1.0 BACKGROUND & PURPOSE

1.1 Electricity is a serious workplace hazard, capable of causing both personnel injury (shocks, electrocution, fires, and explosions) as well as serious property damage. Electricity is different from other forms of hazardous energy because it is both undetectable by human senses and potentially immediately fatal upon contact.

Because electricity is so prevalent, it requires a broad application of specialized equipment, construction methods, and safe work practices to prevent serious injuries or death. Providing personnel with proper training in safe electrical work practices will reduce the risk of such incidents.

1.2 The guidance in this document is not meant to supersede or replace regulatory requirements, nor is it intended to be all inclusive of the applicable regulatory requirements. The content is intended to be supportive and complimentary to such requirements.

All "Must" or "Shall" statements contained in this document reflect a regulatory requirement by OSHA or an enforced industry standard i.e., NFPA, NEC, CSA, ANSI, ASTM, IEEE, NIOSH, ICEA, NETA, and NEMA (full organization names located in the reference section of this document).

Other guidance in this document is based on industry best practice and consensus input from the membership.

2.0 SCOPE

2.1 The scope of this guideline is to provide information to aid in the development of a sound Electrical Safety Program that supports a workplace for personnel that is free from unacceptable risk associated with the presence and use of electricity. A key part of this information includes safe and consistent methods for identifying and mitigating hazards related to working with or around electricity.

This document contains definitions and components of an Electrical Safety Program as options for use but is not intended to be used in its current form as a finished Electrical Safety Program. This guidance does not address design activities, nor does it address all options available for the activities described.

The responsibility for an electrical safety program should be delegated to someone with a complete knowledge of electricity, safe electrical work practices, and the appropriate standards for installation and performance.

2.2 Understanding Electrical Hazards. Electrical accidents can be prevented by following OSHA safety instructions applicable to the workplace. These may include de-energizing equipment before inspection or repair, keeping electrical tools in good working condition with timely maintenance, exercising caution when working near electrical lines, and always using appropriate protective equipment. Personnel should receive appropriate training when working with electrical hazards. OSHA describes electrical safety-related work practice requirements in subpart S of 29 CFR part 1910.

Most electrical accidents result from one of three factors which are unsafe equipment or installation, unsafe environment, or unsafe work practices.

2.3 Electrical Shock. Electricity travels in closed circuits, normally through a conductor. Electrical "Shock" occurs when a person's body becomes part of the electric circuit. Shocks occur when a person's body completes the current path with:

- both wires of an electric circuit
- one wire of an energized circuit and the ground
- a metal part that accidentally becomes energized due to a break in its insulation
- another "conductor" that is carrying a current

When a person receives a shock, electricity flows between parts of the body or through the body to a ground or the earth. This can occur from physically contacting the energized conductor or through a phenomenon called "Arc Flash" where a flashover of electric current leaves its intended path and travels through the air from one conductor to another, or to ground.

Arc flash can be caused by many things including environmental factors like dust or condensation in the air, human error like accidental touching or dropping of tools, or from equipment issues resulting from material failure, corrosion, or faulty installation.

2.4 Electric Shock Hazards. Extra precautions may be necessary to achieve a safe working condition when working with or near certain equipment or components, including molded Case Circuit Breakers, power lines (overhead or down), energized metal parts, and equipment that could be started remotely.

It is important for all personnel to understand that electrical hazards may also be encountered by non-electrical workers, including welders, painters, warehouse workers, laborers, spotters, and heavy equipment operators.

The outcome of an electrical incident can produce an arc flash and/or cause the following outcomes:

- Burns (Non-FR clothing can burn onto skin)
- Fire (could spread rapidly through building)
- Flying objects (often molten metal)
- Blast pressure (upwards of 2,000 lbs. / sf)
- Sound Blast (noise can reach 140 dB – loud as a gun)
- Heat (upwards of 35,000 degrees F)

2.5 Effects of Electrical Current on the Human Body. Severe to fatal injuries can occur from electric shock exposure. These impacts can occur instantaneously. The effects of electric current on the human body depend on the following:

- Circuit characteristics (current, resistance, frequency, and voltage).
- Contact and internal resistance of the body.
- The current's pathway through the body, determined by contact location and internal body chemistry.

- Duration of contact.
- Environmental conditions affecting the body's contact resistance.

3.0 ACRONYMS AND DEFINITIONS

3.1 **Arc Flash Hazard.** A source of possible injury or damage to health associated with the release of energy caused by an electric arc.

3.2 **Arc Rating.** This value describes the performance of clothing or materials to exposure to an electrical arc discharge. The arc rating is expressed in cal/cm2 and is derived from the determined value of the arc thermal performance value (ATPV) or energy of breakopen threshold (EBT) (should a material system exhibit a breakopen response below the ATPV value). Arc rating is reported as either ATPV or EBT, whichever is the lower value.

3.3 **Barricade.** A physical obstruction such as tapes, cones, or A-frame-type wood or metal structures intended to provide a warning and to limit access.

3.4 **Barrier.** A physical obstruction that is intended to prevent contact with equipment or energized electrical conductors and circuit parts or to prevent unauthorized access to a work area.

3.5 **Boundary, Arc Flash.** 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).

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

3.7 **Boundary, Restricted Approach.** 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.

3.8 **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.

3.9 **Electrical Hazard.** A dangerous condition such that contact, or equipment failure can result in electric shock, arc flash burn, thermal burn, or arc blast injury.

3.10 **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.

3.11 **Energized, Hot, or Live Equipment.** Electrically connected to, or is, a source of voltage.

3.12 **Fault Current.** The amount of current delivered at a point on the system during a short-circuit condition.

3.13 **Ground Fault.** An unintentional, electrically conducting connection between an ungrounded conductor of an electrical circuit and the normally non–current-carrying conductors, metallic enclosures, metallic raceways, metallic equipment, or earth.

3.14 **Grounded (Grounding).** Connected (connecting) to ground or to a conductive body that extends the ground connection.

3.15 **Ground-Fault Circuit Interrupter (GFCI).** A device intended for the protection of personnel that functions to deenergize a circuit or portion thereof within an established period when a current to ground exceeds the values established for a Class A device.

3.16 **Incident Energy Analysis.** A component of an arc flash risk assessment used to predict the amount of thermal energy impressed on a surface, a certain distance from the source, generated during an electrical arc event for a specified set of conditions.

3.17 **Insulated Hand Tools.** Those covered with insulating material to protect the user from electric shock and to minimize the risk of short circuits between parts at different potentials.

3.18 **Qualified Person / Qualified Electrical Worker (QEW).** 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.

3.19 **Shall or Must.** Indicates a mandatory requirement.

3.20 **Step Potential.** A ground potential gradient difference that can cause current flow from foot to foot through the body.

3.21 **Stored Energy.** Stored energy means residual mechanical, thermal or electric energy possessed by a machine or equipment after powering and controlling energy source(s) have been isolated.

