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ELECTRICAL SAFETY IN THE WORKPLACE

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I. Purpose

The purpose of this program is to comply with the Occupational Safety and Health Administration (OSHA) 29 CFR 1910.331 through 1910.335 Safety-Related Work Practices and 1910.137. UNC Charlotte's goal is to minimize employee exposure to hazards that can occur during the installation, repair, maintenance, and operation of electrical equipment, components, and systems.

II. Scope

This program is applicable to UNC Charlotte employees both qualified (those familiar with the construction and operation of electrical equipment, the hazards involved and who have training in avoiding the electrical hazards of working on or near energized parts) and unqualified (those with little or no such training) who work on, near or with the following installations during the normal scope of their job duties:

- A. *Premises wiring.* Installations of electric conductors and equipment within or on buildings or other structures, and on other premises such as yards, carnival, parking, and other lots, and industrial substations;
- B. *Wiring for connection to supply.* Installations of conductors that connect to the supply of electricity; and
- C. *Other wiring.* Installations of other outside conductors on the premises.
- D. *Optical fiber cable.* Installations of optical fiber cable where such installations are made along with electric conductors.

This program does not cover the following:

- A. Generation, transmission, and distribution installations.
- B. Communications installations.
- C. Installations in vehicles (e.g., ships, watercraft, railway rolling stock, aircraft, or automotive vehicles other than mobile homes and recreational vehicles).
- D. Railway installations.

III. Definitions

- A. **Approved** – Acceptable to the authority having jurisdiction.
- B. **Arc Flash** – the expanding arc or fireball emanating from the source of the arc. It may be from a fraction of an inch to ten feet or more in size. It involves extremely intense heat and may ignite anything combustible in its path. The duration is usually a fraction of a second. An arc flash can reach temperatures of 35,000 degrees and can produce a concussive force of expanding gases and metal plasma.
- C. **Arc Flash Boundary** – When an arc flash hazard exists, an approach limit from an arc source at which incident energy equals 1.2 cal/cm² (5 J/cm²).
- D. **Arc Flash Hazard** – A source of possible injury or damage to health associated with the release of energy caused by an electric arc.
- E. **Arc Flash Suit** – A complete arc-rated clothing and equipment system that covers the entire body, except for the hands and the feet.
- F. **Arc Rating** - the maximum incident energy resistance demonstrated by a material (or a layered system of materials) prior to break open or at the onset of a second degree skin burn. Arc rating is normally expressed in cal/cm².
- G. **Arc Resistant Equipment** – Equipment designed to withstand the effects of an internal arcing fault and that directs the internally released energy away from the employee.

- H. **Attachment Plug** – A device that, by insertion in a receptacle, establishes a connection between the conductors of the attached flexible cord and the conductors connected permanently to the receptacle.
- I. **Authority Having Jurisdiction (AHJ)** – An organization, office, or individual responsible for enforcing the requirements of a code or standard, or for approving equipment, materials, an installation, or a procedure.
- J. **Automatic** – Performing a function without the necessity of human intervention.
- K. **Balaclava** – An arc-rated head-protective fabric that protects the neck and head except for a small portion of the facial area.
- L. **Circuit breaker** – a device designed to open and close a circuit by non-automatic means and to open the circuit automatically on a predetermined overcurrent without damage to itself when properly applied within its rating.
- M. **Conductive** – Suitable for carrying electric current.
- N. **Conductor** – the physical elements that allow electricity to flow along a path. They include three types:
1. Bare. A conductor having no covering or electrical insulation whatsoever.
 2. Covered. A conductor encased within material of composition or thickness that is not recognized by NFPA 70E as electrical insulation.
 3. Insulated. A conductor encased within material of composition and thickness that is recognized by NFPA 70E as electrical insulation.
- O. **Contractor** – service provider that performs facility-related work including equipment service/maintenance or construction type activities.
- P. **Current** – is the measure of electrical charge (number of electrons) transferred per unit of time.
- Q. **De-energized** – Free from any electrical connection to a source of potential difference and from electrical charge; not having a potential different from that of the earth.
- R. **Device** – A unit of an electrical system, other than a conductor, that carries or controls electric energy as its principal function.
- S. **Electrical Hazard** – A dangerous condition such that contact or equipment failure can result in electrical shock, arc flash burn, thermal burn, or arc blast injury.
- T. **Electrical Safety** – Identifying hazards associated with the use of electrical energy and taking precautions to reduce the risk associated with those hazards.
- U. **Electrically Safe Work Condition** – A state in which an electrical conductor or circuit part has been disconnected from energized parts, locked/tagged in accordance with established standards, tested to verify the absence of voltage, and, if necessary, temporarily grounded for personnel protection.
- V. **Energized** – Electrically connected to or having a source of voltage.
- W. **Energized Electrical Work** – Work performed on or near energized electrical systems or equipment with exposed components operating at 50 volts or greater and as defined by Restricted Approach Boundary and Prohibited Approach Boundary terminology.
- X. **Equipment** – A general term, including fittings, devices, appliances, luminaires, apparatus, machinery, and the like, used as a part of, or in connection with, an electrical installation.
- Y. **Exposed (as applied to energized electrical conductors or circuit parts)** – Capable of being inadvertently touched or approached by personnel nearer than a safe distance. This applies to parts that are not suitably guarded, insulated, or isolated.
- Z. **Exposed (as applied to wiring methods)** – On or attached to the surface or behind panels designed to allow access.
- AA. **Fault Current** – The amount of current delivered at a point on the system during a short-circuit condition.

