Electrical Safety NFPA 70E & NETA

Written Safety Program

Introduction

The purpose of this written program is to provide a practical safe working area for employees and contractors relative to the hazards arising from electricity by aligning OSHA, NFPA 70E, and the NEC. The program will address electrical safety-related work practices, safety-related maintenance requirements, and other administrative controls for employee and contractor workplaces that are necessary for the practical safeguarding of employees and contractors relative to the hazards associated with electrical energy during activities such as the installation, removal, inspection, operation, maintenance, and demolition of electric conductors, electric equipment, signaling and communications conductors and equipment, and raceways. Also included are safe work practices for employees and contractors that may be exposed to electrical hazards during the installation of conductors and equipment that connect to the supply of electricity, and installations used by the electric utility.

OSHA requirements are not recommendations. There are a number of OSHA requirements that address the hazards of working on or near exposed energized parts for construction and maintenance work. These requirements are often written in performance language, requiring compliance without necessarily stating how to comply.

The NFPA 70E, Standard for Electrical Safety in the Workplace, is written in prescriptive language and is an important national consensus standard that defines the requirements for an overall electrical safety program.

As such, the procedures found within this policy are taken directly from the NFPA 70E - 2018 edition and will cover the majority of the work locations and tasks our electricians and contractors face. It is NOT all encompassing.

Certain tasks performed on very high hazard electrical systems and equipment, those with high level available fault currents and / or long fault clearing times, or exposures exceeding 600 volts, will require the direct use of the NFPA 70E standard to determine proper PPE and work procedures.

Responsibility

The General Contractor/Host shall:

- Review the programs provided by our company on Customer or General Contractor electrical related hazards and responsibilities.
- Inform our Safety Department of known hazards associated with electrical installation, maintenance or repair that is related to the work our company will be performing and might not be recognized by our employees
- Inform our Safety Department about the installation that the contract employer needs to make the assessments
- Report any safety violations by our employees that are observed to our Safety Department

Electrical Employer shall:

- Establish, document, implement, and maintain safety-related work practices and procedures
- Train employees on the safety-related work practices and procedures

The Safety Department shall:

- Monitor this Electrical Safety Program. Questions regarding this program and any information associated with it should be directed to the Safety Department.
- With the assistance of the supervisor and/or their designees, perform periodic assessments of employees to ensure their abilities are appropriate for the tasks performed.
- Perform an annual audit of the electrical safety principles identified in this program.

Supervisors shall:

- Ensure that safe work methods and procedures are being utilized.
- Ensure that the right tools are available and used for the jobs performed.
- Ensure that GFCIs are used whenever using cord-and-plug-connected portable electric power tools.
- Ensure that required inspections, testing and maintenance are performed. Where tools or equipment are found to be defective, they shall be tagged, removed from service, and reported to the Safety Department as soon as possible.
- Ensure that an energized work permit is completed before any energized work is conducted (Attachment A).

All employees shall:

- Comply with the safety-related work practices and procedures provided by the employer.
- Continuously remain alert to his or her surroundings and the work activities being performed.
- Perform inspections on all equipment and tools before each use. Where tools or equipment are found to be defective, they shall be tagged, removed from service, and reported to supervision as soon as possible.
- Inspect and test GFCIs prior to each use.
- Report any unsafe conditions or activities. Remember that when you see that a safety rule is being violated, it is your responsibility to use the STOP method.
- Will refer all questions to the Safety Department or Supervisor

Safety-Related Work Practices

Electrical Safety Program Principles, Controls, and Procedures

Inspection

Prior to being placed into service, an inspection must be conducted to verify that newly installed or modified electrical equipment or systems comply with applicable installation codes and standards.

Condition of Maintenance

The condition of maintenance shall be evaluated in regards to the electrical equipment and systems. The equipment owner is responsible for the maintenance of their electrical equipment.

Awareness and Self-Discipline

Employees must practice self-discipline in order to adhere to the safety programs, and remain aware of the safety principles, procedures, potential jobsite hazards, and steps to mitigate the potential jobsite hazards. Employees shall not knowingly be permitted to work on electrical circuits, parts, or equipment:

- When their alertness is recognizably impaired due to illness, fatigue, or other reasons.
- Where obstructions or the lack of illumination prevent a clear view of the work to be performed.

Electrical Safety Program Principles

The following basic principles are the foundation upon which this electrical safety program has been established. All company employees including management, the Safety Department, Supervisors and employees shall apply these principles to all tasks.

- The inspection and evaluation of electrical equipment shall be part of all procedures. All equipment to be worked on shall be inspected and evaluated prior to the work commencing.
- The integrity of equipment enclosures and insulation shall be maintained unless exposure is absolutely necessary and actions have been taken to provide the appropriate protection (i.e. work cannot be performed with the enclosure in place and equipment and conductors have been placed in an electrically safe work condition or an Energized Electrical Work Permit has been completed in accordance with this program.)
- Every job shall be well planned out, and first time procedures shall be documented prior to work commencing.
- The primary method for ensuring safety shall be to de-energize (create an electrically safe work condition) in accordance with the company Lockout/Tagout (LOTO) program.
- Work that must be performed energized shall be justified as follows and requires the completion and approval of an Energized Electrical Work Permit.
    - Energized work shall only be justified when it can be demonstrated that de-energizing introduces additional or increased hazards or is infeasible due to equipment design or operational limitations. Energized parts that operate at less than 50 volts to ground shall not be required to be de-energized if there will be no increased exposure to electrical burns or to explosion due to electric arcs.
    - Examples of increased or additional hazards include, but are not limited to, interruption of life support equipment, deactivation of emergency alarm systems, and shutdown of hazardous location ventilation equipment.
    - Examples of work that might be performed on or near exposed energized electrical conductors or circuit parts because of infeasibility due to equipment design or operational limitations include performing diagnostics and testing (i.e. start-up or troubleshooting) of electric circuits that can only be performed with the circuit energized and work on circuits that form an integral part of a continuous process that

would otherwise need to be completely shut down in order to permit work on one circuit or piece of equipment.

- When preparing for a job, an effort will be made to anticipate unexpected events through a job safety plan, a job briefing, and a risk assessment.
- A risk assessment shall be conducted to identify the hazards associated with each job task, and controls put into place to reduce the risk of the hazard.
- Based on the risk assessment, actions will be taken to minimize or eliminate the risk associated with the identified hazards and protect employees from shock, burn, blast, and other hazards due to the working environment.
- Employees shall use the proper tools for the job task that they are assigned
- Employee's abilities shall be assessed, and their work should be assigned based on their abilities.
- Safety observations shall be conducted, and utilized to assess maintain the adherence of the implemented safety programs and principles.

Electrical Safety Program Controls

- The employer will develop, implement and maintain electrical safety programs and procedures. The employer will train the employees on the programs and procedures, and the employees are required to apply them to their scope of work.
- Employees shall be trained, and have sufficient experience in order to be qualified for working in an environment influenced by the presence of electricity
- The process of conducting a job safety plan, a job briefing, and a risk assessment shall be completed for each job to identify the electrical hazards and eliminate them, or utilize controls to reduce the risk associated with the hazard if it cannot be eliminated.
- All electrical conductors and circuit parts shall be considered energized until tested and proven otherwise.
- Employees shall be aware that the process of de-energizing an electrical conductor or circuit part is a potentially hazardous task.
- Any job tasks within the limited approach boundary must be identified and categorized prior to the job commencing
- Any precautions that are necessary for the working environment shall be addressed and taken.
- A qualified employee shall establish the associated risk level of each task to be performed.

Electrical Safety Program Procedures

Safety program procedures shall be utilized to determine and assess the following:

- The purpose of the tasks to complete
- The employees involved and their qualifications
- The approach limits
- Safe work practices
- The required PPE, tools, and insulating materials for the job
- Any special precautionary measures or techniques
- Electrical diagrams, equipment details, pictures, and reference data