3.22 **Touch Potential.** A ground potential gradient difference that can cause current flow from hand to hand, hand to foot, or another path, other than foot to foot, through the body.

3.23 **Unqualified Person.** A person who is not qualified, or who has little or no training

3.24 **Working Distance.** The distance between a person's face and chest and a prospective arc source.

4.0 ROLES AND RESPONSIBILITIES

4.1 **Management Responsibilities** (Includes all personnel with a supervisory role)

4.1.1 Show commitment to the Electrical Safety process by leading the development and sharing of the hazard assessments, JSA's and any other applicable tool, including actions to confirm that:

- The scope of work is reviewed thoroughly
- All hazards are identified and analyzed
- The hazards are mitigated or eliminated
- Hazard and control information are shared with all affected personnel and all who will be on the specific site
- All who review the hazard assessments, JSA's and other documents supporting the scope of work, have a means to give feedback

4.1.2 Empower applicable (or authorized) personnel with the ability to mitigate or make recommendations on appropriate control measures for site-specific potential hazards.

4.1.3 Assess and evaluate that applicable on-site personnel have reviewed and understand the electrical safety procedure and all other applicable guidance.

4.1.4 Review the hazard assessment, SSSP, JSA's, and all other applicable supporting documents to ensure that all electrical hazards are identified, communicated, and addressed per the approved processes.

4.1.5 Conduct appropriate reviews and revisions to the hazard assessment, SSSP, JSA's, and all other applicable supporting documents and communicate changes to pertinent field personnel as applicable.

4.1.6 Perform objective assessments on the quality of preparation and communication of all Electrical Safety guidance.

4.1.7 Provide recommendations and support to continuously improve their effectiveness (where applicable).

4.2 Health and Safety Personnel Responsibilities

4.2.1 Assist with developing the hazard assessment, SSSP, JSA's, and all other applicable supporting documents, including but not limited to providing technical support.

4.2.2 Perform periodical audits of the hazard assessment, SSSP, JSA's, and all other applicable supporting documents to ensure proper application of Electrical Safety processes.

4.2.3 Review mitigations to identified electrical hazards.

4.2.4 Assist Management/Supervisors in the development/enforcement of Safe Work Practices (SWPs), Training Programs, and compliance with applicable regulation.

4.3 Employee Responsibilities

4.3.1 Be Fit for Duty when performing any role.

4.3.2 Review the SSSP and JSA prior to entering a site / project (where applicable).

4.3.3 Abide by all guidance in the SSSP and JSA applicable to the work scope / site.

4.3.4 Participate in the development and communication of SSSP’s and JSA's, as applicable to assigned tasks and job responsibilities.

4.3.5 Immediately notify supervisor of any unsafe conditions or acts that may be of danger to workers or others.

4.3.6 Review SSSP’s and JSA's when conditions change (e.g., weather, scope of the task, nearby activity), and make appropriate changes to potential hazards and/or control measures.

5.0 ELECTRICAL SAFETY PROGRAM ELEMENTS

5.1 The four major elements required by the NFPA 70E standard are:

- Electrical Safety Program Principles
- Electrical Safety Program Controls
- Hazard/Risk Assessment Procedures
- Electrical Safety Program Procedures

The general principles and controls usually go hand in hand. To adhere to a principle, a control must be in place. NFPA's perspective on procedures is to develop these for the task to be performed. The principles, controls and procedures are all supported by a hazard analysis. The procedures relative to working with electrical and high voltage equipment include the use of insulation, grounding, guarding, electrical protective devices and following safe work practices.

5.2 Electrical Safety Program Principles

NFPA 70E Article 100 Definitions and CSA Z462 Clause 3 Definitions define an electrical safety program as:

“A documented system consisting of electrical safety principles, policies, procedures, and processes that direct activities appropriate for the risk associated with electrical hazards. In this context, a principle is a fundamental truth or proposition that serves as the foundation for a system or belief or behavior or for a chain of reasoning. In simple terms, the electrical safety program’s principles are the key requirements that form the basis of the electrical safety program as a system.”

5.2.1 **Planning and Procedure Use.** All energized electrical work shall be planned and follow a procedure. If an electrical safe work procedure is required for the job and work task(s), it shall be documented and filed for record purposes and future use.

5.2.2 **Risk Assessment** Procedure**.** For a job assigned to a qualified electrical worker, a risk assessment procedure shall be applied and documented to justified energized electrical work tasks to assess the potential severity of injury or damage to health and estimate the likelihood of occurrence. The hierarchy of risk control methods shall be applied to achieve a residual risk level that is as low as reasonably practicable (ALARP).

5.2.3 **Arc Flash and Shock Risk Assessments.** Before a qualified electrical worker works on energized electrical conductors or circuit parts and as a component of the job’s overall risk assessment procedure, both shock and arc flash risk assessments shall be completed and documented to determine additional protective measures that must be applied to reduce risk. This includes work practices, approach boundaries, and the electrical specific PPE, tools, and equipment required when the electrical hazards are real, and the qualified electrical worker is inside the approach boundaries.

5.2.4 **Operating Is Not Maintenance.** Operating energized electrical equipment for its intended use is NOT maintenance and, under normal operating conditions, doesn't require arc flash or shock protective PPE. A risk assessment procedure and process shall be used to validate normal operating conditions inclusive of manufacturer's requirements.

5.2.5 **Electrical Equipment Maintenance.** Electrical equipment shall be maintained in good working order and electrical protective equipment (e.g., circuit FEATURE breakers, relays, etc.) shall be tested on a determined frequency to ensure it will perform as expected and designed. An employer shall document and implement a comprehensive electrical equipment maintenance program.

5.2.6 **Mitigation, Substitution, and Prevention through Design (PtD).** Arc flash and shock mitigation for existing electrical equipment shall be considered and incorporated into new facilities or upgrades. Where arc flash hazard incident energy analysis studies have been completed, technically and cost-feasible incident energy reduction design changes shall be considered.

5.2.7 **Elimination.** As outlined in NFPA 70E Article 110.1(H)(3) and CSA Z462 Clause 4.1.6.8.4, elimination is the highest priority and most effective risk control method related to arc flash and shock hazards. Electrical work shall be performed on de-energized electrical conductors or circuit parts by establishing an electrically safe work condition unless de-energizing introduces additional hazards or increased risk or is infeasible due to equipment design or operational limitations or the voltage is less than 30V for Canada or 50V in the USA.

5.2.8 **Electrical Safety and Technical Skills Training.** Personnel shall receive appropriate workplace electrical safety training and technical skills training depending on their role. First aid and CPR training are required based on employer requirements.

5.2.9 **Qualified and Competent Workers.** Workers shall be qualified, competent, and authorized for the energized electrical work task(s) they undertake, including the ability to identify the electrical hazards related to the work task(s) assigned to them.