- BB. **Flame Resistant (FR)** - The property of a material whereby combustion is prevented, terminated, or inhibited following the application of a flaming or non-flaming source of ignition, with or without subsequent removal of the ignition source.
- CC. **Flash Hazard Analysis** – A study investigating a worker’s potential exposure to arc flash energy, conducted for the purpose of injury prevention and determination of safe work practices and the appropriate levels of personal protective equipment (PPE).
- DD. **Fuse** -- An overcurrent protective device with a circuit-opening fusible part that is heated and severed by the passage of overcurrent through it.
- EE. **Ground** – The earth.
- FF. **Grounded** – Connected to ground or to a conductive body that extends the ground connection.
- GG. **Ground Fault Circuit Interrupter (GFCI)** – A device intended for the protection of personnel that functions to de-energize a circuit or portion thereof within an established period of time when a current to ground exceeds the values established for a Class A device.
- HH. **Guarded** – Covered, shielded, fenced, enclosed, or otherwise protected by means of suitable covers, casings, barriers, rails, screens, mats or platforms to remove the likelihood of approach to a point of danger or contact by persons or objects.
- II. **Incident Energy** – The amount of thermal energy impressed on a surface, a certain distance from the source, generated during an electrical arc event. Incident energy is typically expressed in calories per square centimeter (cal/cm^2).
- JJ. **Insulated** – Separated from other conducting surfaces by a dielectric (including air space) offering a high resistance to the passage of current.
- KK. **Insulated Tools** – Tools tested and approved by the manufacturer for the rated voltage or tools that are covered, surrounded or separated with a nonconductive material in order to prevent or reduce the transfer of electricity.
- LL. **Labeled** – Equipment or materials to which has been attached a label, symbol, or other identifying mark of an organization that is acceptable to the authority having jurisdiction and concerned with product evaluation, that maintains periodic inspection of production of labeled equipment or materials, and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.
- MM. **Live Parts** – Energized conductive components.
- NN. **Load** – Any device that converts electrical energy to motion, light, heat, or sound.
- OO. **Limited Approach Boundary** – An approach limit at a distance from an exposed energized electrical conductor or circuit part within which a shock hazard exists.
- PP. **Near** – conditions where contact with exposed electrical components is possible by slipping, tripping, falling, the actions of others, or inadvertent action of reasonable probability.
- QQ. **Nominal Voltage** – A nominal value assigned to a circuit or system for the purpose of conveniently designating its voltage class (e.g., 120/240 volts, 480Y/277 volts, 600 volts).
- RR. **Overcurrent** – Any current in excess of the rated current of equipment or the ampacity of a conductor. It may result from overload, short circuit, or ground fault.
- SS. **Overload** – Operation of equipment in excess of normal, full-load rating, or of a conductor in excess of rated ampacity that, when it persists for a sufficient length of time, would cause damage or dangerous overheating. A fault, such as a short circuit or ground fault, is not an overload.
- TT. **Protector** – A glove or mitten designed to be worn over rubber insulating gloves.

- UU. **Qualified Person** – One who has demonstrated skills and knowledge related to the construction and operation of electrical equipment and installations and has received safety training to identify the hazards and reduce the associated risk.
- VV. **Receptacle** – A contact device installed at the outlet for the connection of an attachment plug, or for the direct connection of electrical utilization equipment designed to mate with the corresponding contact device. A single receptacle is a single contact device with no other contact device on the same yoke. A multiple receptacle is two or more contact devices on the same yoke.
- WW. **Resistance** – the opposition to the flow of electrons and is measured in ohms.
- XX. **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.
- YY. **Shock Hazard** – A source of possible injury or damage to health associated with current through the body caused by contact or approach to exposed energized electrical conductors or circuit parts.
- ZZ. **Unqualified Person** – A person who is not a qualified person.
- AAA. **Voltage** – is the electromotive force (EMF) or “push” that moves electrons along a conductor. It can be described as the amount of electrical pressure in a circuit. It is either direct current (DC) or alternating current (AC).
- BBB. **Working Distance** – The distance between a person’s face and chest area and a prospective arc source.
- CCC. **Working On (energized electrical conductors or circuit parts)** – Intentionally coming in contact with energized electrical conductors or circuit parts with the hands, feet, or other body parts, with tools, probes, or with test equipment, regardless of the personal protective equipment (PPE) a person is wearing. There are two categories of “working on”: *Diagnostic (testing)* is taking readings or measurements of electrical equipment, conductors, or circuit parts with approved test equipment that does not require making any physical change to the electrical equipment, conductors, or circuit parts. *Repair* is any physical alteration of electrical equipment, conductors, or circuit parts (such as making or tightening connections, removing or replacing components, etc.).

IV. Responsibilities

Executive Leadership

The University of North Carolina at Charlotte has legal responsibility for compliance with the occupational safety and health standards.

Program Administrator

The Environmental Health and Safety Office is responsible for:

- A. Planning and recommending programs that adhere to all applicable federal, state, and local laws and regulations pertaining to environmental health and safety.
- B. Assisting supervisors with implementing environmental health and safety programs in their areas.
- C. Curtailing or stopping work that poses a clear and imminent danger to the health or safety of the University community.
- D. Periodically reviewing the program and updating it as needed to ensure compliance with all applicable federal and state regulations.

Departmental Management

Management is responsible for:

- A. Planning and developing budget requests for departmental safety programs.
- B. Developing safety procedures, work practices, and safe working areas for all those under their supervision.
- C. Supporting safety and health as a model to those they supervise.
- D. Supplying appropriate equipment, tools, and PPE for employee, Ensure all team members complete the required safety training, and keep detailed training records for documentation purposes.
- E. Verify that employees are qualified to perform electrical work before assigning tasks.
- F. Enforcing environmental health and safety regulation by invoking disciplinary action or administrative sanction.

Employees

Every UNC Charlotte employee is responsible for conducting himself/herself in accordance with this program. All employees shall:

- A. Adhere to all safety policies, programs, procedures, and practices while performing his/her duties in a safe manner.
- B. Notifying your immediate supervisor of unsafe working conditions, potential hazards and accidents as soon as possible.

Contractors

UNC Charlotte shall inform contract employers of the following:

- A. Known hazards that are related to the contract employer's work, and that might not be recognized by the contract employer or its employees.
- B. Information about UNC Charlotte's installation(s) or equipment that the contract employer needs to make their own risk assessment.
- C. Contractor Safety program availability.

Contract Employer Responsibilities

- A. Shall comply with all applicable regulatory requirements.
- B. The contract employer shall advise UNC Charlotte of the following:
 - 1. Any unique hazards presented by the contract employer activities.
 - 2. Hazards identified during the course of work by the contract employer that were not communicated by UNC Charlotte.

V. Safe Electrical Work Practices

Safe work practices shall be employed to prevent electric shock or other injuries resulting from either direct or indirect contact with electrically energized equipment or circuits. Listed below are several electrical safety related work practices:

- A. Only qualified persons shall perform electrical maintenance or service work, including tasks such as testing, troubleshooting, and voltage measuring on electrical equipment where an electrical hazard exists

- B. The qualified person(s) shall be familiar with the proper use of special precautionary techniques, personal protective equipment, insulating and shielding materials, and insulated tools.
- C. Follow UNC Charlotte Lockout Tagout Program requirements for de-energizing equipment.
- D. Wear appropriate personal protective equipment (PPE) and observe boundaries.
- E. Repair work must be done de-energized unless the qualified person and departmental management can justify working energized. An energized work permit must be completed unless the repair work is done remotely.

VI. Energized Electrical Work Practices

The Electrical Safety in the Workplace Program is based on the principle of avoiding energized work unless it is necessary. All other possibilities for establishing an electrically safe work condition must be exhausted before working on or near exposed energized parts. If exposed live parts **are not de-energized**, they must be justified by departmental management prior to starting work.

