open the disconnection device(s) for each source.
3. Whenever possible, visually verify that all blades of the disconnection devices are fully open or that draw out-type circuit breakers are withdrawn to the fully disconnected position.
4. Apply lock out /tagout device in accordance with CU lock out tag out procedure see below.
5. Use an adequately rated test instrument to test each phase conductor or circuit part to verify it is de-energized. Test each phase conductor or circuit part both phase-to-phase and phase-to-ground. Before and after each test, determine that the test instrument is operating satisfactorily through verification on a known voltage source.
6. Where the possibility of induced voltages or stored electrical energy exists, ground the phase conductors or circuit parts before touching them. Where it could be reasonably anticipated that the conductors or circuit parts being de-energized could contact other exposed energized conductors or circuit parts, apply ground connecting devices rated for the available fault duty.

CU Lock Out Tag/Out Procedure

1. Refer to procedure to ensure method of shutdown and proper isolation points
2. Communicate with affected employees and prepare for shut-down
3. Shutdown the machine/equipment using normal stopping procedure

4. Disconnect or isolate the machine from its hazardous energy source(s)
5. Apply the lockout/tagout device(s) to the energy-isolating device(s)
6. Release, restrain, or otherwise render safe all potential hazardous stored or residual energy; and if the possibility exists for re-accumulation of hazardous energy, regularly verify during the service and maintenance that such energy has not re-accumulated to hazardous levels
7. Verify the isolation and de-energization of the machine
8. Complete the servicing or maintenance required and then clear work area of all employees, tools and equipment. Verify that all guards and other type of components have been restored to their original condition
9. Remove lockout devices and communicate with affected employees and prepare for returning the machine to service.
10. Return machine to service and verify functionality of machine/equipment.

Work Involving Electrical Hazards

Approach Boundaries to Live Parts and Arc Flash Assessments

1. Safe approach distances will be determined for all tasks in which approaching personnel are exposed to live parts.
2. Safe approach distances to fixed live parts can be determined by referring to Table 1 and 1A.
3. Limited Approach Boundary:
 - a. Unless otherwise permitted in this section no unqualified person shall be permitted to cross the Limited Approach Boundary set forth in Table 1 and 1A.
 - b. Unqualified persons may cross the Limited Approach Boundary when they are under the direct supervision of a qualified person. The unqualified person shall be made aware of the hazards and continuously escorted.
 - c. Where one or more unqualified persons are working
4. Restricted Approach Boundary:
 - a. No qualified person shall approach or take any conductive object closer to the exposed energized electrical conductors or circuit parts operating at 50 volts or more than the restricted approach boundary set forth in table 1 and 1A, unless one of the conditions apply.

- b. The qualified person is insulated or guarded from the energized electrical conductors or circuit parts operating at 50 volts or more. Insulating gloves or insulating gloves and sleeves are considered insulation only regarding the energized parts upon which work is being performed. If there is a need for an uninsulated part of the qualified person's body to contact exposed energized electrical conductors or circuit parts, a combination of C(4)(a), C(4)(b) and C(4)(c) shall be used to protect uninsulated body parts.
 - c. The energized electrical conductors or circuit part operating at 50 volts or more are insulated from the qualified person and from any other conductive object at a different potential.
 - d. The qualified person is insulated from any other conductive object.
5. Arc Flash Assessments
- a. Arc flash assessments shall be conducted for all equipment.
 - b. When conducting arc flash assessment if the incident energy rate can be reduced by mechanical or electrical design, it shall be reduced.
 - c. Arc flash assessments shall be posted on equipment and made of material that can withstand the environment in which the posting is placed.

Energized Electrical Work Permit

1. Working within the limited approach or arc flash boundary of live parts: Work to be performed shall be considered energized electrical work and shall be performed by written permit only. See Attachment B.
2. Exemptions to Work Permit: Work performed within the Limited Approach Boundary of live parts by qualified persons related to tasks such as testing, troubleshooting, voltage measuring, etc., shall be permitted without an energized electrical work permit, provided appropriate safe work practices (JHA's) and PPE are provided and used.

Alerting Techniques

1. Barricades: Barricades shall be used in conjunction with safety signs where it is necessary to prevent or limit employee access to work areas containing live parts. Barricades shall be placed no closer than the Limited Approach Boundary given in Table 1 and Table 1a.
2. Attendants: If signs and barricades do not provide sufficient warning and protection from electrical hazards, an attendant shall be stationed to warn and protect employees. An attendant

shall remain in the area if there is a potential for employees to be exposed to the electrical hazards.

Use of Equipment

1. Portable Power Tools, Equipment and Extension Cords shall be visually inspected prior to use and handled in a manner that will not cause damage. These devices shall not be altered in a manner that was not intended by the manufacturer. Adapters that interrupt the continuity of the equipment-grounding conductor shall not be used. Additionally, GFCI protection is required.
2. Flexible electric cords connected to equipment shall not be used for raising or lowering the equipment. They shall not be fastened with staples or hung in such a manner that could damage the outer jacket or insulation. They shall not be spliced or taped.
3. Extension cords and cables must be (3) wire, 14 gauge or heavier with a ground plug. Damaged or worn cords must be taken out of service and tagged defective and repaired or removed. When cords/cables are passing through the work area, they shall be elevated or covered for protection, and arranged to eliminate any tripping hazards.