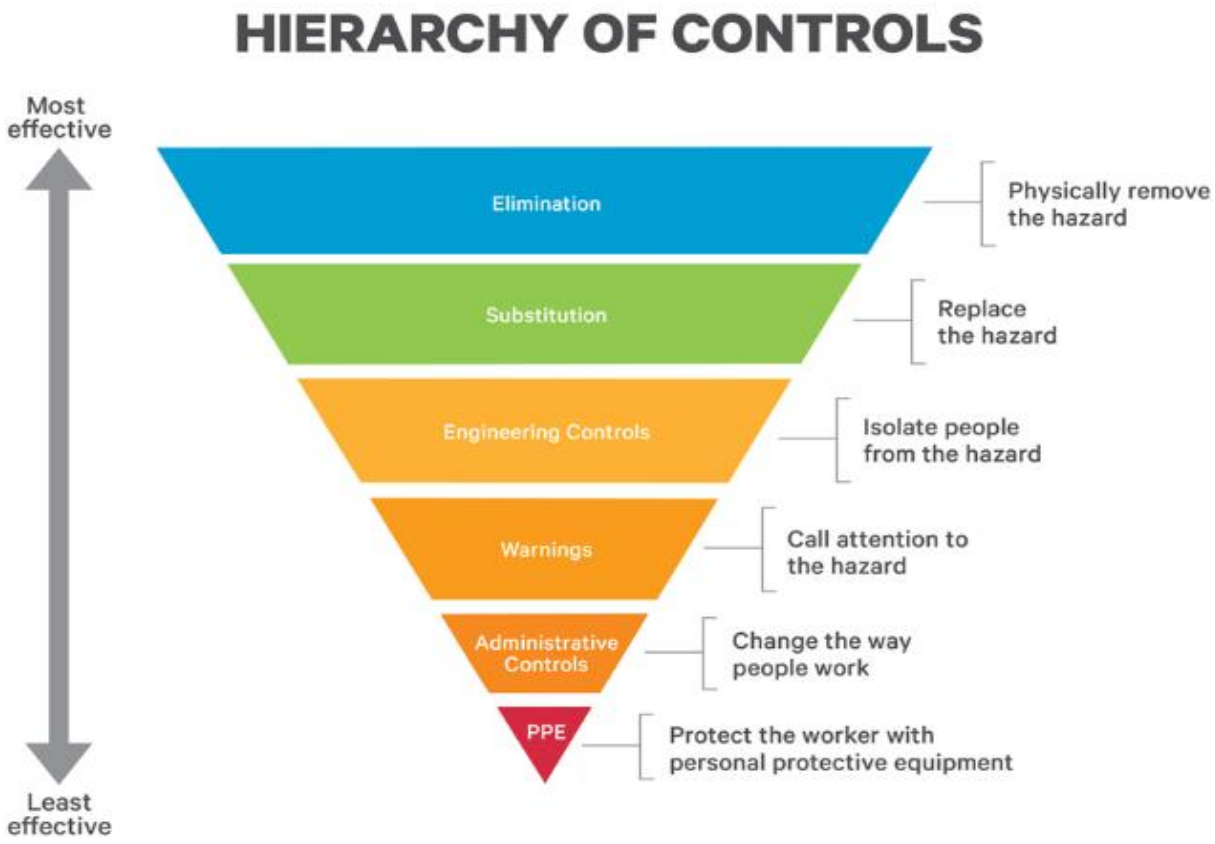
Risk Assessment Procedures

A risk assessment shall be conducted, prior to commencing work, in order to identify employee exposure to electrical hazards.

The risk assessment shall include:

- The identification of hazards, the process to eliminate the hazards, or controls to mitigate the associated risks for hazards that cannot be eliminated
- Human error, and its negative consequences on:
    - People
    - Processes
    - Work environment
    - Equipment
- The possibility of requiring a second person, their necessary level of training/experience, and proper tools/equipment needed to perform the work safely

Hazards should be eliminated or mitigated, and risk should be controlled by utilizing the hierarchy of control methods:



Job Safety Plan

A pre-job briefing shall cover the job safety plan, and the information on the energized electrical work

permit (if an energized work permit is required). The pre-job briefing shall be documented. Additional planning and job briefings shall be conducted in the event that a change occurs that could affect employee safety.

The Job safety plan shall:

- Be completed by the employee in charge, who is a qualified person
- Be documented
- Include:
    - A description of job tasks
    - Identify the hazards associated with each task
    - A shock risk assessment – Attachment A (for voltages greater than 15kV, the use the approach distances in 29CFR1910.269)
    - An arc flash risk assessment – Attachment A
    - Work procedures involved
    - Any special precautions
    - Energy source controls

Risk assessments are essential in determining the type and level of PPE required in order to complete the job safely. It can help the employer determine additional hazard elimination or risk reducing methods.

Incident Investigations and Audits

An incident investigation shall be conducted when an electrical incident occurs.

At intervals of no more than three years, the electrical safety procedures and programs shall be audited to ensure that they are in compliance with the most current requirements and standards. Field work observations shall be conducted in the field to ensure that the safety procedures and programs are being adhered to. When it is identified that the safety procedures and programs are not being followed, sufficient corrective actions shall be identified and implemented. Field work observations shall be conducted frequently enough to not exceed an interval of 1 year.

A qualified person shall audit the company lockout/tagout program and procedures frequently enough to not exceed an interval of 1 year, and ensure that the audits are documented. The audits shall identify and correct any gaps or deficiencies within:

- The lockout/tagout program and procedures
- Training of the lockout/tagout program
- Employee execution of the lockout/tagout procedures

Electrical Safety Training

Only qualified employees are authorized to perform work while exposed to electrical hazards. Qualified employees shall be trained to understand the construction and operations of the equipment and applicable procedures, in order to identify electrical and other hazards associated with the scope of work. Qualified employees should also be familiar with hazard elimination and risk reduction in regards to their scope of work. Employees may be qualified for specific tasks, and unqualified for other tasks in which they have not yet been trained, or have not proven sufficient in performing the task safely. Employees working within the limited approach boundary must be trained in the following at minimum:

- Distinguishing exposed energized electrical equipment from other parts of electrical equipment
- Determining the voltage of exposed electrical equipment
- Understanding and applying approach distances
- Decision making in order to:
    - Safely plan the job
    - Identify electrical and other hazards
    - Assess and mitigate any risk by selecting and implementing proper risk control methods from the hierarchy of controls
- Selecting the appropriate test equipment for the job, how to properly use the test equipment, and the limitations of the test equipment

Through supervision, or audits conducted at intervals exceeding no more than 1 year, the employer shall determine if employees are abiding by the electrical safety procedures and programs.

Employees receiving on-the-job training shall be qualified for the task that they are performing if:

- The employee has sufficient knowledge of the task being performed in order to be a qualified employee
- The employee is under direct supervision of a qualified employee in regards to that task

Unqualified persons shall have sufficient training and familiarity with any electrical safety-related work practices to ensure their safety, and the safety of others.

Safety related work practices shall be retrained in intervals of no more than 3 years. Retraining should occur more frequently when:

- It is identified that an employee is not adhering to the safety procedures and programs
- Equipment updates or changes
- Review is required of specific tasks performed less often than once a year, or safe work practices not normally utilized by the employee
- The employee's job duties are changed

Training conducted may be classroom based, on the job, or a combination of both. The employer shall document all necessary training in order to:

- Document when an employee is capable of performing a task proficiently
- Retain the documentation for the duration of the employee's employment
- Include training content, trained employee's names, and the dates of training

Any employee that will be involved in work requiring lockout/tagout procedures must be trained in the lockout/tagout procedures and the role that they have in the execution of the lockout/tagout. Retraining shall be conducted when revision to the program are made, adherence to the program is not observed, and in intervals no more than 3 years. Once trained, documentation of the employee's proficiency shall be documented. The documentation shall include the training content, employee's names, and training dates.

Employees that are exposed to shock hazards, and others responsible for the release of shock exposed employees, shall be trained in the release of employees that have been exposed to shock hazards, and retrained annually.

Employees responding to medical emergencies shall be trained in first aid, cardiopulmonary resuscitation (CPR), the use of an automated external defibrillator (AED), and emergency procedures. Training for employees responding to medical emergencies shall be in alignment with the certifying organization. The employer shall verify at least annually that emergency response employees have

current training in regards to emergency response. The employer shall properly document the required training.

Host and Contractor Responsibilities

It is the responsibility of the host employer to inform contractors of:

- Any known hazards covered within this program that are related to the contractor's scope of work that may now be known to the contractor and its employees. A meeting covering these hazards between the host employer and contractor shall be documented.
- Any information that pertains to the contractor's scope of work, in order to comply with this program and applicable standards
- Two-way communication shall be utilized to report to the other party when violations of these responsibilities are identified

It is the responsibility of the contractor to ensure that:

- Employees are aware and understand the hazards communicated by the host employer
- Employees follow safe work practices within this program, the requirements of the host employer, and applicable standards
- Notify the host employer of:
    - Unique hazards presented by or identified at any time during the contractor's work which were not communicated by the host employer
    - Any measures taken to correct and prevent a the recurrence of a violation, which was reported by the host employer

Equipment

Only employees that are qualified shall perform testing, troubleshooting, and voltage measuring tasks when equipment's operating voltage is 50 volts or more. Testing tools, equipment, and accessories shall be:

- Adequately rated for the circuits and equipment where they are used
- Approved and designed for performing tasks, in the environment and manner they will be used
- Used following all manufacturer's instructions and guidelines

Test instruments shall be visually inspected to ensure that there are no external defects. The visual inspection shall include:

- Test instruments
- Test equipment
- Test Leads
- Test cables
- Power cords
- Test probes
- Test connectors

When testing a circuit or equipment that typically operates at 50 volts or more, but is currently absent of voltage, a test instrument must be tested on any other known voltage to confirm that the test instrument is functioning properly, prior to, and after performing an absence of voltage test.

Portable Electrically Powered Equipment and Extension Cords

Tools and equipment shall be stored in a safe manner and location, in order to prevent damage to the tool or equipment. Cords shall not be used to life, lower, or pull anything. Cords shall also not be hung with staples or any other fastener that could possibly damage the cords insulating jacket.

If equipment has a cord with a grounding conductor, an extension cord used with that equipment must also have a grounding conductor. Plugs and receptacles shall not be altered in a way that would affect continuity of the grounding conductor, or used in a manner that was not intended by the manufacturer. Adapters that affect the continuity of the equipment's grounding conductor shall not be used.