5.2.10 **Job Safety** Planning**.** Prior to beginning the work task(s), a job safety plan shall be documented by the qualified electrical worker. The plan will include a description of the work task(s); identification and analysis of the electrical hazards that apply to the work task(s); documentation of each work task's arc flash and shock risk assessments; and identification of appropriate work procedures, special precautions, and energy source controls.

5.2.11 **Job Briefing.** A job briefing for specific jobs and related energized electrical work tasks where multiple qualified electrical workers are involved shall be completed before the work task(s) are executed. The job safety plan and any additional requirements of the employer's Safety Management System (SMS) shall be reviewed.

5.2.12 **Electrical Specific PPE, Tools, and Equipment.** Appropriate electrical specific PPE, tools, and equipment designed to safely meet the task requirement shall be selected for a work task. It shall be readily available and properly cared for, maintained, and used. It shall be inspected prior to use. Resources shall be provided for maintaining and upgrading electrical specific PPE, tools, and equipment.

5.2.13 **Energized Electrical Work Permit (EEWP).** Energized electrical work task(s) may require the use of an energized electrical work permit (EEWP). In most cases, routine work tasks such as operating energized electrical equipment in a normal operating condition, voltage and current measurements, inspection, general housekeeping around electrical equipment, and reading meters or using HMI displays DO NOT require an EEWP. Other work tasks may also be exempted due to infeasibility due to equipment design or operational limitations such as:

- Racking power circuit breakers in or out
- Installing or removing temporary protective grounds
- Removing bolts on covers
- Justified repair or alteration work tasks shall require an EEWP to be executed and issued.

5.2.14 **Electrical Work Zone.** An electrical work zone shall be established for energized electrical work tasks with red danger tape and tagged or otherwise barricaded at the arc flash boundary or limited approach boundary, whichever is farther away or at the doors into electrical rooms. Establishing an electrical work zone ensures that unqualified/ unprotected workers are not exposed to arc flash and shock hazards and eliminates interruption of the execution of the work task by others, which could increase the likelihood of occurrence.

5.2.15 **Overhead Power Lines.** HV Substations and Buried Power Cables. Work on high-voltage overhead power lines and other high-voltage outdoor substation electrical equipment with exposed conductors or circuit parts requires regulated limits of approach or minimum approach distances, and additional industry-accepted practices to be followed. When entering an outdoor, fenced-in, high-voltage substation, authorization-to-access policies and procedures shall be followed. Call 811 prior to conducting any digging or excavating.

5.2.16 **Test-Before-Touch.** All electrical conductors and circuit parts shall be considered energized (i.e., voltage present) until proven otherwise by testing for absence of voltage with an approved test instrument. Where required, temporary protective grounds shall be installed. Testing for absence of voltage is energized electrical work, and the process for establishing and verifying an electrically safe work condition shall be followed.

5.2.17 **Safe Installations.** Electrical equipment shall be installed and maintained to the minimum requirements of the jurisdiction having authority. The electrical equipment shall be approved or listed, or equivalently approved or listed by the jurisdiction having authority.

5.2.18 **Portable Cord-and-Plug Connected Electrical Equipment.** Portable cord-and-plug-connected electrical equipment and cord sets shall be approved for the usage and shall be visually inspected before use. Where required, a GFCI shall be used. When a GFCI is used, it shall be inspected and tested before use by pushing the Test and Reset buttons to confirm proper function.

5.2.19 **Electrical Emergency Response.** Emergency response requirements for electrical incidents and methods of release related to shock shall be reviewed with affected personnel and contractors and training provided.

5.2.20 **Electrical Incidents and Near Misses.** Electrical incidents or near misses shall be reported by workers to their supervisors and fully investigated in compliance with the employer's incident management system. Root cause(s) shall be determined, and corrective actions implemented. A continuous improvement model shall be followed.

5.2.21 **Management of Change.** Management of change is required to ensure that changes to the power distribution system, electrical equipment, electrical protective devices, single line drawings, and the electrical safety program that can affect worker exposure to electrical hazards is controlled and approved.

5.2.22 **Assessment of Program.** The principles and the electrical safety program shall be periodically assessed. A continuous improvement model shall be followed. Measure performance and ensure sustainability. The PLAN-DO-CHECK-ACT methodology provides a good approach to this element.

5.3 Electrical Safety Program Controls

5.3.1 **Hierarchy of Risk Control Methods.** To prevent and mitigate hazards, controls must be tailored to the work being performed, the risk of harm posed by the work, and the extent or degree of harm that could occur while performing the work. This tailoring of controls to hazards based upon risk is generally referred to as the "graded approach." The priority must be the elimination of the hazard; each method that follows it is considered less effective than the one before it. The preferred hierarchy of controls is:

(1) Elimination or substitution of the hazards. Elimination is accomplished by disconnecting the electrical equipment from all possible sources of energy and releasing any stored electrical or mechanical energy.

Personnel should confirm the equipment is deenergized by properly interrupting the load, visually verifying the disconnection of the circuit, and using appropriate testing equipment to ensure de-energization.

(2) Engineering controls. When hazards cannot be eliminated, an effort should be made to substitute them for lesser ones. For example, in the design of equipment or apparatus, permanent guarding, enclosing, or insulation of hazardous voltage sources present to prevent unnecessary exposure to the worker. Specific practices include:

- All electrical distribution panels, breakers, disconnects, switches and junction boxes must be completely enclosed;

- Water-tight enclosures must be used if any of these components could possibly be exposed to moisture;
- Structural barriers must be used to prevent accidental damage to electrical components;
- Physical barriers must be used to prevent unauthorized persons from entering areas where new installation or repair of electrical components or equipment is being performed;
- Conduits must be supported for their entire length, and non-electrical attachments to conduits are prohibited;
- Non-rigid electrical cords must have strain relief wherever necessary.
- Electrical-rated matting will be placed in front of all electricity-distribution panels.

(3) Administrative controls. These measures include implementation of an Electrically Safe Work Condition (Lockout/Tagout), restricted access to qualified electrical workers, and documented safe work plans/practices are examples of administrative controls.

These types of controls are normally used in conjunction with other controls that more directly prevent or control exposure to the hazard. Other examples include:

- Only trained, authorized personnel may repair or service electrical equipment
- Contractors must be licensed to perform electrical work
- Only authorized personnel may enter electrical distribution rooms
- All electrical control devices must be labeled properly
- Appropriate management must authorize any work on energized electrical circuits
- Use only tools that are properly insulated

(4) Personal protective equipment (PPE). When exposure to hazards cannot be engineered completely out of normal operations or maintenance work, and when safe work practices and other forms of administrative controls cannot provide sufficient additional protection, a supplementary method of control is the use of protective clothing or equipment. PPE may also be appropriate for controlling hazards while engineering and work practice controls are being installed. Working on energized equipment while protected with PPE is a last resort.