Test Instruments and Equipment

1. Only qualified persons shall perform tasks such as testing, troubleshooting, and voltage measuring within the limited approach boundary of live parts operating at 50 volts or more or where an electrical hazard exists.
2. Test instruments, equipment and their accessories shall be rated for circuits and equipment to which they will be connected. They shall also be designed for the environment to which they will be exposed, and the way they will be used.
3. Test instruments, equipment and all associated test leads, cables, power cords, probes, and connectors shall be visually inspected for external defects and damage before each use. If there is a defect or evidence of damage that might expose an employee to injury, the item(s) shall be removed from service.
4. In addition, all testing equipment or instruments shall be maintained and calibrating per the manufactures written guidelines.

Other Precautions for Personnel Activities

1. Alertness: Employees shall be instructed to be alert always while working within the Limited Approach Boundary of energized electrical conductors or circuit parts. They will not knowingly be permitted to work while their alertness is recognizably impaired due to illness, fatigue, or for any other reason.
2. Blind Reaching: Employees shall be instructed not to reach blindly into areas that might contain exposed energized electrical conductors or circuit parts where an electrical hazard exists.
3. Conductive Articles Being Worn: Conductive articles of jewelry and clothing (such as watchbands, bracelets, rings, key chains, necklaces, metalized aprons, cloth with conductive thread, metal headgear, or metal frame glasses) shall not be worn where they present an electrical contact hazard with exposed energized electrical conductors or circuit parts.
4. Conductive Materials, Tools, and Equipment Being Handled: Conductive materials, tools, and equipment that are in contact with any part of an employee's body shall be handled in a manner that prevents accidental contact with energized electrical conductors or circuit parts.
5. Conductive Work Locations: Portable electric equipment 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. In job locations where employees are likely to contact or be drenched with water or conductive liquids, GFCI protection shall also be used.
6. Confined or Enclosed Work Spaces: When an employee works in a confined or enclosed space containing exposed energized electrical conductors or circuit parts, management shall provide, and the employee shall use, protective shields, protective barriers, or insulating materials as necessary to avoid inadvertent contact with these parts. Doors, hinged panels, and the like shall be secured to prevent their swinging into an employee. In the event of confined space work being performed, Clemson university confined space policy shall be adhered to.
7. Housekeeping Duties: Good housekeeping must be maintained always. Poor housekeeping in mechanical spaces presents many hazards including fire, trip and accidental contact; as well as code violations.
 - The OSHA Regulation (29 CFR 1910.303 (g) (table S-1) requires sufficient access and working space around all equipment serving 600 volts or less.

TABLE S-1

Nominal voltage to ground	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

Notes to Table S-1:

1. Minimum clear distances may be 0.7 m (2.5 ft) for installations built before April 16, 1981.

2. Conditions A, B, and C are as follows:

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.

Insulated wire or insulated busbars operating at not over 300 volts are not considered live parts.

Condition B -- Exposed live parts on one side and grounded parts on the other side.

Condition C -- Exposed live parts on both sides of the work space (not guarded as provided in Condition A) with the operator between.

3. Working space is not required in back of assemblies such as dead-front switchboards or motor control centers where there are no renewable or adjustable parts (such as fuses or switches) on the back and where all connections are accessible from locations other than the back. Where rear access is required to work on deenergized parts on the back of enclosed equipment, a minimum working space of 762 mm (30 in.) horizontally shall be provided.

- The National Electrical Code (NFPA 70 110.26) requires a minimum of 36 inches of clear working space in the direction of any access to live parts.
 - For equipment serving between 120 and 250 volts, the regulations require a minimum of three feet of clearance. The width of the working space in front shall be 30 inches minimum or width of the equipment when greater than 30 inches.
 - Employees shall not perform housekeeping duties inside the limited approach boundary where there is a possibility of contact with energized electrical conductors or circuit parts, unless adequate safeguards (such as insulating equipment or barriers) are provided to prevent contact.
8. Illumination: Employees shall not enter spaces containing electrical hazards unless illumination is provided which enables the employees to perform the work safely.

Personal and Other Protective Equipment

*All PPE worn shall meet the requirements of Table 130.7(C)(15)(A)(a) of NFPA 70E or the most recent version

1. Employees working in areas where electrical hazards are present shall be provided with, and shall use, protective equipment that is designed and constructed for the specific body part to be protected and for the work to be performed.
2. Department supervisors are responsible for providing electrical protective equipment required by this program at no cost to employees, such as AR apparel, eye protection, head protection, hand protection, insulated footwear and face shields. Department supervisors are not responsible for providing non-AR under layers to employees.
3. All PPE shall be maintained in safe, reliable condition by the employee to whom it is issued and shall conform to the standards of Table 130.7(C)(15)(A)(a) of NFPA 70E. Copies of NFPA 70E can be found by contacting EHS.
4. Employee shall wear nonconductive head protection whenever there is a danger of head injury for electric shock or burns due to contact with live parts or from flying objects resulting from electrical explosion.
5. Employees shall wear PPE for the eyes whenever there is a danger of injury from electric arcs, flashes, or from flying objects resulting from electrical explosion.
6. Employees shall wear rubber insulating gloves where there is danger of hand and arm injury due to contact with live parts or possible exposure to arc flash burn. At minimum insulated gloves shall be tested per manufactures requirements every 6 months and discarded if any discrepancies are found. The following ratings can be found on voltage rated gloves:
 - Class 00 = Protect against voltage up to 500 volts
 - Class 0 = Protect against voltage up to 1,000 volts
 - Class 1 = Protect against voltage up to 7,500 volts
 - Class 2 = Protect against voltage up to 17,000 volts
 - Class 3 = Protect against voltage up to 26,500 volts
 - Class 4 = Protect against voltage up to 36,000 volts

7. Where insulated footwear is used as protection against step and touch potential, dielectric overshoes shall be required. Insulated footwear shall not be used as the primary protection.
8. Face shields without an arc rating shall not be used for electrical work. Safety glasses or goggles must always be worn underneath face shields.

