Electrical Safety Program

1. Purpose

- A. The purpose of the USPL Electrical Safety Program (the "Program") is to provide a practical, safe working environment for USPL employees and contractors regarding the hazards arising from the use of electricity.
- B. The hazards include electrical shock, arc flash burn, and other potential electrical safety hazards. The Program complies with electrical systems regulatory requirements, and identifies electrical safety principles, controls and practices to be followed by USPL employees and contractors. Repairing equipment in a de-energized state is required unless de-energizing introduces an increased hazard or is infeasible.

2. Scope

- A. The Program applies to all USPL facilities and work performed by USPL employees and contractors. The Program complies with OSHA 29 CFR 1910 Subpart S and NFPA 70E requirements. NFPA 70E Standard for Electrical Safety in the Workplace has been used as the basis for developing this Program. The Program covers safety-related work practices, maintenance requirements and administrative controls for USPL facilities that safeguard USPL employees and contractors relative to the hazards associated with electrical energy during activities such as installation, inspection, operation, maintenance and demolition of electrical and related equipment. This Program addresses the safety of USPL employees and contractors whose job responsibilities entail potential exposure to energized electrical equipment and circuit parts.
- B. This Program addresses electrical safety requirements for the majority of electrical installations and utilization equipment in USPL. There are electrical installations in USPL that may require additional safety procedures as detailed in OSHA 29 CFR 1910.269 Electrical Power Generation, Transmission and Distribution, and OSHA 29 CFR 1926, Safety and Health Regulations for Construction, Subparts K Electrical, and V Power Transmission and Distribution.
 - 1. OSHA 29 CFR 1910.269 regulations apply to locations where main electrical power is generated or distributed, e.g., those parts of offshore platforms and facilities where main supply power is generated or distributed to other buildings. Note that this Program covers auxiliary electric generating equipment that is used to supply a workplace for emergency, standby, or similar purposes only.
 - 2. OSHA 29 CFR 1926, Subparts K (Electrical) and V (Power Transmission and Distribution) apply to safeguarding workers in construction work. Construction work is generally considered to be new construction, and repair work that involves significantly altering and improving existing equipment or systems.
 - 3. Each site shall be aware if requirements listed in 1910.269 and/or 1926 are applicable and for which electrical equipment and installations. See Appendix X flow charts for guidance in determining applicability of 29 CFR 1910.269. For support, please contact the HSSE Safety Advisor or the Electrical Technical Authority.
- C. This Program also addresses any USPL employees or contractors who are unintentionally exposed to electrical hazards or encounter hazards as part of their job responsibilities. The highest risk of injury from electrical hazards for USPL employees and contractors involves unintentional contact with overhead power lines and electric shock from machines, tools, and

appliances at USPL facilities. This Program aims to reduce risk through Risk Assessment, Prioritization, Planning and Controls, Implementation and Operation, Measurement, Evaluation, Corrective Action, Management Review and Improvement. The goal of the Program is to improve safety and reduce risk through continual improvement through these principles.

D. This Program shall be used in conjunction with the other applicable USPL HSSE policies as part of an overall occupational health and safety management program with an emphasis on safety and continuous improvement. The following USPL safety policies are either referenced or applied to this Program and should be consulted for specific requirements and guidance:

Permit to Work	Confined Space Entry
Lockout	Stop Work
Working at Heights	Personal Protective Equipment
Hot Work	

3. Minimum Requirements

	Minimum Requirements	Supporting Documentation
1.	Qualified and Unqualified Persons have specific training requirements and will receive training on this Policy and its contents.	6.6
2.	USPL employees and contractors have specific responsibilities for safety, training, and compliance with this Policy.	6.7
3.	Establishing an electrically safe work condition is the primary goal of this Program. USPL requires that energized electrical conductors and circuit parts shall be put into an electrically safe work condition before commencing work.	7&8
4.	USPL employees and contractors shall obtain a Permit to Work Checklist if necessary for specific tasks.	8.2
5.	Qualified Persons shall maintain an ESWC while exposed to electrical hazards. Only Qualified Persons may perform work on energized equipment within the restricted approach boundary and the arc flash protection boundary.	8.3
6.	After a circuit is de-energized by the automatic operation of a circuit protective device, the circuit shall not be manually reenergized until it has been determined that the equipment and circuit can be safely energized.	8.4.N
7.	USPL employees and contractors shall follow the Hierarchy of Controls to minimize risk with PPE as a worker's last line of defense.	8.5
8.	Personal and other protective equipment shall be used and worn in the specified manners to prevent injuries.	9

4. Definitions

Definitions per NFPA 70, National Electrical Code, and NFPA 70E, Electrical Safety in the Workplace.