5.4 Electrical Safety Program Procedures

Many procedures support an Electrical Safety Program (i.e., Control of Work, Ladder Safety, JSA, Risk Assessment, etc.), but certain procedures are written specifically for working with electrical and high voltage equipment that define the use of insulation, grounding, guarding, electrical protective devices and following safe electrical work practices.

5.4.1 **Insulation.** Insulators such as glass, mica, rubber, or plastic used to coat metals and other conductors help stop or reduce the flow of electrical current. This helps prevent shock, fires, and short circuits. To be effective, the insulation must be suitable for the voltage used and conditions such as temperature and other environmental factors like moisture, oil, gasoline, corrosive fumes, or other substances that could cause the insulator to fail.

Before connecting electrical equipment to a power source, check the insulation for any exposed wires for possible defects. Insulation covering flexible cords such as extension cords is particularly vulnerable to damage.

5.4.2 **Grounding.** Grounding has a key role in the correct operation of the electrical systems, as well as protecting people. "Grounding" a tool or electrical system means intentionally creating a low-resistance path that connects to the earth. This prevents the buildup of voltages that could cause an electrical accident.

Grounding is normally a secondary protective measure to protect against electric shock. It does not guarantee that you won't get a shock or be injured or killed by an electrical current. It will, however, substantially reduce the risk, especially when used in combination with other safety measures discussed in this guideline.

29 CFR, Part 1910.304, Subpart S, Wiring Design and Protection, requires at times a service or system ground and an equipment ground in non-construction applications. A service or system ground is designed primarily to protect machines, tools, and insulation against damage. One wire, called the "neutral" or "grounded" conductor, is grounded. In an ordinary low-voltage circuit, the white or gray wire is grounded at the generator or transformer and at the building's service entrance.

5.4.3 **Equipment and Safety Grounding.** An equipment ground helps protect the equipment operator. It furnishes a second path for the current to pass through from the tool or machine to the ground. This additional ground safeguards the operator if a malfunction causes the tool's metal frame to become energized. The resulting flow of current may activate the circuit protection devices.

Equipment grounding connects all non-current-carrying metal parts of the wiring system or apparatus to the ground. Examples include the cabinet of the service equipment, the frames of transformers and motors, the metal conduit and boxes, the metal shield of shielded cables, poles, towers, and more.

Equipment grounding limits voltage between non-current-carrying parts and between these parts and earth to a safe value, boosting protection. It also enables fast fault clearing.

5.4.4 Grounding benefits to support in a grounding procedure:

- System grounding helps detect and clear ground faults.
- Equipment grounding provides a return path for ground-fault current.
- Bonding keeps electrical continuity and conductivity.
- Static grounding prevents the build-up of static electricity reducing the chance of fires or explosions where hazardous materials are handled.

- Lightning protection grounding helps protect structures and equipment from direct strikes.
- Overhead ground wires and surge arresters, connected to ground, can limit dangerous system overvoltage to safe values.

5.4.5 Additional grounding considerations that should be addressed in a procedure:

- The system voltage
- Which circuits need grounding and at what voltage.
- The actual location of the ground itself (with consideration to worker location)
- How to physically connect and disconnect
- Type of grounding equipment (cable sizing to carry load)
- Care and use of handheld ground sticks (hot sticks)
- Order of connection or removal of grounds

5.4.6 **Guarding.** Guarding involves locating or enclosing electric equipment to make sure people don't accidentally come into contact with its live parts. Effective guarding requires equipment with exposed parts operating at 50 volts or more to be placed where it is accessible only to authorized people qualified to work with it. Recommended locations are a room, vault, or similar enclosure; a balcony, gallery, or elevated platform; or a site elevated 8 feet (2.44 meters) or more above the floor. Sturdy, permanent screens also can serve as effective guards.

5.4.6.1 **Barricades and Warnings.** Following the requirements set forth in NFPA-70E, all boundaries are to be marked and visible to anyone approaching the work area from any direction. Conspicuous signs must be posted at the entrances to electrical rooms and similarly guarded locations to alert people to the electrical hazard and to forbid entry to unauthorized people. Signs may contain the word "Danger," "Warning," or "Caution," and beneath that, appropriate concise wording that alerts people to the hazard or gives an instruction, such as "Danger/High Voltage/Keep Out."

5.4.6.2 **Equipment Labeling.** Arc flash labeling is the responsibility of the Company, not the manufacturer or installer of the equipment. Examples of typical electrical equipment that must be field marked with a warning label include (but not limited to) electrical switch gear, distribution panel boards, industrial control panels, and motor control centers.

Labeling is required for any piece of electrical equipment that is likely to require examination, adjustment, service, or maintenance while energized, creating the potential for an arc flash incident to occur. All equipment should be labelled with its unique assigned number (IFC) drawings and with voltages, number of feeds, etc.

5.4.7 **Safe Electrical Work Practices.** Electrical accidents are largely preventable through safe work practices. Examples of these practices include (but not limited to) the following:

- Applying methods in the safe work principles
- Applying controls (i.e., insulation, grounding, guarding, electrical protective devices)
- Performing hazard / risk assessments
- Educating the workforce including those in the adjacent areas
- Mitigating or eliminating hazards where possible

6.0 HAZARD ASSESSMENT

6.1 **Hazard/Risk Assessment.** Every electrical job requires an appropriate level of electrical hazard analysis, work planning, authorization and direct field supervision that is commensurate with the risk level of the job. The Hazard/Risk Assessment Procedure focuses on working on or near energized lines/parts/equipment. The goal is to protect personnel from shock, burn, blast and other hazards due to the working environment. Both a shock hazard analysis and arc flash analysis must be part of the evaluation.

The risk assessment procedure shall address employee exposure to electrical hazards and shall identify the process to be used by the employee before work is started to carry out the following:

- Identify hazards
- Assess risks
- Implement risk control according to the hierarchy of risk control methods

The risk assessment procedure shall require that identified hazards be mitigated using preventive and protective risk control methods in accordance with the "Hierarchy of Controls" model described in this guideline (See section 6.2).

6.1.1 **Electrical Hazard / Risk Assessment Procedure.** The intent of this procedure is to perform a risk assessment, which includes a review of the electrical hazards, the associated foreseeable tasks, and the protective measures that are required to maintain an acceptable level of risk. A risk assessment should be performed before work is started. Depending on the scope of work and equipment involved, an Arc Flash Analysis may also be necessary.

The main steps that a Hazard / Risk Assessment procedure includes are:

1. Identify the electrical hazards associated with the task and the electrical system, or electrical process involved (example: shock hazard risk; arc flash hazard risk).
2. Identify the electrical work to be performed within the electrical system or process.
3. Define the possible failure modes that result in exposure to electrical hazards and the potential resultant harm.
4. Assess the severity of the potential injury from the electrical hazards.
5. Determine the likelihood of the occurrence for each hazard.
6. Define the level of risk for the associated hazard.