Extension cords shall be inspected visually before each use. If equipment or an extension cord is identified as defective or damaged, the item should be tagged as out of service, and physically removed from service for repair or replacement. Only a qualified person shall perform repairs and tests in order to confirm that the item is ready to be returned to use.

It shall be confirmed that attachments being connected to a receptacle are of proper mating configurations, prior to connecting them.

In highly conductive work environments where significant rain, water, or other conductive liquids are present, the equipment used must be approved for the work location, and ground-fault circuit-interrupter protection must be used. Batteries, air, and hydraulics can be used to power equipment if it is identified as a safe alternative.

Employee's hands shall not be wet when connecting or disconnecting cords or equipment. Insulating PPE shall only be used when connecting and disconnecting plugs if there is a possible conductive path such as the plug being wet. Connectors that lock shall be locked after the connection is made.

All manufacturer's instructions and safety warnings shall be followed.

Ground-Fault Circuit-Interrupter (GFCI)

Employees shall be provided GFCI protection when required, in alignment with state, federal, or local codes and standards. Cords or devices that have GFCI protection built in shall be considered suitable. GFCI protection shall be used when plug-connected tools or extension cords are being utilized for maintenance, construction, or outdoor work, when they are supplied by 125 volt, 12, 20, or 30 amp circuits. When utilized for maintenance, construction, or outdoor work, circuits greater that 125 volt, 12, 20, or 30 amps can utilize GFCI, or choose to utilize an assured equipment grounding conductor program.

GFCI protection devices shall be tested according to the manufacturer's instructions.

Overcurrent Protection Modification

Circuits and conductors shall not have their overcurrent protection modified; even if the modification is only intended to be temporary, beyond what is allowed by the state, federal, or local codes and standards that apply to overcurrent protection.

Electrically Safe Work Conditions – Lockout/Tagout Program

1.0 Purpose

This procedure establishes the minimum requirements for lockout/tagout of electrical energy sources. It is to be used to ensure that conductors and circuit parts are disconnected from sourced of electrical energy, locked (tagged), and tested before work begins where employees could be exposed to dangerous conditions. Sources of stored energy, such as capacitors or springs, shall be relieved of their energy, and a mechanism shall be engaged to prevent the re-accumulation of energy.

2.0 Responsibility

All employees shall be instructed in the safety significance of the lockout/tagout procedure. All new or transferred employees and all other persons whose work operations are or might be in the area shall be instructed in the purpose and use of this procedure. The employer shall ensure that appropriate personnel receive instructions on their roles and responsibilities. All persons installing a lockout/tagout device shall sign their names and the date on the tag, or state how the name of the individual or person in charge will be available.

3.0 Preparation for Lockout/Tagout

3.1 Review current diagrammatic drawings (or their equivalent), tags, labels, and signs to identify and locate all disconnecting means, to determine that power is interrupted by a physical break and not de-energized by a circuit interlock. Make a list of disconnecting means to be locked (tagged).

3.2 Review disconnecting means to determine adequacy of their interrupting ability. Determine if it will be possible to verify a visible open point, or if other precautions will be necessary.

3.3 Review other work activity to identify where and how other personnel might be exposed to electrical hazards. Review other energy sources in the physical area to determine employee exposure to those sources of other types of energy. Establish energy control methods for control of other hazardous energy sources in the area.

3.4 Provide an adequately rated test instrument to test each phase conductor or circuit part to verify that they are de-energized. Provide a method to determine that the test instrument is operating satisfactorily.

3.5 Where the possibility of induced voltages or stored electrical energy exists, call for grounding the phase conductor or circuit parts before touching them. Where it could be reasonably anticipated that contact with other exposed energized conductor or circuit parts is possible, call for applying ground connecting devices.

4.0 Simple Lockout/Tagout

The simple lockout/tagout procedure will involve sections:

- 1.0
- 3.0
- 5.0 through 9.0
- and 11.0 through 13.0

5.0 Sequence of Lockout/Tagout System Procedures

5.1 The employees shall be notified that a lockout/tagout system is going to be implemented and the

reason for it. The qualified employee implementing the lockout/tagout shall know the disconnecting means location for all sources of electrical energy and the location of all sources of stored energy. The qualified person shall be knowledgeable of hazards associated with electrical energy.

5.2 If the electrical supply is energized, the qualified person shall de-energize and disconnect the electric supply and relieve all stored energy.

5.3 Wherever possible, the blades of disconnecting devices should be visually verified to be fully opened, or draw-out type circuit breakers should be verified to be completely withdrawn to the fully disconnected position.

5.4 Lockout/tagout all disconnecting means with lockout/tagout devices. For tagout, one additional safety measure must be employed, such as opening, blocking, or removing an additional circuit element.

5.5 Attempt to operate the disconnecting means to determine that operation is prohibited.

5.6 A test instrument shall be used. Inspect the instrument for visible damage. Do not proceed if there is an indication of damage to the instrument until an undamaged device is available.

5.7 Verify proper instrument operation on a known source of voltage and then test for absence of voltage.

5.8 Verify proper instrument operation on a known source of voltage after testing for absence of voltage

5.9 Where required, install a grounding equipment/conductor device on the phase conductor or circuit parts, to eliminate induced voltage or stored energy, before touching them. Where it has been determined that contact with other exposed energized conductors or circuit parts is possible, apply ground connecting devices rated for the available fault duty.

5.10 The equipment, electrical source, or both are now locked out (tagged out).

6.0 Restoring the Equipment, Electrical Supply, or Both to Normal Condition

6.1 After the job or task is complete, visually verify that the job or task if complete.

6.2 Remove all tools, equipment, and unused materials and perform appropriate housekeeping.

6.3 Remove all grounding equipment/conductor/devices.

6.4 Notify all personnel involved with the job or task that the lockout/tagout is complete, that the electrical supply is being restored, and that they are to remain clear of the equipment and electrical supply.

6.5 Perform any quality control tests or checks on the repaired or replaced equipment, electrical supply, or both.

6.6 Remove lockout/tagout devices. The person who installed the devices is to remove them.

6.7 Notify the owner of the equipment, electrical supply, or both, that the equipment, electrical supply,

or both are ready to be returned to normal operation.

6.8 Return the disconnecting means to their normal condition.

7.0 Procedure Involving More Than One Person

For a simple lockout/tagout and where more than one person is involved in the job or task, each person shall install his or her own personal lockout/tagout device.

8.0 Procedure Involving More Than One Shift

When the lockout/tagout is still in place at the beginning of the next day, it shall be verified that the lockout/tagout is still in place at the beginning of the next day. When the lockout/tagout is continued on successive shifts, the lockout/tagout is considered to be a complex lockout/tagout.

For a complex lockout/tagout, the person in charge shall identify the method for transfer of the lockout/tagout and of communication with all employees.

9.0 Complex Lockout/Tagout

A complex lockout/tagout plan is required where one or more of the following exist:

- Multiple energy sources (more than one)
- Multiple crews
- Multiple crafts
- Multiple locations
- Multiple employers
- Unique disconnecting means
- Complex or particular switching sequences
- Lockout/tagout for more than one shift; that is, new shift workers

9.1 All complex lockout/tagout procedures shall require a written plan of execution. The plan shall include the requirements in sections:

- 1.0 through 3.0
- 5.0
- 6.0
- 8.0 through 12.0

9.2 A person in charge shall be involved with a complex lockout/tagout procedure. The person in charge shall be at the procedure location.

9.3 The person in charge shall develop a written plan of execution and communicate that plan to all persons engaged in the job or task. The person in charge shall be held accountable for safe execution of the complex lockout/tagout plan. The complex lockout/tagout plan myst address all the concerns of the employees who might be exposed, and they must understand how electrical energy is controlled. The person in charge shall ensure that each person understands the electrical hazards to which they are exposed and the safety-related work practices that they are to use.

9.4 All complex lockout/tagout plans identify the method to account for all persons who might be exposed to electrical hazards in the course of the lockout/tagout.

One of the following methods is to be used:

- Each individual shall install his or her own personal lockout or tagout device.
- The person in charge shall lock his/her key in a lock box.
- The person in charge shall maintain a sign-in/sign-out log for all personnel entering the area.
- Another equally effective methodology shall be used

9.5 The person in charge can install locks/tags or direct their installation on behalf of other employees.

9.6 The person in charge can remove lock/tags or direct their removal on behalf of other employees, only after all personnel are accounted for and ensured to be clear of potential electrical hazards

9.7 Where complex lockout/tagout is continued on successive shifts, the person in charge shall identify the method for transfer of the lockout and the method of communication with all employees

10.0 Discipline

10.1 Knowingly violating the requirements of this program will result in strict disciplinary actions, up to termination.

11.0 Equipment

11.1 Locks shall be constructed specifically for lockout procedures, and shall be keyed uniquely from one another

11.2 Tags shall be visible, attached to the lock, clearly identify the tags purpose, and include:

- Employee's name
- Employee's contact number
- Supervisor's name
- Supervisor's contact number

11.3 Test instruments shall be:

- Approved for company use
- Designed for the scope of testing by the manufacturer
- Within any federal, state, or local required test or calibration date
- Operating properly per the manufacturer's directions, and not altered unless the alteration is approved by the manufacturer
- Repaired only by persons qualified to repair the test instrument, and are authorized to perform repairs and verify they are safe for service

12.0 This program shall be reviewed in increments not to exceed 1 year.

13.0 Lockout/Tagout Training

It is recommended that training on lockout/tagout includes, but is not limited to:

- Recognition of lockout/tagout devices
- Installation of lockout/tagout devices
- Duty of employer in writing procedure
- Duty of employee in executing procedures
- Duty of person in charge
- Authorized and unauthorized removal of locks/tags

- Enforcement of execution of lockout/tagout procedures
- Simple lockout/tagout
- Complex lockout/tagout
- Use of single-line and diagrammatic drawings to identify sources of energy
- Alerting techniques
- Release of stored energy
- Personnel accounting methods
- Temporary protective grounding equipment needs and requirements
- Safe use of test instruments

Work Involving Electrical Hazards – Energized Work Permit

When electrical conductors and circuit parts are energized at voltages equal to or greater than 50 volts, the equipment shall be put into an electrically safe condition prior to:

- An employee being within the limited approach boundary.
- An employee interacting with the equipment that does not have exposed conductors or circuit parts, but has an increased likelihood of injury due to an arc flash.