Additional clarification and insights are indicated by parentheticals.

Asset Operator (AO): A USPL employee who is responsible for the operation of the asset where work is being performed. The Asset Operator shall be accountable for the asset equipment being in a safe condition for the scope of work to be performed. The Asset Operator or an Asset Operator Designee (if used) is responsible for the completion of the PTW form.

Asset Operator Designee (AOD): A USPL employee or contractor who is authorized to issue PTWs and / or Checklists on behalf of the Asset Operator.

Arc Flash Hazard: A dangerous condition associated with the possible release of energy caused by an electric arc. An arc flash hazard may exist when energized electrical conductors or circuit parts are exposed or when they are within equipment in a guarded or enclosed condition, provided a person is interacting with the equipment in such a manner that could cause an electric arc. Under normal operating conditions, enclosed energized equipment that has been properly installed and maintained is not likely to pose an arc flash hazard.

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

Arc Rating: The value attributed to materials that describe their performance 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 break-open threshold (E_{BT}) (should a material system exhibit a break-open response below the ATPV value). Arc rating is reported as either ATPV or E_{BT} , whichever is the lower value.

Arc Resistant Clothing: Arc resistant protective clothing protects from arc flash and electrical arc hazards. Arc resistant clothing has an arc rating that describes their performance to exposure to an electrical arc discharge. The arc rating is expressed in cal/cm².

Arc-Resistant Equipment: See Switchgear, Arc-Resistant definition.

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

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.

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.

Bonded (Bonding): Connected to establish electrical continuity and conductivity.

Boundary, Arc Flash: When an arc flash hazard exists, an approach limit at a distance from a prospective arc source within which a person could receive a second degree burn if an electrical arc flash were to occur. A second degree burn is possible by an exposure of unprotected skin to an electric arc flash above the incident energy level of 5 J/cm² (1.2 cal/cm²).

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

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, for personnel working in close proximity to the energized electrical conductor or circuit part.

Cabinet: An enclosure that is designed for either surface mounting or flush mounting and is provided with a frame, mat, or trim in which a swinging door or doors are or can be hung.

Circuit Breaker: A device designed to open and close a circuit by non-automatic means and to open the circuit automatically on a predetermined overcurrent without damage to itself when properly applied within its rating.

Classified Area: An area that poses electrical hazards and is classified following the guidelines of a nationally recognized electrical code. Areas are defined by class, division, and group. See National Electrical Code, NFPA 70, for complete definition of hazardous areas. For purposes of the Electrical Safety policy, Class I areas are to include Division 1 and Division 2 classified areas. Consult *Facility Electrical Hazardous Area Classification* drawings to identify where Class I areas are defined.

Conductive: Suitable for carrying electric current.

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

Controller (Electrical): A device or group of devices that serves to govern, in some predetermined manner, the electric power delivered to the apparatus to which it is connected.

Current-Limiting Overcurrent Protective Device: A device that, when interrupting currents in its current-limiting range, reduces the current flowing in the faulted circuit to a magnitude substantially less than that obtainable in the same circuit if the device were replaced with a solid conductor having comparable impedance.

Cutout: An assembly of a fuse support with a fuseholder, fuse carrier, or disconnecting blade. The fuseholder or fuse carrier may include a conducting element (fuse link), or may act as the disconnecting blade by the inclusion of a non-fusible member.

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.

Device: A unit of an electrical system, other than a conductor, that carries or controls electric energy as its principal function.

Disconnecting Means: A device, group of devices, or other means by which the conductors of a circuit can be disconnected from their source of supply.

DRM: Document Records Management, the USPL tool for creating, saving, and managing "business-critical" documents and records.

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

Electrical Hazardous Area Classification: See Classified Area.

Electrical Safety: Recognizing hazards associated with the use of electrical energy and taking precautions so that hazards do not cause injury or death.

Electrically Safe Work Condition (ESWC): A state in which an electrical conductor or circuit part has been disconnected from energized parts, locked/tagged in accordance with USPL Lockout Policy, tested to ensure the absence of voltage, and grounded if determined necessary.

Enclosed: Surrounded by a case, housing, fence, or wall(s) that prevents persons from accidentally contacting energized parts.