***All PPE shall be tested and discarded per manufacturers guidelines.**

Insulated Tools and Equipment

Only insulated tools and equipment shall be used within the limited approach boundary of exposed energized parts.

1. Requirements for Insulated Tools
 - a. Insulated tools shall be rated for the voltages on which they will be used and shall be inspected prior to each use.
 - b. Fuse or fuse holder handling equipment, insulated for the circuit voltage, shall be used to remove or install a fuse if the fuse terminals are energized.
 - c. Ropes and hand lines used within the Limited Approach Boundary shall be nonconductive.
 - d. Fiberglass-reinforced plastic rod and tube used for live line tools shall meet the requirements of electrical codes and standards.
 - e. Portable ladders shall have nonconductive side rails and shall meet the requirements of ANSI standards for ladders.
 - f. Protective shields, protective barriers, or insulating materials shall be used to protect employees from shock, burns, or other electrically related injuries while that employee is working within the Limited Approach Boundary.
 - g. Rubber insulating equipment shall meet the ASTM standards.
 - h. Plastic guard equipment shall meet ASTM standards.
 - i. Physical or mechanical (field fabricated) barriers shall be installed no closer than the restricted approach distance given in Table 1 and Table 1a. While the barrier is being installed, the restrictive approach distance specified in Table 1 and Table 1a shall be maintained, or the energized electrical conductors or circuit parts shall be placed in an electrically safe work condition.
2. All insulated equipment shall be tested and discarded per manufactures guidelines.

3. Work within the Limited Approach Boundary or Arc Flash Boundary of Uninsulated Overhead Lines.

Where work is performed in locations containing uninsulated energized overhead lines which are not guarded or isolated, precautions shall be taken to prevent employees from contacting such lines. Where the work to be performed is such that contact with uninsulated energized overhead lines is possible, the lines shall be de-energized and visibly grounded at the point of work, or suitably guarded.

- a. A qualified person shall determine if the overhead electrical lines are insulated for the lines' operating voltage.
- b. If the lines are to be de-energized, arrangements shall be made with the person or organization that operates or controls the lines to de-energize them and visibly ground them at the point of work. If arrangements are made to use protective measures, such as guarding, isolating, or insulation, these precautions shall prevent each employee from contacting such lines directly with any part of his or her body or indirectly through conductive materials, tools, or equipment.
- c. When unqualified persons are working on the ground or in an elevated position near overhead lines, the location shall be such that the employee and the longest conductive object the employee might contact cannot come closer to any unguarded, energized overhead power line than the Limited Approach Boundary in Table 1, Column 2 or Table 1a, column 2.
- d. If any vehicle or mechanical equipment is intentionally grounded, employees working on the ground near the point of grounding shall not stand at the grounding location whenever there is a possibility of overhead line contact. Additional precautions, such as the use of barricades, dielectric overshoe footwear, or insulation, shall be taken to protect employees from hazardous ground potentials (step and touch potential).

4. Arc Flash Safety

It is the goal of CU to control the arc flash hazard which occurs during the maintenance of electrical building components throughout all facilities. To reduce the potential for arc flash incidences, the following procedures shall be followed:

- a. De-energize all circuits before performing work on them (follow Clemson University lockout/tagout policy when de-energizing circuits).
- b. Ensure that all possible sources of supply are found and open disconnecting devices for each source.
- c. Apply Lockout/Tagout devices in accordance with the CU Lockout/Tagout Policy.

- d. Test voltage on each conductor to verify that it is de-energized.
- e. Apply grounding devices where stored energy or induced voltage could exist or where de-energized conductors could contact live parts.
- f. If work is necessary on energized parts, the energized work permit procedure must be followed.
- g. Electrical equipment such as but not limited to switchboards, panelboards, industrial control panels, meter socket enclosures, and motor control centers that are likely to require examination, adjustment, servicing, or maintenance while energized, shall be field marked with a label containing all the following information (See Attachment H):
 - i. At least one of the following:
 - Available incident energy and the corresponding working distance
 - Minimum arc rating of clothing
 - Required level of PPE
 - Highest Hazard/Risk Category (HRC) for the equipment.
 - ii. Nominal system voltage
 - iii. Arc flash boundary

Safety Requirements for Special Equipment

Safety-related Work Practices for Use of Lasers

The requirements of this section apply to the use of lasers in the laboratory and the workshop.

For the purposes of this section, the following definitions apply.

Fail Safe: The design consideration in which failure of a component does not increase the hazard. In the failure mode, the system is rendered inoperative or nonhazardous

Fail Safe Safety Interlock: An interlock that in the failure mode does not defeat the purpose of the interlock, for example, an interlock that is positively driven into the off position as soon as a hinged cover begins to open, or before a detachable cover is removed, and that is positively held in the off position until the hinged cover is closed or the detachable cover is locked in the closed position.

Laser: Any device that can be made to produce or amplify electromagnetic radiation in the wavelength range from 100 nm to 1 mm primarily by the process of controlled stimulated emission.

Laser Energy Source: Any device intended for use in conjunction with a laser to supply energy for the excitation of electrons, ions, or molecules. General energy sources, such as electrical supply services or batteries, shall not be considered to constitute laser energy sources.

Laser Product: Any product or assembly of components that constitutes, incorporates, or is intended to incorporate a laser or laser system.