Energized Work

Certain circumstances related to the scope of work may permit energized work to take place.

Energized work is permitted when an employer can demonstrate that de-energizing the equipment introduces additional hazards or increased risk. Some examples of additional hazards or increased risk that may be a factor are interruption of life-support equipment, deactivation of emergency alarm systems, or a shutdown of hazardous location ventilation equipment.

Energized work is also permitted when an employer can demonstrate that it is not feasible to perform the work de-energized due to the equipment's design or operational limitations. Some examples of tasks that may permit energized work are diagnostic or testing procedures.

Equipment that is operating at less than 50 volts shall not require de-energization where the source and any overcurrent protection are considered, and there is not an increased exposure to electrical burns or explosions due to electrical arcs.

Equipment can only be normally operated when it is in a normal state. The conditions for equipment to be in a normal state are that the equipment must be:

- Properly installed
- Properly maintained
- Used in accordance with the manufacturer's instructions
- In a state that the equipment doors and covers are closed and secured
- There is no evidence of an impending failure

Energized Electrical Work Permit

When work is performed energized in accordance with the above Energized Work section, an Energized Electrical Work Permit is required and documented when:

- Work will be performed within the restricted approach boundary

- The employee interacts with the equipment when conductors or circuit parts are not exposed but there is an increased likelihood of injury due to an arc flash exposure

As required, the Energized Work Permit (Attachment A) shall be completed.

Hampton Tedder NETA Aligned Code of Safe Work Practices

Hampton Tedder has adopted the below safety program requirements in order to align itself with NETA's safe work practices. Hampton Tedder management, supervisors, and employees must adhere to the below work programs and practices.

Safety Committee

Hampton Tedder shall periodically hold safety committee meetings to implement and continually review the company's safety program. Members of the committee shall include management and field employees.

Responsibilities of the committee shall be to:

- Schedule meetings as needed
- Maintain meeting minutes
- Review safety training and overall safety program
- Review accident investigations and corrective actions
- Train and discuss on safety topics related to the employee's scope of work
- Review safety suggestions and take action to remove hazards
- Perform periodic work place inspections to ensure a safe and healthy work place

Emergency Information

Emergency information shall be posted in areas visible to employees, including locations and telephone numbers to contact ambulance, fire, rescue, police, hospital, and burn center services. Permanent work locations such as offices should have maps identifying evacuation routes, location of fire extinguishers, location of pull alarm stations and muster location points. First Aid equipment rated for the number of employee in that immediate work location should be readily available in offices, vehicles, and on job sites. Employees which are required to have First Aid, CPR, and AED training shall have a valid certification, and retraining shall occur at a frequency that satisfies the requirements of the certifying body. Employers shall verify at least annually that employee training required by this section is current and documented. Emergency and Fire codes and standards must be adhered to.

Individual Employee Responsibilities:

- Anyone suspected to be under the influence of drugs or alcohol shall not be allowed on the job.
- Practical jokes, horseplay, and fighting can cause serious injuries and can result in a safety hazard and shall not be permitted on the job.
- Employees found to be in violation of the employer's safety requirements shall be disciplined in accordance with the individual NETA Accredited Company's policies, up to and including termination from employment
- All injuries should be treated immediately and shall be promptly reported to the supervisor.
- Conductive jewelry such as necklaces, rings, earrings, etc., including metal-framed eyeglasses, shall not be worn.

Energized Work Permit Exemptions

Energized work is permitted without an energized electrical work permit when a qualified person utilizes proper safe work practices and PPE, while performing the following work tasks:

- Testing, troubleshooting or voltage measuring
- Thermography, ultrasound or visual inspections if the restricted approach boundary is not crossed.
- Access to and egress from an area with energized electrical equipment if no electrical work is performed and the restricted approach boundary is not crossed.
- General housekeeping and miscellaneous non-electrical tasks if the restricted approach boundary is not crossed.

Personal Protective Equipment (PPE) Selection

NFPA 70 E tables, or the Energy Incident Analysis (but not both) shall be utilized when determining the proper PPE. If the NFPA 70 E table limits are exceeded, an incident energy analysis shall be conducted per NFPA 70 E guidelines to determine the proper PPE required.

Incident Energy Analyses when performed shall be documented and reviewed periodically for accuracy at intervals of no more than 5 years.

Equipment – PPE and Tools

The employer shall ensure that each employee who is exposed to an electrical hazard wears personal protective equipment that is appropriate for the specific parts of the body to be protected and for the work to be performed.
Personal protective equipment shall be maintained in a safe, clean and reliable condition and in accordance with the manufacturer's instructions.
PPE shall be inspected prior to use. PPE found to have defects that could affect the safety of the worker shall be removed from service, tagged as being out of service due to damage, and repaired or exchanged by serviceable PPE.
PPE shall be stored in such a manner to prevent damage or deterioration.

Hard Hats

The employer shall ensure that each affected employee wears a protective helmet when working in areas where there is a potential for injury to the head from falling objects or the risk of injury due to electrical shock or arc flash.
Hard hats shall be worn in accordance with the manufacturer's recommendations and regulatory requirements.

Eye and Face Protection

The employer shall ensure that each affected employee uses appropriate eye or face protection when exposed to eye or face hazards from flying particles, molten metal, liquid chemicals, acids or caustic liquids, chemical gases or vapors, or potentially injurious light radiation.
Safety glasses shall meet ANSI Z87.1 and be UV rated.

Only clear, amber, or other light tint glasses may be worn indoors.

Hearing Protection
Hearing protection is required to be worn whenever working within the arc flash boundary or in areas having warning signs requiring the use of hearing protection.
Hearing protection is required whenever the employee is exposed to noise that exceeds the recommended OSHA PEL's (see 29 CFR 1910.95).

Respiratory Protection

Respiratory protection and its associated programs, training, and qualifications are necessary for members who have NETA Minimum Safety Guidelines employees working in an area determined to have an airborne contaminant which meets or exceeds the permissible exposure limit (PEL) as determined by OSHA 29 CFR 1910.1000 Table Z-1.
The employer shall provide respirators which are appropriate and suitable to protect the employee from airborne hazards or oxygen deficiency.
The employer shall be responsible for the establishment, maintenance and documentation of a respiratory protection program.

Foot Protection

The employer shall ensure that each affected employee uses protective footwear when working in areas where there is a danger of foot injuries due to falling or rolling objects, or objects piercing the sole, and where such employee's feet are exposed to electrical hazards.
Where the employee is exposed to step or touch potentials, dielectric footwear, insulating mats or ground mats shall be used.
Protective footwear must comply with the current edition of ASTM F2412, ASTM F2413; and ANSI Z41, ANSI Z41 standards, whichever is applicable to the work at hand.
Footwear should be lace up to maintain tightness around foot and above the ankle to provide support, and must be hard-toed, puncture resistant, and Electrical Hazard rated.

General Hand Protection

Employers shall select and require employees to use appropriate hand protection when employees' hands are exposed to hazards such as those from absorption of harmful substances; cuts or lacerations; abrasions; punctures; chemical burns; thermal burns; and harmful temperature extremes.

Electrical Protective Devices

Rubber insulating gloves rated for the nominal voltage (V-rated) and leather protector gloves should be of correct size and shall be worn inside the restricted approach boundary.
V-rated gloves and leather protector gloves shall be inspected for defects prior to use. If any damage that could affect the safety of the wearer is found, such as corona cutting or contact with petroleum products, the gloves shall be removed from service immediately, tagged as being out of service due to damage, and repaired or replaced.
V-rated gloves should be air tested prior to each use by rolling up the cuffs and forcing air into the gloves. Alternatively, an air pump designed for this purpose may be used. If leakage is discovered, gloves shall not be used.
Rubber insulating protective equipment shall be visually inspected before each use in accordance with ASTM F-1236.

V-rated gloves shall be tested per ASTM F-496 at the appropriate voltage at least every six months or in accordance with local regulations and marked with the date of testing and the voltage. No rubber insulating glove shall go more than 12 months between testing. Rubber insulating gloves are considered to be issued when purchased.
Blankets, sleeves, line hose and other rubber goods shall be tested per ASTM F-478, F-479, or F-496, as appropriate, at least every 12 months.
6.9.7 A file of testing records shall be maintained. Following each test, a copy of the test forms should be issued with the PPE.