Enclosure: The case or housing of apparatus — or the fence or walls surrounding an installation to prevent personnel from accidentally contacting energized electrical conductors or circuit parts or to protect the equipment from physical damage.

Energized: Electrically connected to, or is, a source of voltage.

Equipment: A general term, including fittings, devices, appliances, luminaires, apparatus, machinery, and the like, used as a part of, or in connection with, an electrical installation.

Exposed (as applied to energized electrical conductors or circuit parts): Capable of being inadvertently touched or approached nearer than a safe distance by a person. It is applied to electrical conductors or circuit parts that are not suitably guarded, isolated, or insulated.

Fuse: An overcurrent protective device with a circuit-opening fusible part that is heated and severed by the passage of overcurrent through it.

Ground: The earth.

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.

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

Grounded Conductor: A system or circuit conductor that is intentionally grounded.

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

Grounding Conductor, Equipment ("EGC"): The conductive path(s) that provides a ground-fault current path and connects normally non–current-carrying metal parts of equipment together and to the system grounded conductor or to the grounding electrode conductor, or both.

Grounding Electrode: A conducting object through which a direct connection to earth is established.

Grounding Electrode Conductor: A conductor used to connect the system grounded conductor or the equipment to a grounding electrode or to a point on the grounding electrode system. **Guarded:** Covered, shielded, fenced, enclosed, or otherwise protected by means of suitable covers, casings, barriers, rails, screens, mats, or platforms to remove the likelihood of approach or contact by persons or objects to a point of danger.

Hazard: A source of possible injury or damage to health.

Hazardous: Involving exposure to at least one hazard.

Incident Energy: The amount of thermal energy impressed on a surface, a certain distance from the source, generated during an electrical arc event. Incident energy is typically expressed in calories per square centimeter (cal/cm²).

Incident Energy Analysis: A component of an arc flash risk assessment used to predict the incident energy of an arc flash for a specified set of conditions.

Insulated: Separated from other conducting surfaces by a dielectric (including air space) offering a high resistance to the passage of current.

Interrupting Rating: The highest current at rated voltage that a device is identified to interrupt under standard test conditions.

Labeled: Equipment or materials to which has been attached a label, symbol, or other identifying mark of an organization that is acceptable to the authority having jurisdiction and concerned with product evaluation, that maintains periodic inspection of production of labeled equipment or materials, and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.

Listed: Equipment, materials, or services included in a list published by an organization that is acceptable to the authority having jurisdiction and concerned with evaluation of products or services, that maintains periodic inspection of production of listed equipment or materials or periodic evaluation of services, and whose listing states that either the equipment, material, or service meets appropriate designated standards or has been tested and found suitable for a specified purpose.

Live parts: Energized conductive components.

Motor Control Center (MCC - NEMA ICS 18): An assembly of one or more enclosed sections having a common power bus and principally containing motor control units.

Overcurrent: Any current in excess of the rated current of equipment or the ampacity of a conductor. It may result from overload, short circuit, or ground fault.

Overload: Operation of equipment in excess of normal, full-load rating, or of a conductor in excess of rated ampacity that, when it persists for a sufficient length of time, would cause damage or dangerous overheating. A fault, such as a short circuit or ground fault, is not an overload.

Panelboard: A single panel or group of panel units designed for assembly in the form of a single panel, including buses and automatic overcurrent devices, and equipped with or without switches for the control of light, heat, or power circuits; designed to be placed in a cabinet or cutout box placed in or against a wall, partition, or other support; and accessible only from the front.

Permit to Work: An approved management system that controls work in a safe manner through the use of the PTW form.

Qualified Person: A USPL employee or contractor who has demonstrated skills and knowledge related to the construction and operation of electrical equipment and installations and has received Electrical Safety Knowledge Training as detailed in this Program.

Raceway: An enclosed channel of metal or nonmetallic materials designed expressly for holding wires, cables, or busbars, with additional functions as permitted in this standard.

Receptacle: A receptacle is a contact device installed at the outlet for the connection of an attachment plug. A single receptacle is a single contact device with no other contact device on the same yoke. A multiple receptacle is two or more contact devices on the same yoke.

Risk: A combination of 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:** An overall process to:

- A. Identify hazards,
- B. Estimate the potential severity of injury or damage to health,
- C. Estimate the likelihood of occurrence of injury or damage to health, and
- D. Determine if protective measures are required.

Arc Flash Risk Assessment and Shock Risk Assessment are types of risk assessments.