Laser Radiation: All electromagnetic radiation emitted by a laser product between 100 nm and 1 mm that is produced as a result of a controlled stimulated emission.

Laser System: A laser in combination with an appropriate laser energy source with or without additional incorporated components.

1. Safety Training

Clemson University will provide training for all operator and maintenance personnel. The training shall include, but is not limited to, the following:

- a. Familiarization with laser principles of operation, laser types, and laser emissions
- b. Laser safety, including the following:
 - i. System operating procedures
 - ii. Hazard control procedures
 - iii. The need for personnel protection
 - iv. Accident reporting procedures
 - v. Biological effects of the laser upon the eye and the skin
 - vi. Electrical and other hazards associated with the laser equipment, including the following:
 - High voltages (> 1 kV) and stored energy in the capacitor banks
 - Circuit components, such as electron tubes, with anode voltages greater than 5 kV emitting X-rays
 - Capacitor bank explosions
 - Production of ionizing radiation
 - Poisoning from the solvent or dye switching liquids or laser media
 - High sound intensity levels from pulsed lasers

- c. Proof of qualification of the laser equipment operator shall be available and in possession of the operator at all times.
2. Safeguarding of Employees in the Laser Operating Area.
 - a. Employees shall be provided with adequate eye protection.
 - b. Warning signs shall be posted at the entrances to areas or protective enclosures containing laser products.
 - c. High power laser equipment shall include a key-operated master control.
 - d. High-power laser equipment shall include a failsafe laser radiation emission audible and visible warning when it is switched on or if the capacitor banks are charged.
 - e. Beam shutters or caps shall be utilized, or the laser switched off, when laser transmission is not required. The laser shall be switched off when unattended for 30 minutes or more.
 - f. Laser beams shall not be aimed at employees.
 - g. Laser equipment shall bear a label indicating its maximum output.
 - h. Personnel protective equipment shall be provided for users and operators of high-power laser equipment.
3. Employees shall be responsible for the following:
 - a. Obtaining authorization for laser use
 - b. Obtaining authorization for being in a laser operating area
 - c. Observing safety rules
 - d. Reporting laser equipment failures and accidents to supervision.

Safety Related Work Practices for Power Electronic Equipment

This section applies to safety-related work practices around power electronic equipment, including ***hazards associated with power electronic equipment***. Employees shall be made aware of the hazards associated with the following:

- a. High voltages within the power supplies
- b. Radio frequency energy – induced high voltages
- c. Effects of radio frequency, RF, fields in the vicinity of antennas and antenna transmission lines, which can introduce electrical shock and burns
- d. Ionizing (X-radiation) hazards from magnetrons, klystrons, thyratrons, cathode-ray tubes, and similar devices

- e. Non-ionizing RF radiation hazards from the following:
 - i. Radar equipment
 - ii. Radio communication equipment, including broadcast transmitters
 - iii. Satellite earth-transmitters
 - iv. Industrial scientific and medical equipment
 - v. RF induction heaters and dielectric heaters
 - vi. Industrial microwave heaters and diathermy radiators

Specific Measures for Personnel Safety

- a. Management shall be responsible for the following:
 - i. Proper training and supervision by properly qualified personnel including the following:
 - The nature of the associated hazard
 - Strategies to minimize the hazard
 - Methods of avoiding or protecting against the hazard
 - The necessity of reporting any hazardous incident
 - ii. Properly installed equipment.
 - iii. Proper access to the equipment.
 - iv. Availability of the correct tools for operation and maintenance.
 - v. Proper identification and guarding of dangerous equipment.
 - vi. Provision of complete and accurate circuit diagrams and other published information to the employee prior to the employee starting work. The circuit diagrams should be marked to indicate the hazardous components.
 - vii. Maintenance of clear and clean work areas around the equipment to be worked.
 - viii. Provision of adequate and proper illumination of the work area.
- b. The employee is responsible for the following:
 - i. Understanding the hazards associated with the work.
 - ii. Being continuously alert and aware of the possible hazards
 - iii. Using the proper tools and procedures for the work

- iv. Informing supervision of malfunctioning protective measures, such as faulty or inoperable enclosures and locking schemes
- v. Examining all documents provided by Management relevant to the work, especially those documents indicating the hazardous components location
- vi. Maintaining good housekeeping around the equipment and work area
- vii. Reporting any hazardous incident
- viii. Using and appropriately maintaining the PPE and tools required to perform the work safely.

Safety-Related Work Requirements for Research and Development Laboratories

The requirements of this section apply to the electrical installations in those areas, with custom or special electrical equipment, designated for research and development (R&D) or as laboratories.

For the purposes of this section, the following definitions apply.

Competent Person: A person meeting all of the requirements of a qualified person, as defined in Section IV of this document and, in addition, is responsible for all work activities or safety procedures related to custom or special equipment, and has detailed knowledge regarding the electrical hazard exposure, the appropriate controls for mitigating those hazards, and the implementation of those controls.

Field Evaluated: A thorough evaluation of non-listed or modified equipment in the field that is performed by persons or parties acceptable to the authority having jurisdiction. The evaluation approval ensures that the equipment meets appropriate codes and standards, or is similarly found suitable for a specified purpose.

Laboratory: A building, space, room, or group of rooms intended to serve activities involving procedures for investigation, diagnostics, product testing, or use of custom or special electrical components, systems, or equipment.

Research and Development (R&D): An activity in an installation specifically designated for research or development conducted with custom or special electrical equipment.

Applications of Other Articles: The electrical system for R&D and laboratory applications shall meet the requirements of this document.