When work is performed on exposed live parts and employees are involved in direct contact with live parts or near enough to live parts to be exposed to any hazard the work practices outlined in the Electrical Energized Work Permit section must be followed.

VII. Justification

Only these criteria may be used to justify working on or near exposed energized parts.

- A. Exposed energized electrical parts that operate at less than 50 volts, where it is determined there will be no increased exposure to electrical burns or an explosion due to electric arcs. If the voltage is less than 50 volts, then only an electric shock hazard is absent. Other hazards such as a thermal or pressure hazard may be present in the event of a short-circuit condition (e.g. batteries).
- B. De-energizing creates an additional hazard or increased risk. Examples of additional hazard or increased risk include, but are not limited to, interruption of life-support equipment, deactivation of emergency alarm systems, loss of power will result in an environmental spill, or shutdown of a hazardous location's ventilation system.
- C. The task to be performed is not feasible in a de-energized state due to equipment design or operational limitations. If it is not possible to de-energize the exposed energized parts by performing the work at a different time, the work task is not able to be performed in an electrically safe work condition. Examples include, but are not limited to, performing diagnostics or testing to troubleshoot electrical circuits (can only be performed with the circuit energized), or working on circuits that are an integral part of a continuous process requiring that process to be completely shut down in order to permit work on one circuit or piece of equipment.

All energized diagnostic, repair and other work should be evaluated to determine if it meets the above criteria. In most instances, this work will require an Energized Work Permit to be completed to justify and approve the work.

VIII. Energized Electrical Work Permit

An Energized Electrical Work Permit (Appendix C) is required for any of the following conditions:

- A. Energized diagnostic work, which includes only testing, troubleshooting, voltage or current measurement and visual inspection will require a permit unless ALL the following apply:

1. An arc flash hazard assessment has been done to determine approach boundaries and PPE;
 2. Appropriate safe work practices and PPE are used;
 3. The work has been approved by departmental management(s);
 4. Only meter probes are allowed near electrical equipment for this type of activity;
 5. Tools other than meter probes are not allowed within the working distance, restricted approach boundary, or arc flash boundary.
- B. Energized repair work or work on battery storage systems, including preventive maintenance and general maintenance activity, on energized circuits, other than testing, troubleshooting, voltage or current measurement, or visual inspection. This work and work on battery systems, which cannot be de-energized, requires an Energized Electrical Work Permit.
- C. Other energized work to be performed within the restricted approach or arc flash boundary, or when the employee is interacting with the equipment in a manner that exposes them to an electric shock or arc flash hazard, such as when racking equipment in-or-out, connecting or disconnecting conductors, or when opening doors or removing covers that expose energized conductors or circuit parts, requires an Energized Electrical Work Permit.

The permit allows employees, managers and equipment owners the opportunity to recognize the increased exposure to electrocution or a thermal hazard and make a decision based on the conditions that exist in the field.

The UNC Charlotte Energized Electrical Work Permit requires electric shock and arc assessments to determine the approach distances and required arc rated PPE. In most instances this information will be located on the electrical equipment label. If not, the Incident Energy (IE) Analysis Method or the Arc Flash Categories Method (Table Method) shall be used to determine the approach distances (arc flash boundary) and the arc rated PPE required for energized work. Note: The IE method is preferred and the two methods shall not be combined.

- A. Incident Energy Analysis Method. This method is based on detailed calculations, often with the aid of specialized software, to determine the maximum potential incident energy exposure in calories per square centimeter (cal/cm^2). Once the incident energy exposure is calculated, the required arc flash boundary can be determined and the appropriate arc rated protective clothing can be specified according to NFPA 70E tables. The Incident Energy Analysis method must be used if the Table Method cannot be utilized. It may be used to determine more accurate results than is available with the Table Method.
- B. Table Method. This method is used by looking up specific equipment types in a table. **Appendix B**, for AC and DC systems. The Table Method may only be used by a person qualified on the equipment to be worked on.
- C. The equipment to be worked on must exactly match the equipment described in the table. Based upon the short-circuit current available and the fault clearing time, the required arc flash PPE category and the arc-flash boundary are then read from the table. If all parameters in the table are not met, this method shall not be used and therefore, the Incident Energy Analysis method is required. Contact the Environmental Health and Safety office, ehsoffice@charlotte.edu or 704-687-1111 if there are questions.

IX. Equipment Labeling

Electrical equipment (switchboards, panel boards, industrial control panels, meter socket enclosures, and motor control centers) requiring examination, adjustment, servicing, or maintenance while energized, shall be field-marked with a label containing all of the following information:

- A. Nominal system voltage.
- B. Arc flash boundary.
- C. At least one of the following:
 - 1. Available incident energy and the corresponding working distance.
 - 2. Minimum arc rating of clothing.
 - 3. Required level of PPE.

X. Other Precautions for Personnel Activities

- A. **Alertness.** Employees shall be instructed to be alert at all times where electrical hazards might exist. When impaired, employees shall not be permitted to work where electrical hazards exist while their alertness is recognizably impaired due to illness, fatigue, or other reasons.
- B. **Changes in Scope.** Employees shall be instructed to be alert for changes in the job or task that could lead the person outside of the electrically safe work condition or expose the person to additional hazards that were not part of the original plan.
- C. **Illumination:** Employees shall not enter spaces containing exposed energized parts, unless illumination is provided that enables the employees to perform the work safely. Employees are not to perform tasks on or near exposed energized parts where there is a lack of illumination or an obstruction which precludes observation of work to be performed. Install temporary lighting for areas with low illumination. Additional lighting may be required due to darkness of a face shield.
- D. **Obstructed View of Work Area.** Where lack of illumination or an obstruction precludes observation of the work to be performed, employees shall not perform any task where an electrical hazard exists.
- E. **Blind Reaching.** Employees shall not reach blindly into areas that might contain exposed live parts.
- F. **Confined or Enclosed Work Spaces.** Prior to entry into confined or enclosed work spaces, employees must be trained in the confined space entry requirements. For employees working in confined or enclosed spaces such as manholes or vaults that contain exposed energized parts, the employee shall use the department provided 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 and causing the employee to contact exposed energized parts.
- G. **Conductive Materials and Equipment.** Conductive materials or equipment that is in contact with any part of an employee's body shall be handled in a manner that will prevent the employee from contacting exposed energized conductors or circuit parts.
- H. If an employee must handle long dimensional conductive objects (such as ducts and pipes) in areas with exposed live parts, the department manager shall institute work practices (such as the use of insulation, guarding, and material handling techniques) which will minimize the hazard. Means shall be employed to ensure that conductive materials approach exposed energized electrical conductors or circuits parts no closer than that permitted by the limited approach boundary.
- I. **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 within the restricted approach boundary or where they present an electrical contact hazard with exposed energized electrical conductors or circuit parts.
- J. **Look-Alike Equipment.** Where work performed on equipment that is de-energized and placed in an electrically safe condition exists in a work area with other energized equipment that is

similar in size, shape, and construction, one of the alerting techniques shall be employed to prevent the employee from entering lookalike equipment.