7. If the risk level is unacceptable, identify the additional measures or corrective actions to be taken. (Example: Wear appropriate PPE and if the risk too great, do not perform the task).

6.1.2 **Arc Flash Hazard (Incident Energy) Analysis.** If the risk assessment indicates the need for an Arc Flash analysis, then the following items should be included in the study:

- The design of the electrical equipment and protection system
- The electrical equipment maintenance & operating condition
- Potential for human error and its negative consequences
- Available incident energy at the working distance in cal/cm2
- Requirement and responsibility of a backup/standby person
- Required PPE rating
- Arc flash boundary
- Limited Approach Boundary
- Restricted Approach Boundary
- Means to restrict access of unauthorized persons

6.1.3 **Electrical Distribution System.** Define the major components of the electrical system and any relative conditions or restrictions including access restrictions (boundaries), identified hazards, signage requirements and housekeeping (storage limitations and clear passage needs).

6.1.4 **Human Error.** Human error is a big factor when employees disregard safety procedures or fail to notice poor equipment condition or even if they take their eyes of the task at hand to make a phone call or send a text. The hazard / risk assessment procedure must address human error and its negative consequences on people, processes, work environments, and equipment.

6.1.5 **Documentation.** Once a hazard is identified (i.e., exposed electrical parts) the employer:

"Shall verify that the required workplace hazard assessment has been performed through a written certification that identifies" [see OSHA 1910.132(d)(1)]:

- the workplace evaluated;
- the person certifying that the evaluation has been performed;
- the date(s) of the hazard assessment; and
- identifies the document as a certification of hazard assessment.

7.0 PPE AND OTHER PROTECTIVE EQUIPMENT

7.1 Personal Protective Equipment (PPE). PPE is an integral part of any employer's safety program. OSHA has determined that PPE although a good way to protect personnel, should be used as a last line of defense and it is important to understand the limitations of PPE in the workplace.

Prior to using PPE, the employer must determine if other means of protection are available. OSHA uses the following sequence for personnel protection:

- Engineering Controls (deals with equipment)
- Administrative Controls (deals with people or processes)
- Personal Protective Controls (deals with what you wear)

How to Determine What PPE Must be Worn. There does not exist a "one size fits all" requirement for the type of PPE that must be worn when working with electrical hazards. Different levels of hazards require different level of personal protection.

To compensate for these variables, OSHA requires that "the employer shall assess the workplace to determine if hazards are present, or are likely to be present, which necessitate the use of personal protective equipment" [see OSHA 1910.132(d)(1)]. Arc Flash potential requires additional analysis to understand the energy potential so that the appropriate level of PPE is used.

7.2 Required PPE for Electrical Work. For those personnel working in areas where there are potential electrical hazards, they must be provided with (and must use) electrical protective equipment that is appropriate for the specific parts of the body to be protected and for the work to be performed. [see 1910.335(a)(1)(i)].

7.2.1 **PPE for the Head.** Personnel must wear nonconductive head protection wherever there is a danger of head injury from electric shock or burns due to contact with exposed energized parts [see 1910.335(a)(1)(iv)].

7.2.2 **PPE for Eyes and Face.** Personnel shall wear protective equipment for the eyes or face wherever there is danger of injury to the eyes or face from electric arcs or flashes or from flying objects resulting from electrical explosion. [see 1910.335(a)(1)(v)].

7.2.3 **PPE for the Body - Arc-Rated Clothing.** Personnel working in areas where there are potential electrical hazards must be provided with, and must use, electrical protective equipment that is appropriate for the specific parts of the body to be protected and for the work to be performed [see 1910.335(a)(1)(i)]. This would include flame resistant (FR) clothing. Selection of Arc-Rated Clothing should use the Incident Energy Analysis Method.

7.2.4 **Hand Protection from Electric Shock Hazards**. Insulating gloves provide an excellent means of protecting the workers from accidental electrical contact. The employer and personnel must become familiar with the differences between the various types and classes of insulating gloves available.

7.3 Maintenance of PPE. OSHA has identified design and in-service care and use standards for electrical protective equipment. Protective equipment must be maintained in a safe, reliable condition and shall be periodically inspected or tested, as required by 1910.137 [see 1910.335(a)(1)(ii)]. Visually inspect personal safety and protective equipment before initial use and at intervals not to exceed one (1) year and test personal safety and protective equipment before initial use and at intervals not to exceed three (3) years.

- Test Instruments and Safety Equipment
- Approved Electrical/Electronic Devices
- Interlock and other Safety Devices
- Voltage Categories
- Insulated Tools

8.0 HAZARD MITIGATION

8.1 General Procedures

8.1.1 **Job Briefing and Planning Checklist (per NFPA 70E) (Job Safety Assessment - JSA).** NFPA 70E requires "Job Briefings" before each task. Briefings must describe to the personnel the hazards, procedures, controls, and personal protective equipment needed. Generally, the briefings are a short review. However, when the task is complex or extremely hazardous, the program should call for a thorough discussion of the job and the practices to be used. An extensive briefing should also be performed when the hazards may not be apparent to the personnel.

The NFPA 70E standard provides a checklist of what to cover in a job briefing.

The job briefing should be documented on a JSA form, and all areas should be discussed and documented - potential problem areas, mitigation strategies, PPE, and boundaries that need to be identified and marked. Also document who is and is not permitted in those work areas, what to do if you leave the work area to prevent unauthorized persons from entering that work area.

8.1.2 **Abnormal Conditions.** This should be detailed out in the JSA for the work, and it should have a well-documented mitigation strategy and plan for any potential abnormal condition.

8.1.3 **Defeating Safety Devices.** Workers must not defeat a safety device. Understanding what is included in this area may require specific training.

8.1.4 **Proper body positioning.** Positioning must be an integral part of both everyday work habits and detailed work planning. This principle is embedded in the shock protection and arc flash protection boundaries but must also be emphasized in everything from routine switching activities to setting up barriers and barricades.

8.1.5 **Emergency Preparedness.** Establish an Emergency Action Plan to include potential electrical incidents. A good comprehensive plan should factor in the following:

- Is the standby person CPR trained? Is the required emergency equipment available?

- Where is the nearest telephone? Are the emergency phone numbers known?
- Are there alternatives if telephone is down? Are radio communications available?
- What is the exact work location? Is site readily accessible by EMS? When to call for helicopter?
- How is the equipment shut off in an emergency? Is confined space rescue needed / available?
- Where is the fire alarm? Where is the fire extinguisher?

8.1.6 **Emergency Response**. During emergencies, hazards appear that normally are not found in the workplace. These may be the result of natural causes (floods, tornadoes, etc.), events caused by humans but beyond control (train or plane accidents, terrorist activities, etc.), or within a facility's own systems due to unforeseen circumstances or events.