Note: Examples of these applications include low voltage-high current power systems; high voltage-low current power systems; dc power supplies; capacitors; cable trays for signal cables and other systems, such as steam, water, air, gas, or drainage; and custom-made electronic equipment.

Specific Measures and Controls for Personnel Safety

Each laboratory or R&D system application shall be assigned a competent person to ensure the use of appropriate electrical safety-related work practices and controls.

Listing Requirements

The equipment or systems used in the R&D area or in the laboratory shall be listed or field evaluated prior to use.

Note: Laboratory and R&D equipment or systems can pose unique electrical hazards that might require mitigation. Such hazards include ac and dc, low voltage and high amperage, high voltage and low current, large electromagnetic fields, induced voltages, pulsed power, multiple frequencies, and similar exposures.

Periodic Audits

1. The Electrical Safety Program shall be audited to verify the principles and procedures follow NFPA 70E. The frequency of the audit shall not exceed 3 years and shall be documented.
2. Field work shall be audited to verify the requirements contained in the procedures of the Electrical Safety Program are being followed. When the auditing determines that the principles and procedures of the Electrical Safety Program are not being followed, the appropriate revisions to the training program or revisions to the procedures shall be made. See Attachment C.
3. The Department shall conduct a periodic, documented audit of live electrical work safety procedures. Supervisors/Electrical Engineers will perform the audit. Departments may use this audit to correct any deviations or inadequacies identified.
4. The audit shall include direct observation of electrical work methods and verification that procedures are appropriate, understood and implemented. See Attachment C.

Table 1 – Approach Boundaries to Energized Electrical Conductors and Circuit Parts for Shock Protection for Alternating-Current Systems. (All dimensions are distance from live part to employee.)

1	2	3	4
Nominal System Voltage Range, Phase to Phase ^a	Limited Approach Boundary ^b		Restricted Approach Boundary ^b , Includes Inadvertent Movement Adder
	Exposed Movable Conductor ^c	Exposed Fixed Circuit Part	
Less than 50	Not specified	Not specified	Not specified
50 to 150	10 ft. 0 in.	3 ft. 6 in.	Avoid contact
151 to 750	10 ft. 0 in.	3 ft. 6 in.	1 ft. 0 in.
751 to 15 kV	10 ft. 0 in.	5 ft. 0 in.	2 ft. 2 in.
15.1 kV to 36 kV	10 ft. 0 in.	6 ft. 0 in.	2 ft. 7 in.
36.1 kV to 46 kV	10 ft. 0 in.	8 ft. 0 in.	2 ft. 9 in.
46.1 kV to 72.5 kV	10 ft. 0 in.	8 ft. 0 in.	3 ft. 3 in.
72.6 kV to 121 kV	10 ft. 8 in.	8 ft. 0 in.	3 ft. 4 in.
138 kV to 145 kV	11 ft. 0 in.	10 ft. 0 in.	3 ft. 10 in.
161 kV to 169 kV	11 ft. 8 in.	11 ft. 8 in.	4 ft. 3 in.
230 kV to 242 kV	13 ft. 0 in.	13 ft. 0 in.	5 ft. 8 in.
345 kV to 362 kV	15 ft. 4 in.	15 ft. 4 in.	9 ft. 2 in.
500 kV to 550 kV	19 ft. 0 in.	19 ft. 0 in.	11 ft. 10 in.
765 kV to 800 kV	23 ft. 9 in.	23 ft. 9 in.	15 ft. 11 in.

^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 and text in 7.C.3 for elaboration.

^c This 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 1a Approach Boundaries to Energized Electrical Conductors or Circuit Parts for Shock Protection, Direct-Current Voltage Systems

1	2	3	4
Nominal Potential Differences	Limited Approach Boundary		Restricted Approach Boundary, Includes Inadvertent Movement Adder
	Exposed Movable Conductor	Exposed Fixed Circuit Part	
Less than 100 V	Not specified	Not specified	Not specified
100 V – 300 V	10 ft. 0 in.	3 ft. 6 in.	Avoid contact
301 V – 1kV	10 ft. 0 in.	3 ft. 6 in.	1 ft. 0 in.
1.1 kV – 5 kV	10 ft. 0 in.	5 ft. 0 in.	1 ft. 5 in.
5 kV – 15 kV	10 ft. 0 in.	5 ft. 0 in.	2 ft. 2 in.
15.1 kV – 45 kV	10 ft. 0 in.	8 ft. 0 in.	2 ft. 9 in.
45.1 kV – 75 kV	10 ft. 0 in.	8 ft. 0 in.	3 ft. 2 in.
75.1 kV – 150 kV	10 ft. 8 in.	10 ft. 0 in.	4 ft. 0 in.
150.1 kV – 250 kV	11 ft. 8 in.	11 ft. 8 in.	5 ft. 3 in.
250.1 kV – 500 kV	20 ft. 0 in.	20 ft. 0 in.	11 ft. 6 in.
500.1 kV – 800 kV	26 ft. 0 in.	26 ft. 0 in.	16 ft. 5 in.