Arc-Rated (AR) Clothing and Equipment

Arc-flash protective equipment may be chosen by using the tables located in the NFPA 70E Article 130. These tables may only be used within the parameters as defined in the corresponding section of the table. Arc-rated clothing personal protective equipment shall have an arc thermal performance value (ATPV) rating equal to or greater than the estimated incident energy exposure available at the working distance. Note: The overall rating may be greater than the sum of the ATPV ratings of two or more layers. Check the PPE vendor's literature and the current edition of NFPA 70E for more information regarding layering.

Locks and Tags

It is suggested that each employee be individually assigned single keyed locks for the use in locking out equipment. This preferred method is known as a "one lock, one key" policy. However, this is not the only method of providing a proven NETA Minimum Safety Guidelines effective means for locking out and/or tagging out of equipment. Various other methods are suggested in 29 CFR 1910.147. The method utilized should be applicable to the type of equipment involved and the means of isolating and ensuring de-energization. The method used should ensure the safety of the personnel performing the work on the equipment de-energized.
Locks used for the purpose of lock out / tag out must only be used for the control of hazardous energy. Identification of the assigned lock can either be done by placing name and phone number directly on the lock or by placing an identifying tag on the lock.
Tags should state that the operation of the equipment could be hazardous, and identify who locked out the equipment and how to contact them (i.e. cell number).

Live-Line Tools

Live-line tools used for primary employee protection shall be removed from service every two years for inspection, cleaning, repair, and testing in accordance with OSHA 29 CFR 1910.269(j)(2)(iii).
Live-line tools shall be rated for circuit voltage on which they are to be used.
Live-line tools shall be inspected prior to each use. If any defect is found as specified in IEEE 978, "Guide for In-Service Maintenance and Electrical Testing of Live-Line Tools" the tool shall be tagged out of service and retested before use.
Correctly rated rubber insulating gloves and leather protectors should be worn when using live-line tools.

Use of Test Instruments

Only qualified persons shall perform tasks where they may be exposed to electrical hazards.
Test instruments, equipment and their accessories shall meet the following conditions:
They must be rated for the circuits and equipment where they are utilized.

They must be approved for the purpose.
Used in accordance with the manufacturer's instructions and any listing and labeling instructions.
Designed for the environment to which they will exposed and the manner in which they will be utilized.
Inspected prior to each use, including all accessories, leads, probes, cables, power cords and connectors.
If there is any defect or damage that might expose an employee to injury, the defective or damaged item shall be removed from service and tagged as being defective.
Only persons qualified to repair the test instrument are authorized to perform repairs and verify they are safe for service.
When test instruments are used for absence of voltage testing, the operation of the test instrument shall be verified before and after the absence of voltage test is performed.

Safety Policies & Procedures

Communication and Power Generation Facilities

When Hampton Tedder employees are conducting work in communication facilities or power generation plants, they shall adhere to all of Hampton Tedder's safety policies and procedures as they pertain to the job tasks and work place.

Grounding Test Equipment

When using test equipment:

- Prior to testing, conductors/terminals associated with the isolated apparatus should be grounded (use proper PPE and live line tools whole applying and removing grounds)
- Connect the equipment's approved ground lead to the correct ground location (per manufacturer's instructions)
- Verify that the AC source used to power the test set is properly grounded
- Plug power cord into test set and AC power source (chassis ground)

When operating test equipment, all manufacturer's instructions and recommendations shall be followed.

Scaffolding

If scaffolding is going to be constructed, only authorized workers shall be permitted to erect them.
Scaffolding shall comply with local, state, and federal codes and standards.

Powered Industrial Trucks

Only the certified driver wearing a seatbelt should ride on motor-driven lift trucks unless otherwise designed to carry a passenger.
Forklifts must be inspected prior to each use for defects that could create a hazardous condition, and the inspections shall be documented.
Lift trucks shall be operated at speeds which are safe for existing conditions.
Approach blind corners, doors and intersections cautiously and sound the horn.
Loads should be picked up near the center of their weight.
Loose material should be secured to prevent shifting or toppling while in motion.
Employees shall not be lifted from one elevation to another by a forklift truck unless it is equipped with an approved platform with railing and toe boards securely fastened to the forks.
When not in use, the forks or platform should be in the lowered position.
Forklifts shall only be operated in the manner for which they were designed.

Hampton Tedder shall maintain a program to ensure that operators are trained.
Hampton Tedder shall ensure that local, state, and federal codes are adhered to.

Hazard Communication

A survey shall be completed annually to determine the quantity and type of chemicals at their facility, ensure that labels are in compliance, and that Safety Data Sheets are properly filed and accessible. Training shall occur when a new chemical is introduced into the workplace.

Machinery and Machine Guarding

Employees shall be trained on how to safely operate machinery that they are assigned to operate, and the guarding to reduce the risk associated with the machinery. Examples of guarding methods are barrier guards, two-hand tripping devices, and electronic safety devices.

Employees shall inspect and properly operate all machinery to protect from the hazards such as the point of operation, ingoing nip-points, rotating parts, flying chips and sparks.

Equipment Specific Safe Work Practices

The proper Personal Protective Equipment (PPE) shall be used when working. PPE shall be maintained in a safe, clean, and reliable condition and in accordance with the manufacturer's instructions. PPE shall be inspected prior to use. PPE found to have defects that could affect the safety of the worker shall be removed from service, tagged as being out of service due to damage, and repaired or exchanged by serviceable PPE.

Energized electrical equipment shall be placed in an electrically-safe work condition prior to employees crossing the arc flash or limited approach boundaries. Exceptions shall be based on OSHA 29 CFR 1910.333 and 1910.269.

1. Switchgear

1.1. Using up-to-date electrical drawings, determine all potential sources of electrical power, their location and the device(s) required to place electrical equipment into an electrically-safe work condition.
1.2. Verify that all applicable breakers and switches are locked and tagged out. Check for possible sources of back-feed such as an automatic transfer switch and emergency generators. Take appropriate action to provide adequate protection.
1.3. Verify that all voltage transformers are disconnected and grounded.
1.4. Verify that all control power transformers are disconnected and grounded.
1.5. Verify that there is no possibility of other back-feed.
1.6. Verify that all equipment to be worked on is tested for the absence of voltage at the point of contact. Confirm operation of voltage detection devices before and after the absence of voltage test to verify correct operation. Use temporary personal protective ground sets that meet ASTM F-855 and comply with OSHA 29 CFR 1910.269.
1.7. Verify that the appropriate persons have been notified that personnel are working on the switchgear.
1.8. Discharge stored energy devices such as capacitors, UPS systems and other high-capacitance devices, springs, capacitors, hydraulic lines and tanks, and compressed air lines and tanks.
1.9. Use personal protective equipment as determined by the risk assessments including rubber

insulating gloves with leather protector gloves, insulating mats, barriers, insulating sticks, arc-rated clothing, arc-rated face shields, arc-rated balaclavas, arc flash suits, and arc flash hoods. Observe the arc flash boundary and the limited and restricted approach boundary distances in accordance with NFPA 70E.

2. Transformers

2.1. Test to ensure that no voltage is present at the transformer terminals and verify the operation of the voltage detection device before and after the absence of voltage test.
2.2. Visually verify that the transformer is isolated using visible air gap switches or disconnects.
2.3. Using live-line tools, apply personal protective grounds to the transformer's terminals. When performing DC tests, leave the grounds connected for an adequate period of time to ensure the windings are discharged or when the test instrument indicates the system is discharged. Remove temporary personal protective grounds when the work is completed.
2.4. When filtering or filling transformers, wear appropriate personal protective equipment for the type of fluid being handled to prevent contact from spillage or accidental discharge, e.g., face shields and work gloves.
2.5. Prior to working on the inside of transformer tanks, provide adequate fresh air supply and assure that all toxic fumes have been removed by testing and the oxygen level is adequate.
2.6. Manholes and other confined spaces should be tested for oxygen level, percent combustible gases, and parts per million of carbon monoxide before entry and while occupied.
2.7. Use air and gas monitors to warn of hazardous environments and to continuously monitor for percent of oxygen, percent of combustible gas, and parts per million of carbon monoxide.
2.8. Prior to replacing covers, account for all tools or other materials that were used inside the transformer or near its opening.
2.9. Perform a visual inspection prior to replacing covers.
2.10. When testing is completed, remove all tools and grounds.
2.11. When oil testing or using chemicals, wear appropriate personal protective equipment for the eyes and exposed skin areas, even when using safety solvents. The term safety solvent only means it has a flash point above 140◦C, not that it is safe to breathe.
2.12. Inspect for EPA-mandated labeling on transformers. Beware of units containing PCBs or other hazardous fluids. When working on such units, follow appropriate state and federal standards in fluid handling and disposal.