- K. **Portable Ladders.** All portable ladders shall be nonconductive if they are used where the employee or the ladder could contact exposed energized parts.
- L. **Conductive Apparel.** Employees are not allowed to wear conductive articles of jewelry and clothing such as watch bands, bracelets, rings, key chains, necklaces, metalized aprons, cloth with conductive thread, or metal headgear if they might contact exposed energized parts.
- M. **Housekeeping Duties.** 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. Electrically conductive cleaning materials (including conductive solids such as steel wool, metalized cloth, and silicone carbide, as well as conductive liquid solutions) shall not be used inside the limited approach boundary unless procedures to prevent electrical contact are followed.
- N. **Safety Interlocks.** Only qualified persons are allowed to defeat an electrical safety interlock following the above specified procedures for working on or near exposed energized parts, and then only temporarily while they are working on the equipment. Also, the interlock system will be returned to its operable condition when this work is completed and verified to be operational.
- O. **Occasional use of flammable or ignitable materials.** Where flammable or ignitable materials are present only occasionally, electric equipment capable of igniting them shall not be used unless measures are taken to prevent hazardous conditions from developing. Materials include, but are not limited to, flammable gases, vapors or liquids; combustible dust; and ignitable fibers or flying objects.
- P. **Cutting or Drilling.** Before cutting or drilling into equipment, floors, walls, or structural elements where a likelihood of contacting energized electrical lines or parts exists, qualified person shall evaluate the work site to:
 - 1. Identify and mark the location of conductors, cables, raceways, or equipment
 - 2. Create an electrically safe work condition
 - 3. Identify safe work practices and PPE to be used
- Q. **Alerting Techniques.** The following alerting techniques are used to warn and protect employees from electrical shock hazards, burns, or failure of electric equipment parts.
 - 1. **Safety Signs and Tags:** Safety signs, safety symbols, or accident prevention tags are to be used where necessary to warn employees about electrical hazards which may endanger them. Such signs and tags shall meet the requirements of CFR 1910.145 *Specifications for accident prevention signs and tags.*
 - 2. **Barricades.** Methods of restriction are used in conjunction with safety signs where necessary to prevent or limit employee access to work areas exposing employees to uninsulated energized conductors or circuit parts. Conductive barricades may not be used where they might cause an electrical contact hazard. Barricades shall be placed no closer than the limited approach boundary.
- R. **Attendants.** If signs and barricades do not provide sufficient warning from hazards, an attendant is to be stationed to warn and protect employees.

XI. Use of Electrical Equipment

Portable electrical equipment applies to the use of cord-and-plug connected equipment and flexible cord sets (extension cords). All electrical equipment shall be used in accordance with the manufacturer's instructions and safety warnings.

- A. **Handling.** Portable equipment shall be handled in a manner which will not cause damage. Flexible electric cords connected to equipment may not be used for raising or lowering the equipment.
1. Flexible cords are not to be fastened with staples or otherwise hung in such a fashion as to damage the outer jacket or insulation.
- B. **Visual Inspection.** Portable cord-and-plug connected equipment and flexible cord sets (extension cords) shall be visually inspected before use (on any shift) for external defects such as loose parts, deformed and missing pins, or damage to outer jacket or insulation and for possible internal damage such as pinched or crushed outer jacket.
1. When defects or evidence of damage which might expose employees to injury are detected, the defective or damaged item shall be removed from service and no person shall use it until it is repaired and tested to ensure it is safe for use.
 2. When an attachment plug is to be connected to a receptacle (including any on a cord set), the relationship of the plug and receptacle contacts shall first be checked to ensure that they are of proper mating configurations.
- C. **Anticipating Failure.** When there is evidence that electric equipment could fail and injure employees, the electric equipment shall be de-energized, unless supervision can demonstrate that de-energizing introduces additional hazards or increased risk or is infeasible because of equipment design or operational limitation. Until the equipment is deenergized or repaired, employees shall be protected from hazards associated with the impending failure of the equipment by suitable barricades and other alerting techniques necessary for safety of the employees.
- D. **Grounding-Type Equipment.** Flexible cords used with grounding-type equipment shall contain an equipment grounding conductor. Other protective measures include double insulation or ground-fault circuit-interrupters (GFCIs).
1. Employees shall be provided with GFCI protection where required by applicable state, federal, or local codes and standards.
 2. GFCI protection devices shall be tested in accordance with the manufacturer's instructions.
 3. GFCI protection shall be provided when an employee is conducting maintenance and construction activities or outdoors and operating or using cord- and plug-connected equipment supplied by 125-volt, single phase, 15-, 20-, or 30-amp circuits. For equipment supplied by other voltages and amps an assured equipment grounding conductor program shall be implemented to verify the integrity of the grounding conductor of cord sets and cord-and-plug connected equipment.
 4. Attachment plugs and receptacles may not be connected or altered in any manner which would prevent proper continuity of the equipment grounding conductor at the point where plugs are attached to receptacles. Additionally, these devices may not be altered to allow the grounding pole to be inserted into current-carrying connector slots. Clipping the grounding prong from an electrical plug is prohibited.
 5. Adapters which interrupt the continuity of the equipment grounding connection may not be used.

- E. **Conductive or Wet Work Locations.** All portable electric equipment and flexible cords used in highly conductive work locations, such as those with water or other conductive liquids, or in places where employees are likely to contact water or conductive liquids must be approved for those locations. In work locations where employees are likely to contact or be drenched with water or conductive liquids, ground-fault circuit-interrupter protection for personnel shall be used.
- F. **Connecting Attachment Plugs.** Employees hands shall not be wet when plugging and unplugging flexible cords and cord-and-plug connected equipment, if energized equipment is involved.
1. If the connection could provide a conducting path to employees' hands, (e.g., a cord connector is wet from being immersed in water) the energized plug and receptacle connections must be handled only with insulating protective equipment.
 2. Locking-type connectors shall be properly locked into the connector.
- G. **Cutting, Removing, or Rerouting of Conductors.** Where conductors are de-energized in order to cut, remove, or reroute them and the conductor terminations are not within sight from the point of work, such as where the conductors are remote from the source of supply in a junction or pull box, additional steps to verify absence of voltage or identify the conductors shall be taken prior to cutting, removing, or rerouting the conductors.
- H. **Routine Opening and Closing of Circuits.** 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.
1. Cable connectors (not of the load-break type), fuses, terminal lugs, and cable splice connections may not be used for opening, reversing, or closing circuits under load conditions, except in an emergency where the risk is increased by not taking such action.
- I. **Reclosing Circuits after Protective Device Operation.** 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. The repetitive manual reclosing of circuit breakers (or re-energizing circuits through replaced fuses) is prohibited.
2. When a circuit overload, not a fault condition, causes the automatic operation of a device (as determined from the design of the circuit and overcurrent devices involved), no examination of the circuit (or connected equipment) is required before re-energizing the circuit.
- J. **Overcurrent Protection Modification.** Overcurrent protection of circuits and conductors may not be modified, even on a temporary basis.
- K. **Underground Electrical Lines and Equipment.** Before excavation starts where there exists a reasonable possibility of contacting electrical lines or equipment, supervision shall take the necessary steps to contact the appropriate owners or authorities to identify and mark the location of the electrical lines or equipment. When it has been determined that a reasonable possibility of contacting electrical lines or equipment exists, appropriate safe work practices and PPE shall be used during the excavation.