You must become aware of possible emergencies and plan the best way to control or prevent the hazards they present. Some of the steps in emergency planning include:

- Survey of possible emergencies;
- Planning actions to reduce impact on the workplace;
- Personnel information, training, and drills as needed

8.1.7 **Incident Management (include reporting and investigation).** All incidents are to be recorded. Immediately following an incident, work is to halt, and the site is to be preserved. If injury occurred, take care of the injured first and notify 911. Restrict access to the area and make sure nothing is disturbed. Take photos of the area, talk to witnesses and coworkers who might have witnessed the incident. Notify all affected parties as outlined in company incident reporting and investigation procedures.

8.1.8 **Electrical Power Tools.** Procedures that require the use of electrical power tools include, but are not limited to, the following:

- Damaged or defective tools should be tagged out of service inaccessible to workers (i.e., securely held until repaired or removed from the job site).
- 29 CFR 1926.404(f)(7)(iv) states that electric power tools must be grounded except when they are double insulated.

8.1.9 **Power cords.** The condition of power cords can increase the risk of electric shock. Worn or modified cords can expose the wires within or loosen the connections on the plug end. Extension cords that are not 3-wire type, not designed for hard-usage, or that have been modified are not as durable. The following practices should be used at a minimum:

- Use equipment that is approved by a nationally recognized testing laboratory.
- Do not modify cords or use them incorrectly.
- Use factory-assembled cord sets and extension cords that are 3-wire type.
- Use cords, connection devices, and fittings equipped with strain relief.

- Remove cords from receptacles by pulling on the plugs, not the cords.

8.1.10 **Working in Wet Conditions.** Certain OSHA standards specific to electrical safety, including 1910.303(b)(6) and 1926.432(a)(1), focus on the necessary requirements for installation and on the suitability of equipment for an identified purpose. Part of the standard language details: "Unless identified for use in the operating environment, no conductors or equipment shall be located in damp or wet locations…"

8.1.11 **Watertight Wiring Devices.** Watertight devices include plugs, connectors, inlets, outlets, and FD boxes which commonly feature:

- IEC IP66/IP67 and NEMA 4, 4X, 6, 6P, 12 ratings
- UV stabilized elastomer parts that resist water and most acids, grease, and oil
- Nickel-coated brass blades, contacts, wiring screws and wiring clamps for corrosion-resistance
- Strain relief systems that provide watertight seals and prevent cord slippage
- Heavy-duty contacts for maximum conductivity

8.2 Control of Work

8.2.1 **Lock Out - Tag Out.** Ensure ALL affected parties are aware of, and fully understand, the LOTO process and procedure for the project or site. This should be discussed in detail during the LOTO planning, and ALL parties should participate in the planning meeting. Key details from OSHA include:

- Because a deenergized circuit can easily be energized while personnel are working on it, the circuits energizing the parts shall be locked out or tagged or both [see 1910.333(b)(2)].
- Electric equipment that has been deenergized but has not been locked out or tagged shall be treated as energized parts [see 1910.333(b)(1)].
- The employer must develop and maintain a written copy of the lockout / tagout procedures and make it available to personnel. [see 1910.333(b)(2)(i)].
- Once lockout / tagout has been applied to the circuit, a qualified person must verify that the equipment cannot be restarted.

8.2.2 **Permits and Energized Electrical Work Certificate.** If permits or certificates are issued for hot work, then it should detail the work that is to be completed and a timeline for completion. Someone should be monitoring the work and be prepared to notify emergency services if needed. ALL permits MUST be posted and visible in the work area(s).

If live parts are not placed in an electrically safe work condition (i.e., for the reasons of increased or additional hazards or infeasibility per NFPA-70E), work to be performed shall be considered energized electrical work and shall be permitted by written permit.

Some combinations of switching, testing and LOTO can involve significant procedural complexity. In these cases, written work plans are developed, reviewed, and approved by knowledgeable parties in advance and executed with formal procedural compliance.

Conditions to consider when use of an Energized Electrical Work Permit may be viable:

- When de-energizing the circuit will introduce additional hazards or increased risk
- When de-energizing is infeasible due to equipment design or operational limitations
- When work is performed within the restricted approach boundary
- There is a likelihood of injury from a shock and/or arc flash hazard
- Energized work on 50 volts or above
- Work in the proximity of energized conductor with risk of inadvertent contact is considered energized work (which can also require adequate lighting and a physical barrier)

8.3 Electrical Safety Program Procedures

The Electrical Safety Program Procedures element refers to task procedures. The sample provided by NFPA offers the following: identify the purpose of the task and the qualifications of and number of personnel needed to perform the task. The hazards and scope of the task should be described. Sketches, electrical diagrams, equipment specifications, etc., should be used to explain the task and the safe work practices to be used. Be sure to include approach distances, personal protective equipment needed and insulating materials and tools to be used. These procedures will include support of best practices including insulation, grounding, guarding, electrical protective devices and following safe work practices.

8.3.1 **Energized Electrical Work.** OSHA regulations state that live parts should be de-energized before any personnel works on them. However, if the employer can prove that doing so would increase or add additional hazards—or it simply isn't feasible to de-energize—this regulation can be nullified. If the personnel must work "hot", the employer shall develop and enforce safety-related work practices to prevent electric shock or other injuries resulting from either direct or indirect electrical contacts. Personnel shall not take on tasks where the risks are not known and understood clearly. Everyone has the right to stop work until the risk has been isolated and/or mitigated to acceptable risk level.

The specific safety-related work practices shall be consistent with the nature and extent of the associated electrical hazards. [see 1910.333(a)] These safety related work practices may include (but not limited to) use of Energized Electrical Work Permit; PPE; Insulated Tools; Written Safety Program; and Ladder Safety".

8.3.2 **Establishing and verifying an electrically safe work condition.** If the system is put into a safe work condition, the affected personnel must check and verify the condition is safe. Therefore, the equipment they are using must be rated for the work they are performing.

8.3.3 **Voltage Back Feed.** This is always a potential that should be looked for prior to attempting the work at hand. If molded case circuit breakers are involved, always make sure if they are tripped, they are reset and placed in the off position and locked out. Tripped breakers sometimes have contacts that do not fully open on the trip, causing some energization.

8.3.4 **Stored Energy Electrical/Non-Electrical.** Stored electric energy including capacitors and cable runs must be discharged and grounded. Stored non-electrical energy in devices (springs in circuit breakers, etc.), shall be blocked or released to the extent that the isolated equipment could not be accidentally re-energized.

8.3.5 **Work near Underground Energized Power.** Buried power lines are especially hazardous because they are not always marked sufficiently. Fatal electrocution is the main risk but burns and falls are also hazards. The following practices should be used at a minimum:

- Call for a locate before you dig.
- Look for buried power line indicators.
- Assume lines are live until verified otherwise.