3. Cables

3.1. Verify the routing of cables to be tested and the isolation of other cables in the vicinity. Confirm that junction box covers are secure.
3.2. The ends of a cable and splices being tested should be made inaccessible by barriers or other means. Depending on accessibility, guards and a suitable communication method (i.e. signage or an attendant) may be necessary to prevent unauthorized access. Refer to NFPA 70E 130.7(E) Alerting Techniques and 130.7(F) Look-Alike Equipment for additional information.
3.3. Test to assure that cables have been de-energized and that any switches that may energize the cables have been opened, locked out, and tagged. Disable stored energy mechanisms.
3.4. Using a live-line tool, apply temporary personal protective grounds to the cable under test after testing for the absence of voltage. Wait a minimum of 5 minutes before removing grounds for test using a live-line tool.
3.5. Ground any nearby cables that are not energized and are not under test.
3.6. After completing cable testing, re-ground all conductors. Upon the completion of dc tests, the minimum discharge time should be at least four times the duration of the applied potential.

3.7. Remove all static discharge grounding conductors before leaving the job site on each shift or advise the appropriate personnel of any grounds left on cables after the testing has been completed. When removing static grounds, rubber insulating gloves and leather protectors are permitted to be used.
3.8. Consult the cable test equipment manufacturer's instruction book for specific safety precautions.
3.9. Disconnects (Air Switches)
3.10. Test to determine that all circuits have been de-energized by performing an absence of voltage test and verifying the operation of the voltage detection device before and after the absence of voltage test.
3.11. Apply personal protective grounding sets on both line and load sides of the open load-break disconnect.
3.12. Use grounds sized to carry the available fault current for the time needed to clear the fault. Refer to ASTM F-855 Table 1 and use the Withstand rating to size ground sets. Apply temporary personal protective grounds in compliance with OSHA 29 CFR 1910.269.
3.13. Prior to performing electrical tests, verify that no one is working on any portion of the circuit(s) which are to be tested.
3.14. Use warning signs, barriers, barricades or attendants as appropriate to ensure unqualified persons do not enter the test area.
3.15. Use appropriate lockout/tagout (LOTO) procedures to ensure no one can energize the circuit. Discharge stored energy mechanisms which may present a mechanical hazard.

4. Current Transformers (CT)

4.1. Take precautions to assure that the secondary or secondary of an energized current transformer are not open-circuited.
4.2. Prior to the removal of secondary connections, ensure the secondary are shorted. If available, the preferred method of shorting a CT is to use factory-installed shorting links.
4.3. When monitoring current transformer circuits, assure the test equipment is of the non-fused type.
4.4. Follow safe work guidelines outlined in IEEE C57.13.1.

5. Potential Transformers (PT)
5.1. When testing the ratio of potential transformers, always inject the test voltage into the primary winding and measure the voltage on the secondary winding. Never inject voltage into the secondary of a potential transformer.

6. Motor Control Centers (MCCs)

6.1. Before beginning any testing, verify that all equipment and cables to be tested have been de-energized and locked, tagged and tested for the absence of voltage. Discharge or mechanically restrain stored energy systems.
6.2. When inserting starters, verify that the contact fingers have made connection with the bus. This is best accomplished on de-energized MCCs. If the MCC bucket must be installed when the MCC is energized, wear appropriate arc-flash protective equipment in accordance with the current edition of the NFPA 70E.
6.3. Before inserting a MCC bucket into the motor control center, verify that its disconnecting means is in the open position.
6.4. Never open a motor isolation switch when the motor starter is engaged. Ensure the load is interrupted by the starter contacts or with an upstream circuit breaker or load-break device.

7. **Rotating Machinery**

7.1. Verify that all circuits and control systems are de-energized and locked out and tagged and tested for the absence of voltage prior to the start of work.
7.2. Verify all starting systems (i.e., remote, air, battery) are disabled and locked out and tagged.
7.3. Test operate the controls to verify the lockout/tagout has been successful. Return the controls to the OFF position when finished.
7.4. If working with hoses, straps of other loose materials or equipment, be certain to keep it clear of rotating assemblies.
7.5. Loose fitting clothes and ties shall not be worn around rotating equipment.
7.6. Watches, rings, necklaces, or other jewelry shall not be worn around rotating equipment.

8. Automatic Transfer Equipment

8.1. Obtain written approval from the customer prior to performing maintenance procedures on equipment that will compromise life safety.
8.2. Verify that both normal and emergency sources have been de-energized and locked and tagged out-of-service and tested for the absence of voltage prior to the start of testing or maintenance.
8.3. Before making any functional operational check, verify that no one is present in elevators or on vital equipment supplied by the transfer equipment.

9. Batteries

9.1. Verify that areas containing storage batteries are adequately ventilated.
9.2. Smoking, open flames, and spark-producing tools or equipment are prohibited.
9.3. Only nonconductive and non-sparking tools shall be used within the restricted approach boundary of batteries and battery banks
9.4. Face shields, gloves, and aprons shall be worn when working in the battery vicinity and/or when handling electrolyte or batteries.
9.5. Determine that an eye wash station is present and operational before starting any work. Eye wash stations must be readily available and easy to access in an emergency.
9.6. Using the results of an incident energy analysis or Table 130.7(C)(15)(b) “Arc Flash PPE Categories for Direct Current (dc) Systems” select and wear the appropriate arc-rated PPE for the estimated exposure.
9.7. Do not handle energized parts of batteries unless necessary precautions have been taken to avoid shock and short circuits.
9.8. Extreme caution should be used when moving batteries. Do not drag, push, or rock cells into position. Improper handling can result in personal injury.

10. Capacitors

10.1. Unless inoperable, capacitor installations should be energized and de-energized using the remote control station.
10.2. When switches are used, they should be checked for proper position before fuses/line disconnects are opened or closed.
10.3. Appropriate tools should be used to operate line disconnects or fuses. Rubber insulating gloves rated for the system voltage shall be worn for any control box operation.
10.4. Due to capacitive charges that may be stored in a capacitor, the sequence to perform work on de-energized capacitors is as follows:
10.5. Open line disconnects
10.6. Wait five minutes
10.7. Test for potential and if found de-energized

10.8. Apply grounds with terminals short-circuited, and bonded to the capacitor case or rack. If found energized, replace grounds and wait an additional five minutes.
10.9. Note: Large capacitors will often have internal bleed resistors, which slowly discharge the capacitor. These resistors are internal and may be defective. Always test for the absence of voltage prior to handling.
10.10. Capacitors should not be grounded except through a grounding stick that has a resistance in it. A straight ground connection will discharge the capacitors instantaneously, increasing the risk for damage to the capacitor and an arc flash.
10.11. When substation capacitor banks are de-energized, the source and frame should be tested for potential and grounded before further work is done.

11. Substations

11.1. Before driving a vehicle into a substation, the radio antenna must be lowered and secured in place. Parking in close proximity to energized equipment or directly under overhead power lines shall be avoided.
11.2. The chassis of the vehicle should be grounded, depending on the voltage and configuration of the overhead bus, to prevent induced voltages creating a step or touch potential hazard.
11.3. Before touching gates in substation fences, verify the gate is bonded to the substation fence.
11.4. Gates in substation fences must be kept closed and locked when working in the yard, except when entering or exiting.
11.5. Substation entries and exits shall be announced to the proper authority. Only qualified personnel are allowed unescorted access into substations.
11.6. Doors to enclosures containing energized equipment must be kept closed, except when work is actively being performed inside.
11.7. When carrying ladders, pipes, conduit, reinforcing rods, and other long material into substations, switchyards, bus compartment rooms and other places where there is danger of making contact with energized parts, the material should be held by 2 workers, 1 at each end, and carried in the hands and not above the shoulders.
11.8. Appropriate rubber insulating gloves with leather protector gloves must be worn when working within the substation.
11.9. Approved personal protective equipment and clothing must be used in accordance with the risks associated with the work being performed.
11.10. Barriers should be used while work is being performed on deenergized equipment in order to prevent accidental contact with adjacent energized equipment.
11.11. Approved barricades of rope, tape, or netting, with appropriate signs to identify the hazard, shall be used to mark off and limit access to energized areas adjacent to the work area.
11.12. When testing with high-voltage test equipment, the test area should be barricaded with rope, tape, or other means and appropriate warning signs displayed to identify the hazard and warn unauthorized personnel.
11.13. When required to work in close proximity of energized conductors or equipment, workers should avoid making contact with such energized parts by the use of barriers, rubber protective equipment, warning tapes, appropriate signs to identify the hazard, or any other safety devices which may be required to make the work area safe.
11.14. After operating gang-operated air break switches, a visual check should be made to see that all blades are in either a full open or full closed position as the case may be.
11.15. In order to work on the grounded end of a disconnect or air break switch, which is opened and tagged, to isolate the work area while the other end remains energized, barriers should be securely placed between the worker and the energized end of the switch. If, in the opinion of the person in charge, it is hazardous to install such barriers, the procedure for working on the switch as outlined below should be followed:

11.15.1. In order to carry out routine maintenance on a disconnect or air break switch, which includes the bus and line sides of the switch, all sources of potential should be identified, disconnected, tested for the absence of voltage, grounded, and tagged according to approved procedures.

11.15.2. When grounding devices are removed from conductors or equipment for testing, the grounding devices shall be reapplied before any further work is performed.

11.15.3. All lightning arrester equipment should be treated as though it were charged at full line potential unless it is disconnected from the energized line, tested, and grounded.

11.15.4. Safety straps shall not be placed around lightning arrester or porcelain insulator stacks for support.

11.16. To avoid static buildup during fluid transfer operations, bond and ground all vessels and equipment, including tanks, bushings, filtering equipment, etc.