XII. Test Equipment and Instrument Use

Only qualified persons may perform testing, troubleshooting, and voltage measuring within the limited approach boundary of energized electrical conductors or circuit parts operate at 50 volts or more, or where an electrical hazard exists. When test instruments are used for determining the absence of voltage on conductors or circuit parts operating at 50 volts or more, verification of the test instrument's proper operation shall occur before and after the test is performed. An indication of zero volts might mean that no voltage is present when the test is performed or that the instrument has failed.

- A. **Visual Inspections.** Test instruments and equipment (including all associated test leads, cables, power cords, probes and connectors) shall be visually inspected for external defects and damage before the equipment is used. 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, tagged out of service and no employee may use it until all necessary repairs and tests have been made to render the equipment safe.
- B. **Rating of Equipment.** Test instruments, equipment, and their accessories shall be rated and designed for the purposes in which they will be used. Such equipment shall also be designed for the environment to which they will be exposed and for the manner in which they will be utilized.

XIII. Personal Protective Equipment

When working in areas where energized exposed live parts and/or equipment are within the Limited Approach Boundary, employees shall wear protective clothing and other personal protective equipment in accordance with this program and as indicated by PPE Categories in **Appendix B**.

A. Use of Personal Protective Equipment

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.
2. Protective equipment shall be maintained in a safe, reliable condition, and be visually inspected before each use and periodically tested as required.
3. If the insulating capability of protective equipment may be subject to damage during use, the insulating material shall be protected by covering with leather or other appropriate materials.
4. Nonconductive head protection shall be worn whenever there is danger of head injury due to contact with exposed energized parts resulting in electric shock or burn.
5. Protective equipment for the eyes or face shall be worn whenever there is danger of injury to the eyes or face from arcs, flashes or flying objects resulting from an explosion.

B. General Protective Equipment and Tools

1. Insulated tools or handling equipment shall be used by employees working near exposed energized conductors or circuit parts, if the tools or handling equipment might contact such conductors or parts.
2. Fuse handling equipment, insulated for the circuit voltage, shall be used to remove or install fuses when the fuse terminals are energized.
3. If the insulating capability of insulated tools or handling equipment is subject to damage, the insulating material shall be protected.

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

C. Personal Protective Equipment While Working on Energized Parts

1. Employees working in the restricted approach boundary must wear personal protective equipment for protection against electrical shock hazards. Also, employees shall wear arc-rated clothing while in the arc flash boundary whenever there is possible exposure to an electric arc flash above the threshold incident energy level for a second-degree burn (1.2 cal/cm²). All parts of the body inside the arc flash boundary shall be protected.
2. Once the hazard/risk category has been identified, the employee shall wear at least the recommended minimum PPE for the task.

D. Arc-Rated Apparel and Under Layers

1. Employees shall wear arc-rated clothing whenever there is a possible exposure to an electrical arc flash above the threshold incident level for a second-degree burn [1.2 cal/cm²].
2. Arc-rated apparel shall be visually inspected before each use. Arc-rated apparel that is contaminated or damaged shall not be used. Protective items that become contaminated with grease, oil, flammable liquids, or combustible liquids shall not be used.
3. The garment manufacturer's instructions for care and maintenance of arc-rated apparel shall be followed.
4. Arc-rated apparel shall be stored in a manner that prevents physical damage; damage from moisture, dust, or other deteriorating agents; or contamination from flammable or combustible materials.
5. When arc-rated apparel is worn to protect an employee during energized work, it shall cover all ignitable clothing and allow for movement and visibility.
6. Non-melting, flammable garments (e.g., cotton, wool, rayon, silk, or blends of these materials) must be used as under layers beneath arc-rated apparel.
7. Meltable fibers such as acetate, nylon, polyester, polypropylene, and spandex shall not be permitted in fabric worn by employees as a part of their daily uniforms or in under layers next to the skin (An incidental amount of elastic used on non-melting fabric underwear or sock shall be permitted).
8. When arc-rated clothing is repaired, the same arc-rated materials used to manufacture the clothing shall be used to provide repairs.
9. Arc-rated garments worn as outer layers over arc-rated apparel (e.g., jackets or rainwear) must also be made from arc-rated material.

E. Head, Face, Neck and Chin Protection:

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

- b. Employees shall wear nonconductive protection for the face, neck, and chin whenever there is danger of injury from exposure to electric arcs or flashes or from flying objects resulting from an electrical explosion.
- c. An arc-rated balaclava (sock hood) shall be used with an arc-rated face shield when the back of the head is within arc flash boundary.
- d. An arc-rated hood shall be permitted to be used instead of an arc-rated face shield and balaclava. When exterior air is supplied into the hood, the hoses and pump housing shall be either covered by arc-rated materials or constructed of non-melting and nonflammable materials.
- e. Employees shall wear protective equipment for the eyes and face whenever there is a danger of injury from electric arcs, flashes, or from flying objects resulting from an electrical explosion.
- f. Face shields shall have an arc rating suitable for the arc flash exposure.
- g. Face shields with a wrap-around guarding to protect the face, chin, forehead, ears, and neck area shall be used.
- h. Eye protection (ANSI approved safety glasses with side shields or goggles) shall always be worn under the face shield.
- i. Employees shall wear hearing protection whenever working within the arc flash boundary.
- j. Additional illumination may be needed when using tinted face shields as protection during electrical work.

F. Hand and Arm Protection

- 1. Employees shall wear rubber insulating gloves with protectors where there is danger of hand and/or arm injury from electric shock due to contact with energized electrical conductors or circuit parts.
- 2. Rubber insulating gloves shall be rated for the voltage for which gloves will be exposed.
- 3. Hand and arm protection shall be worn where there is possible exposure to arc flash burn.