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

^b This 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 2 – Protective Clothing and Personal Protective Equipment (PPE)

Hazard/Risk Category	Protective Clothing and PPE
1	<p>Arc-Rated Clothing, Minimum Arc Rating of 4 cal/cm² (See Note 1)</p> <p>Arc-rated long-sleeve shirt and pants or arc-rated coverall</p> <p>Arc-rated face shield (see Note 2) or arc flash suit hood</p> <p>Arc-rated jacket, parka, or rainwear, or hard hat liner (AN)</p>
	<p>Protective Equipment</p> <p>Hard hat</p> <p>Safety glasses or safety goggles (SR)</p> <p>Hearing protection (ear canal inserts)</p> <p>Heavy duty leather gloves (Note 3)</p> <p>Leather footwear (AN)</p>
2	<p>Arc-Rated Clothing, Minimum Arc Rating of 8 cal/cm² (See Note 1)</p> <p>Arc-rated long-sleeve shirt and arc-rated pants or arc-rated coverall</p> <p>Arc-rated flash suit hood or arc-rated face shield (See Note 2) and arc flash balaclava</p> <p>Arc-rated jacket, parka, rainwear, or hard hat liner (AN)</p>
	<p>Protective Equipment</p> <p>Hard hat</p> <p>Safety glasses or safety goggles (SR)</p> <p>Hearing protection (ear canal inserts)</p> <p>Heavy duty leather gloves (Note 3)</p> <p>Leather footwear</p>

Table 2 Continued

Hazard/Risk Category	Protective Clothing and PPE
3	<p>Arc-Rated Clothing Selected so that the System Arc Rating Meets the Required Minimum Arc Rating of 25 cal/cm² (See Note 1)</p> <p>Arc-rated long-sleeve shirt (AR)</p> <p>Arc-rated pants (AR)</p> <p>Arc-rated coverall (AR)</p> <p>Arc-rated arc flash suit jacket (AR)</p> <p>Arc-rated arc flash suit pants (AR)</p> <p>Arc-rated arc flash suit hood</p> <p>Arc-rated gloves (See Note 1)</p> <p>Arc-rated jacket, parka, or rainwear, or hard hat liner (AN)</p> <hr/> <p>Protective Equipment</p> <p>Hard hat</p> <p>Safety glasses or safety goggles (SR)</p> <p>Hearing protection (ear canal inserts)</p> <p>Leather footwear</p>
4	<p>Arc-Rated Clothing Selected so that the System Arc Rating Meets the Required Minimum Arc Rating of 40 cal/cm² (See Note 1)</p> <p>Arc-rated long-sleeve shirt (AR)</p> <p>Arc-rated pants (AR)</p> <p>Arc-rated coverall (AR)</p> <p>Arc-rated arc flash suit jacket (AR)</p> <p>Arc-rated arc flash suit pants (AR)</p> <p>Arc-rated arc flash suit hood</p> <p>Arc-rated gloves (See Note 1)</p> <p>Arc-rated jacket, parka, rainwear, or hard hat liner (AN)</p> <hr/> <p>Protective Equipment</p>
	Hard hat

	Safety glasses or safety goggles (SR) Hearing protection (ear canal inserts) Leather Footwear
--	---

AN = As needed (optional).

AR = As required.

SR = Selection required

Notes:

1. Arc rating is defined in article 100 2015 NFPA 70e
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.
3. If rubber insulating gloves with leather protectors are used, additional leather or arc rated gloves are not required. The combination of rubber insulating gloves with leather protectors satisfies the arc flash protection requirement.

Attachment A – Job Briefing and Planning Checklist

Identify	
<input type="checkbox"/> The hazards	<input type="checkbox"/> The shock protection boundaries
<input type="checkbox"/> The voltage levels involved	<input type="checkbox"/> The available incident energy
<input type="checkbox"/> Skills required	<input type="checkbox"/> Potential for arc flash (Conduct a flash-hazard analysis.)
<input type="checkbox"/> Any "foreign" (secondary source) voltage source	<input type="checkbox"/> Flash protection boundary
<input type="checkbox"/> Any unusual work conditions	<input type="checkbox"/> Number of people needed to do the job
Ask	
<input type="checkbox"/> Can the equipment be de-energized?	<input type="checkbox"/> Is a "standby person" required?
<input type="checkbox"/> Are backfeeds of the circuits to be worked on possible?	
Check	
<input type="checkbox"/> Job plans	<input type="checkbox"/> Safety procedures
<input type="checkbox"/> Single-line diagrams and vendor prints	<input type="checkbox"/> Vendor information
<input type="checkbox"/> Status board	<input type="checkbox"/> Individuals are familiar with the facility
<input type="checkbox"/> Information on plant and vendor resources is up to date	
Know	
<input type="checkbox"/> What the job is	<input type="checkbox"/> Who is in charge
<input type="checkbox"/> Who else needs to know – Communicate!	
Think	
<input type="checkbox"/> About the unexpected event...What if?	<input type="checkbox"/> Install and remove grounds
<input type="checkbox"/> Lockout / Tagout	<input type="checkbox"/> Install barriers and barricades
<input type="checkbox"/> Test for voltage – FIRST	<input type="checkbox"/> What else....?
<input type="checkbox"/> Use the right tools and equipment, including PPE	
Prepare for an Emergency	
<input type="checkbox"/> Is the standby person CPR trained?	<input type="checkbox"/> What is the exact work location?
<input type="checkbox"/> Is the required emergency equipment available? Where is it?	<input type="checkbox"/> How is the equipment shut off in an emergency?
<input type="checkbox"/> Where is the nearest telephone?	<input type="checkbox"/> Are the emergency telephone numbers known?
<input type="checkbox"/> Where is the alarm?	<input type="checkbox"/> Where is the fire extinguisher?
<input type="checkbox"/> Is confined space rescue available?	<input type="checkbox"/> Are radio communications available?