12. Circuit Breakers

12.1. Verify that the circuit breaker is open and discharged prior to placing hands inside or near the mechanism.

12.2. Verify that the circuit breaker is opened and the closing springs are discharged prior to racking the circuit breaker in or out of its cubicle.

12.3. Use proper lifting methods whenever moving a circuit breaker to prevent back or other injuries.

ATTACHMENT A

ENERGIZED ELECTRICAL WORK PERMIT Job/Work Order Number _____

PART I: TO BE COMPLETED BY THE REQUESTER:

(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:

_____

Start Date: _____ Expire Date: _____

_____

Requester/Title Date

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

Detailed job description procedure to be used in performing the above detailed work including hazards, conditions, mechanical, environmental, space obstructions, other voltages:

_____

_____

_____

_____

_____

Description of the Safe Work Practices: ☐ LOTO ☐ Two Workers ☐ Safety Watch ☐ Notify affected workers ☐ Reason not to LOTO: _____

_____

_____

SHOCK RISK ASSESSMENT:

A shock risk assessment shall be conducted to identify the following:

(1) Shock hazards present: _____

(2) Estimate of the likelihood and severity of injury:

a. Likelihood (1 = Unlikely, 5 = Highly Likely) : _____

b. Severity of Possible Injury (1 = Minor, 5 = Possible Fatality) : _____

(3) Are additional protective measures are required, including PPE? (circle one) YES / NO

If additional protective measures are required including the use of PPE, determine the following:

(4) Identify the voltage to which personnel will be exposed: _____

(5) Identify the boundary requirements: _____

(6) Identify personal and other protective equipment required to prevent shock: _____

_____

ARC FLASH RISK ASSESSMENT:

An arc flash risk assessment shall be performed to identify the following:

(1) Arc flash hazards present: _____

(2) Estimate of the likelihood and severity of injury:

The estimate of severity shall take into account:

a. Design of electrical equipment, overcurrent protective device and operating time: _____

_____

b. Operating condition and condition of maintenance: _____

_____

Based on the above equipment status and condition, estimate the likelihood and severity:

c. Likelihood (1 = Unlikely, 5 = Highly Likely) : _____

d. Severity of Possible Injury (1 = Minor, 5 = Possible Fatality) : _____

If additional protective measures are required, they should be selected and implemented. If the measures include the use of PPE the following shall be determined:

(3) Appropriate arc flash safety work practices: _____

_____

(4) Proper PPE to be used within the arc flash boundary: _____

_____

Incident Energy (cal/cm^2)		Flash Hazard (-1 to 4)		Limited Approach		Working Distance	
Shock Hazard (max V)		Flash Boundary		Restricted Approach		Glove Class, minimum	

Authorized Workers **Authorized Workers**

_____ _____

_____ _____

_____ _____

_____ _____

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

_____

Department Chair/Division Manager Date

_____

Electrically Knowledgeable Person Date

PART IV: WORK

Evidence of completion of Job Briefing including discussion of any job-related hazards: _____

_____

Means used to restrict the access of unqualified persons from the work area: _____

_____

PART V: POST WORK-FEEDBACK (Worker Initials)

_____ _____

_____ _____

_____ _____

_____ _____

_____ _____

Safety Manager/Representative Close-out Date

ALTERNATING CURRENT TABLE:

Table 130.4(D)(a) Shock Protection Approach Boundaries to Exposed Energized Electrical Conductors or Circuit Parts for Alternating-Current Systems

(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 V	Not specified	Not specified	Not specified
50 V–150 V[d]	3.0 m (10 ft 0 in.)	1.0 m (3 ft 6 in.)	Avoid contact
151 V–750 V	3.0 m (10 ft 0 in.)	1.0 m (3 ft 6 in.)	0.3 m (1 ft 0 in.)
751 V–15 kV	3.0 m (10 ft 0 in.)	1.5 m (5 ft 0 in.)	0.7 m (2 ft 2 in.)
15.1 kV–36 kV	3.0 m (10 ft 0 in.)	1.8 m (6 ft 0 in.)	0.8 m (2 ft 9 in.)
36.1 kV–46 kV	3.0 m (10 ft 0 in.)	2.5 m (8 ft 0 in.)	0.8 m (2 ft 9 in.)
46.1 kV–72.5 kV	3.0 m (10 ft 0 in.)	2.5 m (8 ft 0 in.)	1.0 m (3 ft 6 in.)
72.6 kV–121 kV	3.3 m (10 ft 8 in.)	2.5 m (8 ft 0 in.)	1.0 m (3 ft 6 in.)
138 kV–145 kV	3.4 m (11 ft 0 in.)	3.0 m (10 ft 0 in.)	1.2 m (3 ft 10 in.)
161 kV–169 kV	3.6 m (11 ft 8 in.)	3.6 m (11 ft 8 in.)	1.3 m (4 ft 3 in.)
230 kV–242 kV	4.0 m (13 ft 0 in.)	4.0 m (13 ft 0 in.)	1.7 m (5 ft 8 in.)
345 kV–362 kV	4.7 m (15 ft 4 in.)	4.7 m (15 ft 4 in.)	2.8 m (9 ft 2 in.)
500 kV–550 kV	5.8 m (19 ft 0 in.)	5.8 m (19 ft 0 in.)	3.6 m (11 ft 8 in.)
765 kV–800 kV	7.2 m (23 ft 9 in.)	7.2 m (23 ft 9 in.)	4.9 m (15 ft 11 in.)

Notes:
(1) For arc flash boundary, see 130.5(A).
(2) All dimensions are distance from exposed energized electrical conductors or circuit part to employee.
[a]For single-phase systems above 250 volts, select the range that is equal to the system's maximum phase-to-ground voltage multiplied by 1.732.
[b]See definition in Article 100 and text in 130.4(D)(2) and Informative Annex C for elaboration.
[c]*Exposed movable conductors* 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.
[d]This includes circuits where the exposure does not exceed 120 volts nominal.

ESTIMATE: LIKELIHOOD OF OCCURANCE OF AN ARC FLASH INCIDENT FOR AC & DC:

Table 130.5(C) Estimate of the Likelihood of Occurrence of an Arc Flash Incident for ac and dc Systems

Task	Equipment Condition	Likelihood of Occurrence*
Reading a panel meter while operating a meter switch. Performing infrared thermography and other non-contact inspections outside the restricted approach boundary. This activity does not include opening of doors or covers. Working on control circuits with exposed energized electrical conductors and circuit parts, nominal 125 volts ac or dc, or below without any other exposed energized equipment over nominal 125 volts ac or dc, including opening of hinged covers to gain access. Examination of insulated cable with no manipulation of cable. For dc systems, insertion or removal of individual cells or multi-cell units of a battery system in an open rack. For dc systems, maintenance on a single cell of a battery system or multi-cell units in an open rack.	Any	No
For ac systems, work on energized electrical conductors and circuit parts, including voltage testing. For dc systems, working on energized electrical conductors and circuit parts of series-connected battery cells, including voltage testing. Removal or installation of CBs or switches. Opening hinged door(s) or cover(s) or removal of bolted covers (to expose bare, energized electrical conductors and circuit parts). For dc systems, this includes bolted covers, such as battery terminal covers. Application of temporary protective grounding equipment, after voltage test. Working on control circuits with exposed energized electrical conductors and circuit parts, greater than 120 volts. Insertion or removal of individual starter buckets from motor control center (MCC). Insertion or removal (racking) of circuit breakers (CBs) or starters from cubicles, doors open or closed. Insertion or removal of plug-in devices into or from busways. Examination of insulated cable with manipulation of cable. Working on exposed energized electrical conductors and circuit parts of equipment directly supplied by a panelboard or motor control center. Insertion or removal of revenue meters (kW-hour, at primary voltage and current). Removal of battery conductive intercell connector covers. For dc systems, working on exposed energized electrical conductors and circuit parts of utilization equipment directly supplied by a dc source. Opening voltage transformer or control power transformer compartments. Operation of outdoor disconnect switch (hookstick operated) at 1 kV through 15 kV. Operation of outdoor disconnect switch (gang-operated, from grade) at 1 kV through 15 kV.	Any	Yes
Operation of a CB, switch, contactor, or starter. Voltage testing on individual battery cells or individual multi-cell units. Removal or installation of covers for equipment such as wireways, junction boxes, and cable trays that does not expose bare, energized electrical conductors and circuit parts. Opening a panelboard hinged door or cover to access dead front overcurrent devices. Removal of battery nonconductive intercell connector covers.	Normal	No
Maintenance and testing on individual battery cells or individual multi-cell units in an open rack Insertion or removal of individual cells or multi-cell units of a battery system in an open rack. Arc-resistant switchgear Type 1 or 2 (for clearing times of less than 0.5 sec with a prospective 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, 1 kV through 15 kV. Insertion or removal (racking) of CBs from cubicles; Insertion or removal (racking) of ground and test device; or Insertion or removal (racking) of voltage transformers on or off the bus.	Abnormal	Yes

(continues)

ESTIMATE: LIKELIHOOD OF OCCURANCE OF AN ARC FLASH INCIDENT FOR AC & DC CONTINUED:

Table 130.5(C) *Continued*

Task	Equipment Condition	Likelihood of Occurrence*
Equipment condition considered to be "normal" if all of the following circumstances apply: (1) The equipment is properly installed in accordance with the manufacturer's recommendations and applicable industry codes and standards. (2) The equipment is properly maintained in accordance with the manufacturer's recommendations and applicable industry codes and standards. (3) The equipment is used in accordance with instructions included in the listing and labeling and in accordance with manufacturer's instructions. (4) Equipment doors are closed and secured. (5) Equipment covers are in place and secured. (6) There is no evidence of impending failure such as arcing, overheating, loose or bound equipment parts, visible damage, or deterioration.		