G. Foot Protection

- 1. Heavy-duty leather work shoes with non-conductive safety toe shall be worn in all exposures greater than 4 cal/cm².

H. Hearing Protection

- 1. Employees shall wear ear plugs that insert into the canal (ear canal inserts) to protect from hearing loss whenever working within the arc flash boundary.

I. Rubber Insulating Equipment

- 1. Rubber insulating equipment includes protective devices such as gloves, sleeves, blankets, and matting.
- 2. Maintenance and Use. Electrical protective equipment shall be maintained in a safe, reliable condition. Insulating equipment shall be inspected for damage before each day's use and immediately following any incident that can reasonably be suspected of having caused damage. Insulating gloves shall be given an air test, along with the inspection. Maximum use voltages for rubber insulating gloves shall not exceed that

specified in Table 2. The top of the cuff of the protector glove shall be shorter than the rolled top of the cuff of the insulating glove by at least the distance specified in Table 2.

Table 2 -- Maximum Use Voltage for Rubber Insulating Gloves

Class Designation of Glove or Sleeve	Maximum ac Use Voltage rms, volts	Maximum dc Use Voltage avg, volts	Distances Between Gauntlet and Cuff, minimum
00	500	750	13 mm (0.5 in.)
0	1,000	1,500	13 mm (0.5 in.)
1	7,500	11,250	25 mm (1 in.)
2	17,000	25,500	51 mm (2 in.)
3	26,500	39,750	76 mm (3 in.)
4	36,000	54,000	102 mm (4 in.)

- Maximum use voltages of rubber insulating equipment must conform with the voltages listed in the table below:

Rubber Insulating Equipment, Voltage Requirements

Class of equipment	Maximum use voltage ¹ AC rms	Retest voltage ² AC rms	Retest voltage ² DC avg
00	500	2,500	10,000
0	1,000	5,000	20,000
1	7,500	10,000	40,000
2	17,000	20,000	50,000
3	26,500	30,000	60,000
4	36,000	40,000	70,000

4. The maximum use voltage is the ac voltage (rms) classification of the protective equipment that designates the maximum nominal design voltage of the energized system that may be safely worked. The nominal design voltage is equal to the phase-to-phase voltage on multiphase circuits. However, the phase-to-ground potential is considered to be the nominal design voltage if:
 - a. There is no multiphase exposure in a system area and the voltage exposure is limited to the phase-to-ground potential, or
 - b. The electrical equipment and devices are insulated or isolated or both so that the multiphase exposure on a grounded wye circuit is removed.
5. The proof-test voltage shall be applied continuously for at least 1 minute, but no more than 3 minutes.
6. Insulating equipment must be visually inspected before use and immediately following any incident that could have caused damage.
7. Insulating equipment with any of the following defects may not be used:
 - a. A hole, tear, puncture, or cut;
 - b. Ozone cutting or ozone checking (that is, a series of interlacing cracks produced by ozone on rubber under mechanical stress);
 - c. An embedded foreign object;
 - d. Any of the following texture changes: swelling, softening, hardening, or becoming sticky or inelastic.
 - e. Any other defect that damages the insulating properties.
8. Insulating equipment found to have other defects that might affect its insulating properties must be removed from service and reported to management.
9. Insulating equipment shall be cleaned as needed to remove foreign substances.
10. Where the insulating capability of protective equipment is subject to damage during use, the insulating material shall be protected by an outer covering of leather or other appropriate material (e.g., gloves).
11. Rubber insulating equipment must be stored in an area protected from light, temperature extremes, excessive humidity, ozone, and other substances and conditions that may cause damage.
12. An air test should be performed on rubber insulating gloves before each use. Fill the glove with air, either manually or by an inflator, and then checked for leakage. The leakage is detected by either listening for escaping air or holding the glove against the tester's cheek to feel air releasing.
13. Protector gloves shall be worn over insulating gloves, except as follows:
 - a. When using Class 0 gloves, under limited-use conditions, when small equipment and parts manipulation necessitate unusually high finger dexterity.

- b. Persons inspecting rubber insulating gloves used under these conditions need to take extra care in visually examining them.
 - c. Employees using rubber insulating gloves under these conditions need to take extra care to avoid handling sharp objects.
14. If the voltage does not exceed 250 volts, ac, or 375 volts, dc, protector gloves need not be used with Class 00 gloves, under limited-use conditions, when small equipment and parts manipulation necessitate unusually high finger dexterity.
 15. Any other class of glove may be used without protector gloves, under limited-use conditions, when small equipment and parts manipulation necessitate unusually high finger dexterity but only if the departmental manager can demonstrate that the possibility of physical damage to the gloves is small and if the class of glove is one class higher than that required for the voltage involved.
 16. Insulating gloves that have been used without protector gloves may not be reused until they have been tested.
 17. Rubber insulating equipment must be tested for leakage based on the test intervals listed in the table below:

Rubber Insulating Equipment, Test Intervals

Type of Equipment	When to Test
Rubber insulating gloves	Before first issue and every 6 months thereafter ¹ upon indication that insulating value is suspect; and after repair.
Rubber insulating sleeves	Before first issue and every 12 months thereafter ¹ upon indication that insulating value is suspect; and after repair.
Rubber insulating covers	Upon indication that the insulating value is suspect and after repair.
Rubber insulating blankets	Before first issue and every 12 months thereafter; ¹ upon indication that insulating value is suspect; and after repair.
Rubber insulating line hose	Upon indication that the insulating value is suspect and after repair.

¹If the insulating equipment has been electrically tested but not issued for service, it may not be placed into service unless it has been electrically tested within the previous 12 months.

18. Test methods shall reliably indicate whether the insulating equipment can withstand the voltages involved. Such test methods must meet or exceed the national consensus standards as specified in CFR 1910.137(c)(2)(ix).
19. Insulating equipment failing to pass inspections or electrical tests may not be used. The owning department of the insulating equipment shall certify that the equipment has been tested. The certification shall identify the equipment that passed the test and the date it was tested.

J. Insulated Tools and Equipment

1. Insulated tools shall be rated for the voltages on which they are used.

2. Insulated tools and equipment shall be visually inspected prior to each use. The inspection shall look for damage to the insulation or damage that may limit the tool from performing its intended function or could increase the potential for an incident. If damaged should be immediately taken out of service and management notified.

K. Ropes and Handlines

1. Ropes and handlines used near exposed energized parts shall be nonconductive and stored within manufacture guidelines.

XIV. Training

The training requirements contained in this program apply to employees who face a risk of electric shock that is not reduced to a safe level by the installation as required by the National Electrical Code and 29CFR1910 Subpart S, Electrical. Listed below are qualified persons who may face such a risk and shall be trained:

- A. Electrical and electronic engineers
- B. Electrical and electronic technicians
- C. Electricians

An unqualified person who may reasonably be expected to face comparable risk of injury due to electric shock or other electrical hazards must also be trained.