Attachment B - ENERGIZED ELECTRICAL WORK PERMIT

PART I: TO BE COMPLETED BY THE REQUESTER:		
	Work Order Number _____	
1	Description of circuit/equipment/job location:	
2	Description of work to be done: _____	
3	Justification of why the circuit/equipment cannot be de-energized or the work deferred until the next scheduled outage:	
	Requester/Title	Date
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:	<input type="checkbox"/>
2	Description of the Safe Work Practices to be employed:	<input type="checkbox"/>
3	Results of the Shock Hazard Analysis:	<input type="checkbox"/>
4	Determination of Shock Protection Boundaries:	<input type="checkbox"/>
5	Results of the Flash Hazard Analysis:	<input type="checkbox"/>
6	Determination of the Flash Protection Boundary:	<input type="checkbox"/>
7	Necessary personal protective equipment to safely perform the assigned work:	<input type="checkbox"/>
8	Means employed to restrict the access of unqualified persons from the work area:	<input type="checkbox"/>
9	Evidence of completion of a Job Briefing including discussion of any job-related hazards:	<input type="checkbox"/>
10	Do you agree the above-described work can be done safely? <input type="checkbox"/> Yes <input type="checkbox"/> 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:		
	Requesting Department Manager _____	Maintenance/Engineering Manager _____
	Safety Manager _____	Electrically Knowledgeable Person _____
	Maintenance Director _____	Date _____

Note: Once the work is complete, forward this form to the UF Safety Coordinator for retention.

Attachment C – Energized Electrical Work Audit

Energized Electrical Work Audit

Date of Audit:		
Location of work:		
Specific Job audited:		
Personnel involved:		
Reason for Energized Electrical Work:		
Energized Electrical Work Checklist and Permit at job site:	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Energized Electrical Work Procedure understood/followed:	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Appropriate Lock-Tag-Try procedures followed:	<input type="checkbox"/> Yes	<input type="checkbox"/> No
List procedure(s):		
Appropriate JHA (Job Hazard Analysis) followed:	<input type="checkbox"/> Yes	<input type="checkbox"/> No
List JHA:		
Proper PPE utilized during energized electrical work:	<input type="checkbox"/> Yes	<input type="checkbox"/> No
List PPE:		

Audit Conducted by:

Attachment D - HAZARD/RISK EVALUATION PROCEDURE

Task: _____
 Equipment: _____
 Date: _____
 Issued by: _____
 Signature: _____
 Print Name: _____

Document no.: _____
 Part of: _____
 Pre-risk assessment
 Intermediate risk assessment
 Follow-up risk assessment

Black area = Safety measures required
 Grey area = Safety measures recommended

Consequences	Severity Se	Class Cl					Frequency Fr		Probability Pr		Avoidance Av	
		3-4	5-7	8-10	11-13	14-15						
Irreversible trauma, death	4						Daily	5	Common	5		
Permanent, third-degree burn	3						Weekly	4	Likely	4		
Reversible, second-degree burn	2						Monthly	3	Possible	3	Impossible	5
Reversible, first aid	1						Yearly	2	Rarely	2	Possible	3
							Less	1	Negligible	1	Likely	1

Hzd. No.	Hazard	Se	Fr+	Pr+	Av+	= Cl	Severity Mitigators	Safe

Comments: _____

Attachment E – Hazard/Risk Evaluation Procedure Sample

HAZARD/RISK EVALUATION PROCEDURE

Task: Voltage testing Document no.: _____

Equipment: _____ Part of: _____

Date: _____ Pre-risk assessment

Issued by: _____ Intermediate risk assessment

Signature: _____ Follow-up risk assessment

Print Name: _____

Black area = Safety measures required
 Grey area = Safety measures recommended

Consequences	Severity Se	Class Cl					Frequency Fr	Probability Pr	Avoidance Av		
		3-4	5-7	8-10	11-13	14-15					
Irreversible trauma, death	4						Daily	5	Common	5	
Permanent, third-degree burn	3						Weekly	4	Likely	4	
Reversible, second-degree burn	2						Monthly	3	Possible	3	Impossible
Reversible, first aid	1						Yearly	2	Rarely	2	Possible
							Less	1	Negligible	1	Likely

Hzd. No.	Hazard	Se	Fr+	Pr+	Av+	= Cl	Severity Mitigators	Safe
1	Human factors	4	5	3	5	13	Use appropriate PPE and follow established safety procedures.	Y
2	Shortened test leads	3	5	2	5	12	Inspect leads before each use.	Y
3	Meter misapplication	4	5	3	5	13	Ensure that the meter is rated for the level of voltage being tested.	Y
4	Meter malfunctions	3	5	2	5	12	Ensure that the meter is CAT rated to the appropriate hazard level.	Y