*As defined in this standard, the two components of risk are the likelihood of occurrence of injury or damage to health and the severity of injury or damage to health that results from a hazard. Risk assessment is an overall process that involves estimating both the likelihood of occurrence and severity to determine if additional protective measures are required. The estimate of the likelihood of occurrence contained in this table does not cover every possible condition or situation, nor does it address severity of injury or damage to health. Where this table identifies "No" as an estimate of likelihood of occurrence, it means that an arc flash incident is not likely to occur. Where this table identifies "Yes" as an estimate of likelihood of occurrence, it means that additional protective measures are required to be selected and implemented according to the hierarchy of risk control identified in 110.1(H).

Informational Note No. 1: An example of a standard that provides information for arc-resistant switchgear referred to in Table 130.5(C) is IEEE C37.20.7, *Guide for Testing Metal-Enclosed Switchgear Rated Up to 38 kV for Internal Arcing Faults.*

Informational Note No. 2: Improper or inadequate maintenance can result in increased fault clearing time of the overcurrent protective device, thus increasing the incident energy. Where equipment is not properly installed or maintained, PPE selection based on incident energy analysis or the PPE category method might not provide adequate protection from arc flash hazards.

Informational Note No. 3: Both larger and smaller available fault currents could result in higher incident energy. If the available fault current increases without a decrease in the fault clearing time of the overcurrent protective device, the incident energy will increase. If the available fault current decreases, resulting in a longer fault clearing time for the overcurrent protective device, incident energy could also increase.

Informational Note No. 4: The occurrence of an arcing fault inside an enclosure produces a variety of physical phenomena very different from a bolted fault. For example, the arc energy resulting from an arc developed in the air will cause a sudden pressure increase and localized overheating. Equipment and design practices are available to minimize the energy levels and the number of procedures that could expose an employee to high levels of incident energy. Proven designs such as arc-resistant switchgear, remote racking (insertion or removal), remote opening and closing of switching devices, high-resistance grounding of low-voltage and 5000-volt (nominal) systems, current limitation, and specification of covered bus or covered conductors within equipment are available to reduce the risk associated with an arc flash incident. See Informative O for safety-related design requirements.

Informational Note No. 5: For additional direction for performing maintenance on overcurrent protective devices, see Chapter 2, Safety-Related Maintenance Requirements.

Informational Note No. 6: See IEEE 1584, *Guide for Performing Arc Flash Calculations*, for more information regarding incident energy and the arc flash boundary for three-phase systems.

Table 130.5(G) Selection of Arc-Rated Clothing and Other PPE When the Incident Energy Analysis Method Is Used

Incident energy exposures equal to 1.2 cal/cm² up to 12 cal/cm²
Arc-rated clothing with an arc rating equal to or greater than the estimated incident energy[a]
Long-sleeve shirt and pants or coverall or arc flash suit (SR)
Arc-rated face shield and arc-rated balaclava or arc flash suit hood (SR)[b]
Arc-rated outerwear (e.g., jacket, parka, rainwear, hard hat liner) (AN)
Heavy-duty leather gloves, arc-rated gloves, or rubber insulating gloves with leather protectors (SR)[c]
Hard hat
Safety glasses or safety goggles (SR)
Hearing protection
Leather footwear
Incident energy exposures greater than 12 cal/cm²
Arc-rated clothing with an arc rating equal to or greater than the estimated incident energy[a]
Long-sleeve shirt and pants or coverall or arc flash suit (SR)
Arc-rated arc flash suit hood
Arc-rated outerwear (e.g., jacket, parka, rainwear, hard hat liner) (AN)
Arc-rated gloves or rubber insulating gloves with leather protectors (SR)[c]
Hard hat
Safety glasses or safety goggles (SR)
Hearing protection
Leather footwear

SR: Selection of one in group is required.
AN: As needed.
[a]Arc ratings can be for a single layer, such as an arc-rated shirt and pants or a coverall, or for an arc flash suit or a multi-layer system if tested as a combination consisting of an arc-rated shirt and pants, coverall, and arc flash suit.
[b]Face shields with a wrap-around guarding to protect the face, chin, forehead, ears, and neck area are required by 130.7(C)(10)(c). Where the back of the head is inside the arc flash boundary, a balaclava or an arc flash hood shall be required for full head and neck protection.
[c]Rubber insulating gloves with leather protectors provide arc flash protection in addition to shock protection. Higher class rubber insulating gloves with leather protectors, due to their increased material thickness, provide increased arc flash protection.

ARC FLASH PPE CATEGORIES

Table 130.7(C)(15)(a) Arc-Flash PPE Categories for Alternating Current (ac) Systems

Equipment	Arc-Flash PPE Category	Arc-Flash Boundary
Panelboards or other equipment rated 240 volts and below Parameters: Maximum of 25 kA available fault current; maximum of 0.03 sec (2 cycles) fault clearing time; minimum working distance 455 mm (18 in.)	1	485 mm (19 in.)
Panelboards or other equipment rated greater than 240 volts and up to 600 volts Parameters: Maximum of 25 kA available fault current; maximum of 0.03 sec (2 cycles) fault clearing time; minimum working distance 455 mm (18 in.)	2	900 mm (3 ft)
600-volt class motor control centers (MCCs) Parameters: Maximum of 65 kA available fault current; maximum of 0.03 sec (2 cycles) fault clearing time; minimum working distance 455 mm (18 in.)	2	1.5 m (5 ft)
600-volt class motor control centers (MCCs) Parameters: Maximum of 42 kA available fault current; maximum of 0.33 sec (20 cycles) fault clearing time; minimum working distance 455 mm (18 in.)	4	4.3 m (14 ft)
600-volt class switchgear (with power circuit breakers or fused switches) and 600-volt class switchboards Parameters: Maximum of 35 kA available fault current; maximum of up to 0.5 sec (30 cycles) fault clearing time; minimum working distance 455 mm (18 in.)	4	6 m (20 ft)
Other 600-volt class (277 volts through 600 volts, nominal) equipment Parameters: Maximum of 65 kA available fault current; maximum of 0.03 sec (2 cycles) fault clearing time; minimum 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 available fault current; maximum of up to 0.24 sec (15 cycles) fault clearing time; minimum working distance 910 mm (36 in.)	4	12 m (40 ft)
Metal-clad switchgear, 1 kV through 15 kV Parameters: Maximum of 35 kA available fault current; maximum of up to 0.24 sec (15 cycles) fault clearing time; minimum working distance 910 mm (36 in.)	4	12 m (40 ft)
Arc-resistant switchgear 1 kV through 15 kV [for clearing times of less than 0.5 sec (30 cycles) with an available 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, 1 kV through 15 kV Parameters: Maximum of 35 kA available fault current; maximum of up to 0.24 sec (15 cycles) fault clearing time; minimum 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 available fault current; maximum of up to 0.24 sec (15 cycles) fault clearing time; minimum 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.

Informational Note to Table 130.7(C)(15)(a): The following are typical fault clearing times of overcurrent protective devices:

(1) 0.5 cycle fault clearing time is typical for current limiting fuses when the fault current is within the current limiting range.

(2) 1.5 cycle fault clearing time is typical for molded case circuit breakers rated less than 1000 volts with an instantaneous integral trip.

(3) 3.0 cycle fault clearing time is typical for insulated case circuit breakers rated less than 1000 volts with an instantaneous integral trip or relay operated trip.

(4) 5.0 cycle fault clearing time is typical for relay operated circuit breakers rated 1 kV to 35 kV when the relay operates in the instantaneous range (i.e., "no intentional delay").

(5) 20 cycle fault clearing time is typical for low-voltage power and insulated case circuit breakers with a short time fault clearing delay for motor inrush.

(6) 30 cycle fault clearing time is typical for low-voltage power and insulated case circuit breakers with a short time fault clearing delay without instantaneous trip.

Informational Note No. 1: See Table 1 of IEEE 1584TM, *Guide for Performing Arc Flash Hazard Calculations*, for further information regarding Notes b through d.

Informational Note No. 2: An example of a standard that provides information for arc-resistant switchgear referred to in Table 130.7(C)(15)(a) is IEEE C37.20.7, *Guide for Testing Metal-Enclosed Switchgear Rated Up to 38 kV for Internal Arcing Faults.*

PERSONAL PROTECTIVE EQUIPMENT

Arc-Flash PPE Category	PPE
1	**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 leather gloves[d] Leather footwear
2	**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 leather gloves[d] Leather footwear
3	**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
4	**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

AN: As needed (optional). AR: As required. SR: Selection required.

[a]*Arc rating* is defined in Article 100.

[b]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.

[c]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.

[d]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.