8.3.6 **Work near Exposed Uninsulated Energized Overhead Power.** Overhead power lines are especially hazardous because they carry dangerously high voltage. Fatal electrocution is the main risk but burns and falls are also hazards. The following practices should be used at a minimum:

- Look for overhead power lines and mark appropriately with an approved method.
- Use non-conductive wood or fiberglass ladders when working near power lines.
- Treat all down power lines as if they are energized.
- Review INGAA Foundation construction safety & quality guideline CS-S-8 - Overhead Utilities Safety.

8.3.7 **Approach Distances for Qualified/Unqualified Persons.** When defining approach distances, the following practices should be used at a minimum:

- Confirm the volage of the lines.
- Calculate the actual boundary limits using an industry accepted process.
- Stay at least 10’ away from overhead power lines and always assume they are energized.

8.3.8 **Vehicular and Mechanical Equipment.** Any vehicle or elevated mechanical equipment capable of having parts of its structure elevated near energized 138Kv overhead lines shall be operated so that a clearance of 20 ft. is maintained. Also refer to Aerial Work Platform and other Elevated Work Surfaces Procedures.

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

8.3.10 **Adjustable Circuit Breakers.** Adjustable circuit breakers have setting adjustments that can be used to define how the device responds to short circuit currents. Changing the device settings should only be done by a QEW with the proper expertise and all necessary data to make the adjustments based on the actual workplace setting.

8.3.11 **Testing of Circuits and Electrical Equipment.** All circuits and equipment to be worked on, shall have both the voltage and current tested by equipment rated for the voltages and currents it will be testing. Calibration certifications should be provided to ensure the equipment is well with-in the manufacturer's calibration guidelines.

Inspect all electrical equipment for hazards that could cause personnel injury or death. Some forms of diagnostics require the equipment to be energized while circuit parts are exposed. Only Qualified Electrical Workers (QEW) with the proper PPE may perform diagnostics. Consider the following factors when determining the safety of the equipment:

- Suitability for the intended use;
- Proper insulation;
- Heating effects under conditions of use;
- Arcing effects;
- Classification by type, size, voltage, current capacity and intended use.

Other testing to consider based on scope and hazards:

- Voltage Testing
- Current Testing
- Megger or Insulation Resistance Testing
- High-Potential (HiPot) Testing
- Phase Sequence Testing (Phasing Tests) of Two Power Source

8.3.12 **Equipment Inspection Tools**. Only electrical test tools and instruments that provide adequate safety protection shall be used in performing electrical testing. Tools and instruments must be certified by independent testing laboratories such as UL in the United States and CSA in Canada. Personnel shall be familiar with the test instruments that they are using and qualified for electrical work. Each instrument shall have an appropriate manual specifically for the test instrument in use.

8.3.13 **Tool Insulation.** When personnel are working near exposed energized parts, they must use tools that are insulated to at least the level of the voltage levels they are exposed to. These tools must be inspected prior to each use for damage and if damage is identified they must be removed from service.

- Live-Line Tools
- Protective Shields – Insulating Blankets

- Insulating Rubber Mats
- Equipment Labeling

8.4 De-Energizing and Re-Energizing Electrical Circuits

8.4.1 **During Routine Work.** Safe procedures for de-energizing electrical circuits and equipment must be determined by a Qualified Electrical Worker (QEW) before the circuit or equipment is de-energized.

8.4.2 **Control of Work.** Circuits and equipment to be worked on will be disconnected by the worker from all electric energy sources. Control circuit devices, such as push buttons, selector switches, and interlocks will not be used as the sole means for de-energizing circuits or equipment. Interlocks for electric equipment may not be used as a substitute for lockout and tagging procedures.

A lock and tag must be placed on each disconnecting means used to de-energize circuits and equipment on which work is to be done. The lock must be attached to prevent persons from re-energizing the circuit unless they resort to undue force or the use of tools.

8.4.3 **Stored Energy.** Stored electrical energy that may endanger personnel must be released prior to the work. This might include, for example, discharging capacitors, and short-circuiting and grounding high capacitance elements. If the capacitors or associated equipment are handled during this work, they must be treated as energized.

Stored non-electrical energy (for example, hydraulic or pneumatic) in devices that could re-energize electric circuit parts must be blocked or relieved so that circuit parts cannot be accidentally re-energized by the device.

8.4.4 **De-Energizing or Guarding.** Where possible, de-energize and ground lines when working near them. Guard lines when de-energizing is not an option.

8.4.5 **Verification** of **De-energized Condition.** The following requirements must be met before any circuit or equipment is considered de-energized or may be worked on as de-energized:

- A qualified person must activate the equipment operating controls or use other methods to verify that the equipment cannot be restarted.
- A Qualified Electrical Worker (QEW) must use test equipment to ensure that electrical parts and circuit elements are de-energized. The test must confirm there is no energized condition from induced voltage or voltage back feed.
- Test equipment and instruments must be visually inspected for external defects or damage before being used to verify that the equipment or circuit is de-energized.
- When voltage over 600 volts nominal is tested, the test equipment must be checked for proper operation immediately before and after the test.

8.4.6 **Re-energizing Equipment.** In addition to the requirements of the Lockout/Tagout Program, the following requirements must be met, in the order, before circuits or equipment are re-energized, even temporarily:

- A Qualified Electrical Worker (QEW) must conduct tests and visual inspections as necessary to verify that all tools, electrical jumpers, shorts, grounds, and other such devices have been removed so that circuits and equipment can be safely energized;
- Personnel potentially exposed to hazards of re-energizing the circuit must be warned to stay clear; and each person removes his or her own lock(s) and tag(s).

8.4.7 **Re-Energizing After a Trip Due to Electrical Fault or Overload.** 2018 Edition of NFPA 70E: 130.6(M) Reclosing Circuits After Protective Device Operation: After a circuit is de-energized by the automatic operation of a circuit protective device, the circuit shall not be manually re-energized until it has been determined that the equipment and circuit can be safely energized.

8.4.8 **Standby Person.** A standby person is recommended for certain electrical tasks which pose electrical shock and/or electrical arc flash hazards to workers. A matrix based on the hazard assessment should be created to define which tasks require a standby person and what that person's level of training must be.

The responsibilities of the standby person are driven by the specific scope and hazards and generally include (but not limited to):

- Understand the job scope and safety implications of the job task.
- Keep non-essential or unqualified persons out of the work area.
- Must not be a standby person for more than one task in progress.
- Know where and how to de-energize the electrical circuit when needed.
- Summon emergency response personnel as necessary via area radio, telephone, etc.
- Must maintain visual and audible contact with the Qualified Electrical Worker (QEW) doing the work.
- Shall wear and use the same personal and other protective equipment as the Qualified Electrical Worker (QEW) performing the work.
- Monitor the person doing the work for any sign of distress.