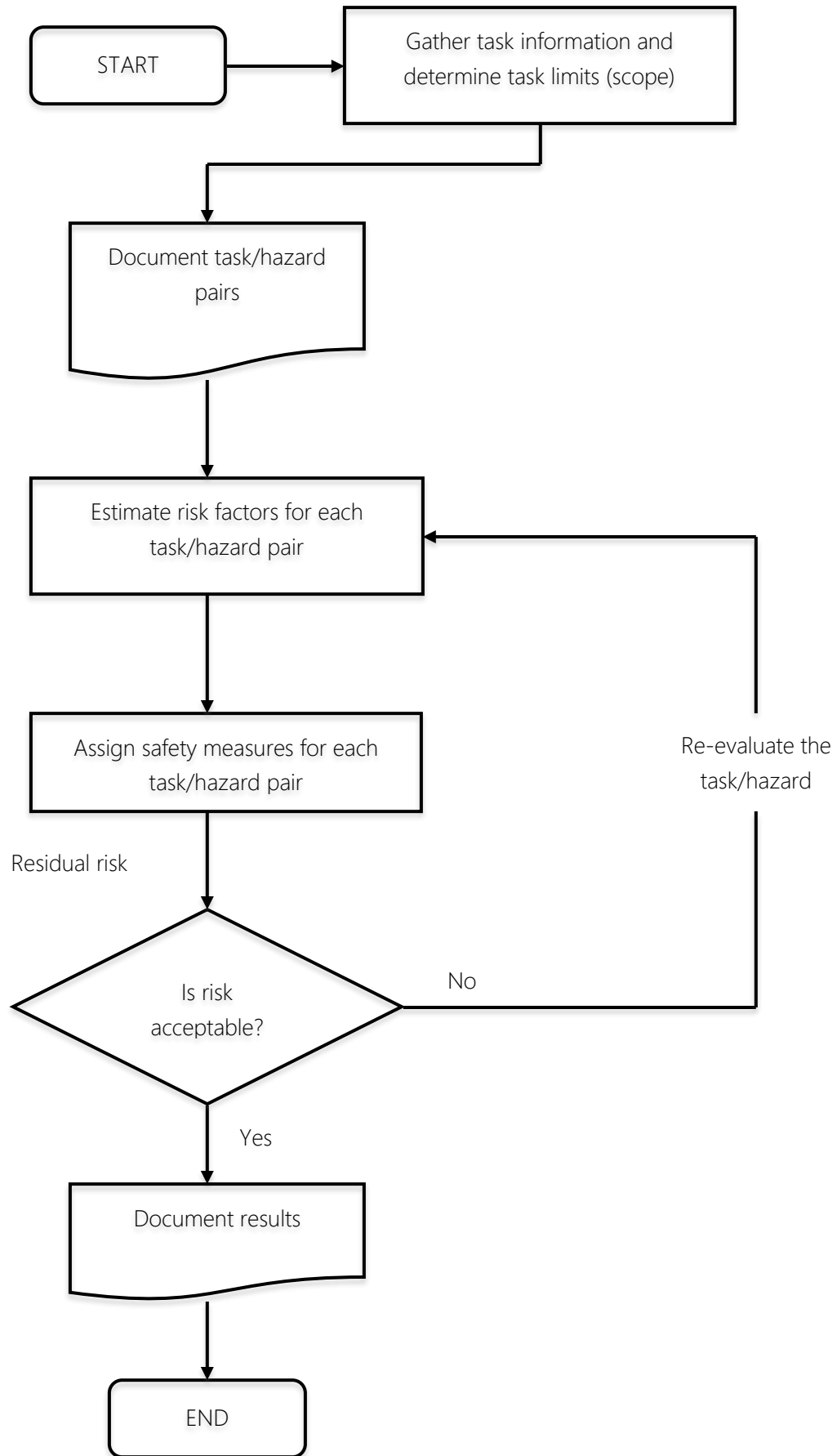
Comments:
 PPE required: Voltage rated gloves and leather protectors, face and head protection, clothing rated for the incident energy exposure.


Attachment G – Job Hazard Analysis Sample


JOB HAZARD ANALYSIS

Task:	Install electrical conduit.		
Conducted By:	John Doe		
Reviewed By:	Jane Smith		
Date:	6/20/14	Department:	UF – Central Campus

Task/Step	Potential Hazards	Safe Job Procedures
Pre-job set up.	<ul style="list-style-type: none"> • Hand tools. • Power tools (electric, gas, hydraulic, pneumatic). 	Check operating condition of hand and power tools; inspect power cords for frays and nicks. Use proper extension cord.
Install hangers.	<ul style="list-style-type: none"> • Elevated loads. • Elevated work platform or stairs. • Hand tools. • Lifting equipment (forklifts, hoists). 	Use forklift to raise hangers to ceiling, mark area under platform. Tie hanger to platform to prevent dropping. Do not sort hangers on platform.
Drill hole for hanger.	<ul style="list-style-type: none"> • Elevated loads. • Elevated work platform or stairs. • Hand tools. • Power tools (electric, gas, hydraulic, pneumatic). 	Mark area under platform; keep personnel out of area, falling object hazard. Locate tools and power cord to minimize tripping hazard. Gloves and eye protection required.
Place conduit.	<ul style="list-style-type: none"> • Elevated loads. • Elevated platform or stairs. • Hand tools. • Lifting equipment (forklifts, hoists). 	Lift pipe with forklift. Block area under pipe from foot traffic. Tie pipe to lift until hangers are tight.



	
DANGER	
NO SAFE PPE EXISTS	
ENERGIZED WORK PROHIBITED	
224 in 75 cal/cm²	Arc Flash Boundary Arc Flash at 18 in
PPE	DO NOT WORK ON LIVE!
480 VAC 00 42 in 12 in	Shock Risk when cover is removed Glove Class Limited Approach Restricted Approach
Location: 1227 1SHA MAIN SWBD	
Protective Device 1227 1SHA SWBD MBkr	
Max SC Amps 19.87 kA Date: May 31, 2017	

	
WARNING	
Arc Flash and Shock Risk	
Appropriate PPE Required	
65 in 9.8 cal/cm²	Arc Flash Boundary Arc Flash at 18 in
PPE	Consult Electrical Safety Program Manual
208 VAC 00 42 in Avoid Contact	Shock Risk when cover is removed Glove Class Limited Approach Restricted Approach
Location: 1227 1LDA2 LOAD KING COFFEE-Sh	
Protective Device 1227 1LDA CKT 1,3-	
Max SC Amps 2.64 kA Date: May 31, 2017	