The Electrical Safety training is designed for qualified person and unqualified person. The training requirements for both are listed below:

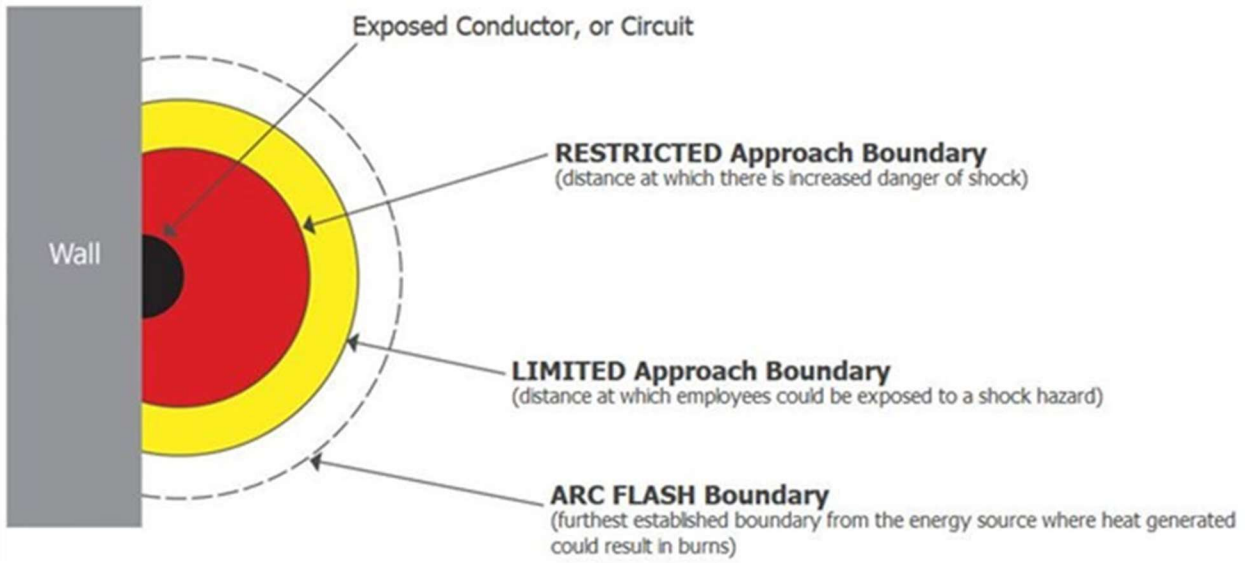
1. Qualified Person (Electrical Engineers, Electrical Technicians, and Electricians) are generally permitted to work on or near exposed energized parts and shall, at a minimum, be trained in and familiar with the following:
 - a. The skills and techniques necessary to distinguish exposed live parts from other parts of electric equipment.
 - b. The skills and techniques necessary to determine the nominal voltage of exposed live parts.
 - c. The clearance distances and the corresponding voltages to which the qualified person will be exposed.
 - d. The proper use of special precautionary techniques, personal protective equipment, insulating and shielding materials, and insulated tools.
 - e. Electrical safety-related work practices outlined in this program that pertain to their respective job assignments.
- B. Unqualified Person (Electrical Helper, Preventive Maintenance, etc.) who are covered by program but who are not qualified persons shall also be trained in and familiar with the following:
 1. Electrical safety- related work practices not specifically addressed by this program but which are necessary for their safety.
 2. The training will be administered online, classroom and where applicable on-the-job type. The training will be administered given the risk to qualified and unqualified employees.

Appendices

Appendix A - Approach Boundaries

All dimensions are distances from the live part to the employee

Shock Protection Approach Boundaries to Exposed Energized Electrical Conductors or Circuit Parts for Alternating-Current Systems			
	Limited Approach Boundary		
Nominal System Voltage Range Phase to Phase Voltage	Exposed Movable Conductor	Exposed Fixed Circuit Part	Restricted Approach Boundary
	Less than 50	Not Specified	Not Specified
50 V to 150 V	10 ft., 0 in.	3 ft., 6 in.	Avoid Contact
151 V to 750 V	10 ft., 0 in.	3 ft., 6 in.	1 ft., 0 in.
751 V to 15 kV	10 ft., 0 in.	5 ft., 0 in.	2 ft., 2 in.
15.1 kV- 36 kV	10 ft., 0 in.	6 ft., 0 in.	2 ft., 9 in.
Shock Protection Approach Boundaries to Exposed Energized Electrical Conductors or Circuit Parts for Direct-Current Voltage Systems			
	Limited Approach Boundary		
Nominal System Voltage Range Phase to Phase Voltage	Exposed Movable Conductor	Exposed Fixed Circuit Part	Restricted Approach Boundary
	Less than 50	Not Specified	Not Specified
50 V to 300 V	10 ft., 0 in.	3 ft., 6 in.	Avoid Contact
301 V to 1 kV	10 ft., 0 in.	3 ft., 6 in.	1 ft., 0 in.
1.1 kV to 5 kV	10 ft., 0 in.	5 ft., 0 in.	1 ft., 5 in.
5 kV to 15 kV	10 ft., 0 in.	5 ft., 0 in.	2 ft., 2 in.
15.1 kV to 45 kV	10 ft., 0 in.	8 ft., 0 in.	2 ft., 9 in.



Appendix B - Arc-Flash Hazard PPE Categories and Arc Flash Boundaries for Alternating Current (ac) Systems

Equipment	rc-Flash PPE Category	Arc-Flash Boundary
Panelboards or other equipment rated 240 V and below Parameters: Maximum of 25 kA short-circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.)	1	485 mm (19 in.)
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 cycles) fault clearing time; working distance 455 mm (18 in.)	2	900 mm (3 ft)
600-V class motor control centers (MCCs) Parameters: Maximum of 65 kA short-circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.)	2	1.5 m (5 ft)
600-V class motor control centers (MCCs) Parameters: Maximum of 42 kA short-circuit current available; maximum of 0.33 sec (20 cycles) fault clearing time; working distance 455 mm (18 in.)	4	4.3 m (14 ft)
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 0.5 sec (30 cycles) fault clearing time; working distance 455 mm (18 in.)	4	6 m (20 ft)
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 cycles) fault clearing time; working distance 455 mm (18 in.)	2	1.5 m (5 ft)
NEMA E2 (fused contactor) motor starters, 2.3 kV through 7.2 kV Parameters: Maximum of 35 kA short-circuit current available; maximum of 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)	4	12 m (40 ft)
Metal-clad switchgear, 1 kV through 15 kV Parameters: Maximum of 35 kA short-circuit current available; maximum of 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)	4	12 m (40 ft)
Arc-resistant switchgear Type 1 or 2 [for clearing times of 0.5 sec (30 cycles) with a perspective fault current not to exceed the arc-resistant rating of the equipment], and metal-enclosed interrupter switchgear, fused or unfused of arc-resistant-type construction, tested in accordance with IEEE C37.20.7, 1 kV through 15 kV Parameters: Maximum of 35 kA short-circuit current available; maximum of 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)	N/A (doors closed) 4 (doors open)	N/A (doors closed) 12 m (40 ft)
Other equipment 1 kV through 15 kV Parameters: Maximum of 35 kA short-circuit current available; maximum of 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)	4	12 m (40 ft)

Note: For equipment rated 600 volts and below and protected by upstream current-limiting fuses or current-limiting circuit breakers sized at 200 amperes or less, the arc flash PPE category can be reduced by one number but not below arc flash PPE category 1.