8.5 Suggested potential support materials based on scope of work and potential exposure:

- **Electrical Work Authorization Levels Matrix** (A matrix to define electrical work authorization levels (relative to voltage) based on training and experience level / job level)
- **Job Briefing & Planning Checklist** (NFPA 70E has an example checklist to use pre-job to help ensure that hazards are identified, addressed, and communicated)
- **Limited & Restrictive Approach Boundary** (Table listing Approach Boundaries to Energized Electrical Conductors or Circuit Parts for Shock Protection for AC & DC

Systems. All dimensions are distance from energized electrical conductor or circuit part to personnel.)

- **Voltage Requirements and test interval for Rubber Gloves, Blankets & Mats** (Table showing details for Reference: ASTM F496, ASTM F479 & D178)
- **PPE requirements Matrix:**
  - For work on 120/208/240 V systems and panels/switchboards at 480-600 V (Includes molded case or insulated case circuit breakers)
  - For inspection of energized equipment compartments / enclosures below 480V
  - For work on systems 480V and above
  - For testing and work on or near DC systems
- **Approach Distances for Overhead Power Lines** (Reference: Table S-5 - 29 CFR 1910.333)

9.0 TRAINING

9.1 Training & Competency. Approved personnel or "Qualified Electrical Workers" (QEW's) who service, modify, repair, or build electrical equipment must be trained and able to recognize the hazards and establish controls to prevent injury. Operators and anyone working in the vicinity of live electrical parts or equipment must be sufficiently trained to safely interact with electrical equipment including staying within its design intent and not defeating engineering controls

Qualification and Authorization to perform electrical or electronics work are based on a combination of formal training, experience, and on-the-job training. On-the-job training for specified equipment should be documented to ensure that training is consistent for all personnel with similar tasks. This documentation should be reviewed and approved by a person who is knowledgeable in safe work practices and is familiar with the hazards involved. This training should cover NFPA-70E, Standard for Electrical Safety in The Workplace and:

- Features of the equipment, including any specialized configuration.
- Location of energy-isolating devices.
- Techniques, tools, and personal protective equipment used for the specific equipment.
- Relevant documents such as wiring diagrams, schematics, service manuals, and operating, testing, and calibration procedures.
- The system's energy control procedures, including energy-isolating devices, grounding and shorting procedures, and other energy-control procedures.
- Specific operations in which live work is anticipated (if any).
- Record keeping and logging per designated company requirements.
- Copies of all completed training hall be kept on file and available for review at any time.

9.1.1 **Qualified Person / Qualified Electrical Worker (QEW).** The personnel must have successfully completed training on NFPA-70E, Standard for Electrical Safety in The Workplace; Trained in LOCKOUT/TAGOUT for the company having the work done; Completed an Adult CPR & First Aid Safety Training that includes AED Operation; Completed Electrical Hazard Awareness training.

OSHA defines a qualified electrical worker (QEW) as one who has received training in and has demonstrated skills and knowledge in the construction and operation of electric equipment and installations and the hazards involved. QEWs must protect themselves against all electrical hazards including shock, arc flash, burns and explosions. Even an experienced electrician is not “qualified” in OSHA’s eyes unless the employer can show proof of the appropriate training and certifications.

The most fundamental aspect of QEW training is the ability to Test Before Touch. Without an innate human sense to detect a hazardous condition, QEW’s must understand how to properly use test equipment to prove an Electrically Safe Work Condition.

9.1.2 **Unqualified Worker.** OSHA 1910.332(b)(2) also requires unqualified workers to be trained in the electrical safe work practices that are necessary for their safety. Unqualified workers, such as painters or cleaners, occasionally come into contact with energized equipment, and therefore they must be trained to recognize and avoid electrical hazards.

An "unqualified" worker is anyone not familiar with electrical work; has never received training in electrical; and/or does not hold electrical certification or licenses. Even an experienced electrician is not “qualified” in OSHA’s eyes unless the employer can show proof of the appropriate training and certifications.

Unqualified workers are not authorized to perform work on electrical equipment and components and will be trained in general electrical safety precautions for the purpose of hazard awareness.

Unqualified workers shall not be permitted to enter spaces that are required to be accessible to qualified persons only, unless the electric conductors and equipment involved are in an electrically safe work condition (deenergized, locked-out & tagged).

Where one or more unqualified workers are working at or close to the Unified Approach Boundary, the designated person in charge of the workspace where the electrical hazard exists shall cooperate with the designated person in charge of the unqualified worker(s) to ensure that all work can be done safely. This shall include advising the unqualified worker(s) of the electrical hazard and warning him or her to stay outside of the Unified Approach Boundary.

Where there is a need for an unqualified worker(s) to cross the Unified Approach Boundary, a qualified person shall advise him or her of the possible hazards and continuously escort the unqualified worker(s) while inside the Unified Approach Boundary. The unqualified worker must wear the required PPE. Under no circumstances shall the escorted unqualified worker(s) be permitted to cross the Restricted Approach Boundary.

9.2 Additional Training Considerations. Other training that should be considered in an Electrical Safety Program include (but not limited to) ARC Flash and ARC Blast; Unified Approach Boundary, Limited Approach Boundary and Restricted Approach Boundary; NFPA-70E, Standard for Electrical Safety in the Workplace; LOTO; Adult CPR and First Aid / AED; and Electrical Hazard Awareness.

10.0 CONTINUOUS IMPROVEMENT

10.1 Program Assessment. Assessment of the program and the personnel. Workers must have the ability to do their job safely. The employer needs to evaluate their skill. The safety program should contain the procedures to be used for this evaluation. The program itself should be audited to determine if the principles used are effective.

- Document findings including any gaps / deficiencies
- Assign corrective actions if needed
- Perform follow-up review to ensure all identified gaps / deficiencies have been addressed.
- If conditions warrant, document gap/deficiency and corrective action in a Lessons Learned tool to share with the organization.

10.1.1 Ensure the program is kept up to date with the OSHA regulations, NFPA standards and all other applicable safety guidelines.

10.1.2 Document findings from assessments, investigations, lessons learned, and apply all learnings to program improvement efforts.

11.0 REFERENCES

11.1 Regulatory / Government Entities and Industry Organizations

- Occupational Safety & Health Administration (29 CFR 1910 & 1926)
- America National Standards Institute (ANSI)
- American Society of Testing and Materials (ASTM)
- Institute of Electrical and Electronics Engineers (IEEE) 1584-2018, “Guide for Performing Arc Flash Hazard Calculations”
- National Fire Protection Association (NFPA 70E), “Standard for Electrical Safety in the Workplace”, 2018 edition
- National Institute for Occupational Safety and Health (NIOSH)
- Insulated Cable Engineers Association (ICEA)
- International Electrical Testing Association (NETA)
- National Electrical Manufacturers Association (NEMA)

11.2 Reference or Related Documents

- INGAA Foundation CS-S-8 - Overhead Utilities Safety
- (Placeholder)

12.0 REVISION HISTORY

Number	Date	Description
0	2/2023	Initial publication