Arc-Flash Hazard PPE Categories for Direct Current (dc) Systems

Equipment	Arc Flash PPE Category	Arc-Flash Boundary
Storage batteries, dc switchboards, and other dc supply sources 100 V > Voltage < 250 V Parameters: Voltage: 250 V Maximum arc duration and working distance: 2 sec @ 455 mm (18 in.)		
Short-circuit current < 4 kA	1	900 mm (3 ft)
4 kA ≤ short-circuit current < 7 kA	2	1.2m (4 ft)
7 kA ≤ short-circuit current < 15 kA	3	1.8 m (6 ft)
Storage batteries, dc switchboards, and other dc supply sources 250 V ≤ Voltage ≤ 600 V Parameters: Voltage: 600 V Maximum arc duration and working distance: 2 sec @ 455 mm (18 in.)		
Short-circuit current 1.5 kA	1	900 mm (3 ft)
1.5 kA ≤ short-circuit current < 3 kA	2	1.2 m (4 ft)
3 kA ≤ short-circuit current < 7 kA	3	1.8 m (6 ft)
7 kA ≤ short-circuit current < 10 kA	4	2.5 m (8 ft)

Note: Apparel that can be expected to be exposed to electrolyte must meet both of the following conditions:

1. Be evaluated for electrolyte protection in accordance with ASTM F1296, Standard Guide for Evaluating Chemical Protective Clothing
2. Be arc-rated in accordance with ASTM F1891, Standard Specification for Arc Rated and Flame Resistant Rainwear, or equivalent

Note: For equipment rated 600 volts and below, and protected by upstream current limiting fuses or current limiting circuit breakers sized at 200 amperes, the arc flash PPE category can be reduced by one number but not below arc flash PPE category 1.

Arc-Flash PPE Categories and PPE Requirements

Category	PPE
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1	<p>Arc-Rated Clothing, Minimum Arc Rating of 4 cal/cm² (16.75 J/cm²)^a Arc-rated long-sleeve shirt and pants or arc-rated coverall Arc-rated face shield^b or arc flash suit hood Arc-rated jacket, parka, rainwear, or hard hat liner (AN) Protective Equipment Hard hat Safety glasses or safety goggles (SR) Hearing protection (ear canal inserts)^c Heavy-duty protector gloves^d Leather footwear (AN)</p>
2	<p>Arc-Rated Clothing, Minimum Arc Rating of 8 cal/cm² (33.5 J/cm²)^a Arc-rated long-sleeve shirt and pants or arc-rated coverall Arc-rated flash suit hood or arc-rated face shield^b and arc-rated balaclava Arc-rated jacket, parka, rainwear, or hard hat liner (AN) Protective Equipment Hard hat Safety glasses or safety goggles (SR) Hearing protection (ear canal inserts)^c Heavy-duty protector gloves^d Leather footwear</p>
3	<p>Arc-Rated Clothing Selected so That the System Arc Rating Meets the Required Minimum Arc Rating of 25 cal/cm² (104.7 J/cm²)^a 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^d Arc-rated jacket, parka, rainwear, or hard hat liner (AN) Protective Equipment Hard hat Safety glasses or safety goggles (SR) Hearing protection (ear canal inserts)^c 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 (167.5 J/cm²)^a 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^d Arc-rated jacket, parka, rainwear, or hard hat liner (AN) Protective Equipment Hard hat Safety glasses or safety goggles (SR) Hearing protection (ear canal inserts)^c Leather footwear</p>
	<p>AN: As needed (optional). AR: As required. SR: Selection required. Arc rating is defined in the definitions section of this program. 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. Other types of hearing protection are permitted to be used in lieu of or in addition to ear canal inserts provided they are worn under an arc-rated arc flash suit hood. If rubber insulating gloves with protectors are used, additional leather or arc-rated gloves are not required. The combination of rubber insulating gloves with protectors satisfies the arc flash protection requirement.</p>

Appendix C - UNC Charlotte Energized Electrical Work Permit

Instructions:

A. PART I:

1. The requester shall describe and justify what work they believe needs to be performed energized.
2. The requester shall sign and print his/her title and date the request.

B. PART II:

1. The electrically qualified person assigned to perform the work shall review the request and evaluate if it is necessary to perform work under energized conditions.
2. If the electrically qualified person concurs that it is necessary to work energized, he/she will then establish the PPE Category (1, 2, 3, 4), the Minimum Approach Safe Distance and establish the technical requirements in Section II to perform the work with proper precautions.

C. PART III:

1. The permit is submitted to your supervisor and department manager for signature approval prior to starting electrical work.
2. The permit is submitted to the Environmental Health and Safety office (ehsoffice@charlotte.edu or 704-687-5302) once the work has been completed.

ENERGIZED ELECTRICAL WORK PERMIT

PART 1: TO BE COMPLETED BY THE REQUESTER

Job/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

1. Detailed description of the job procedures to be used in performing the above detailed work:

2. Description of the safe work practices to be employed:

3. Results of the shock risk assessment:

- _____
a. Voltage to which personnel will be exposed: _____
b. Limited approach boundary: _____
c. Necessary shock, Personal, and other protective equipment to safely perform the assigned task:

4. Results of the arc flash assessment:

- _____
a. Available incident energy at the working distance or arc flash PPE category:

b. Necessary arc flash personal and other protective equipment to safely perform the assigned task:

c. Arc flash boundary: _____

5. Means employed to restrict the access of unqualified persons from the work area:

6. Evidence of completion of a job briefing, including discussion of any job related hazards:

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

Electrically Qualified Person(s) Date

Qualified Person(s) Date Electrically

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

Department Manager Date

Immediate Supervisor Date

Department Manager

Immediate Supervisor

Send a copy to the Environmental Health & Safety office (ehsoffice@charlotte.edu, 704-687-5302) once work has been completed.