Shock Hazard: A dangerous condition associated with the possible release of energy caused by contact or approach to energized electrical conductors or circuit parts.

Short-Circuit Current Rating: The prospective symmetrical fault current at a nominal voltage to which an apparatus or system is able to be connected without sustaining damage exceeding defined acceptance criteria.

Single-line (or one-line) drawing: A diagram that shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used in the circuit or system.

Substation: Typically a fenced area of electrical equipment, e.g., switches, circuit breakers, buses, and transformers, under the control of Qualified Persons, through which electric energy is passed for the purpose of switching and reducing transmission voltage for facility usage.

Switchboard: A large single panel, frame, or assembly of panels on which are mounted on the face, back, or both, switches, overcurrent and other protective devices, buses, and usually instruments. These assemblies are generally accessible from the rear as well as from the front and are not intended to be installed in cabinets.

Switchgear, **Arc-Resistant:** Equipment designed to withstand the effects of an internal arcing fault and that directs the internally released energy away from the employee. An arc-resistant switchgear has successfully meet the test requirements of IEEE Std. C37.20.7-2007.

Switchgear, Metal-Clad: A switchgear assembly completely enclosed on all sides and top with sheet metal, having drawout switching and interrupting devices, and all live parts enclosed within grounded metal compartments.

Switchgear, Metal-Enclosed: A switchgear assembly completely enclosed on all sides and top with sheet metal (except for ventilating openings and inspection windows), containing primary power circuit switching, interrupting devices, or both, with buses and connections. This assembly may include control and auxiliary devices. Access to the interior of the enclosure is provided by doors, removable covers, or both. Metal-enclosed switchgear is available in non-arc-resistant or arc-resistant constructions.

Ungrounded: Not connected to ground or to a conductive body that extends the ground connection.

Unqualified Person: Any USPL or contractor employee who is not a Qualified Person (but has exposure to field electrical equipment and installations) but is trained and familiar with any safety electrical practices necessary for their safety as identified in Electrical Safety Knowledge Training detailed in this Program . See Qualified Person.

Voltage (of a Circuit): The greatest root-mean-square (RMS) (effective) difference of potential between any two conductors of the circuit concerned.

Voltage, nominal: A nominal value assigned to a circuit or system for the purpose of conveniently designating its voltage class (e.g., 120/240 volts, 480Y/277 volts, 600 volts). The actual voltage at which a circuit operates can vary from the nominal within a range that permits satisfactory operation of equipment. System voltage classes:

Low Voltage (LV): A class of nominal system voltages 1000 volts or less

Medium Voltage (MV): A class of nominal system voltages greater than 1000 volts and less than 100 kV.

High Voltage (HV): A class of nominal system voltages equal to or greater than 100 kV and equal to or less than 230 kV.

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

- *Diagnostic (testing)* is taking readings or measurements of electrical equipment with approved test equipment that does not require making any physical change to the equipment;
- *Repair* is any physical alteration of electrical equipment (such as making or tightening connections, removing or replacing components, etc.).

5. Roles and Responsibilities

5.1. USPL

- A. USPL, through this Program, has the responsibility to provide the following:
 - 1. Safety-related work practices Section 6, 7 and 8;
 - 2. Training for employees Section 6.6;
 - 3. Supervision;
 - 4. Audits Section 6.5; and
 - 5. Documentation Section 8.

5.2. All personnel

- A. USPL employees and contractors shall follow the safety-related work practices and procedures detailed in this Program and shall be trained accordingly.
- B. USPL contract employer provides qualified people to work on USPL facilities and ensures its employees follow the work practices outlined in this Program.
- C. This Program provides the required self-discipline for all USPL employees and contractors who perform work involving electrical hazards. All USPL employees and contractors shall be aware of the potential electrical hazards present in their work environment.
- D. USPL employees and contractors shall:
 - 1. Perform only the work that they are competent, trained, and qualified to perform.
 - 2. Adhere to safe working procedures, ensuring the safety of themselves and others.
 - 3. Stop any work deemed unsafe.
- E. Assure that all new and existing electrical work is correctly documented on controlled electrical drawings, e.g., one-line diagrams, area classification, arc flash drawings.
- F. A person may be qualified with respect to certain equipment and methods but still be unqualified for others.

5.3. I&E Engineers or, as requested, the Electrical Technical Authority

- A. The I&E Engineer or, as requested, the Electrical Technical Authority shall:
 - 1. Provide guidance and direction on electrical drawings.
 - 2. Provide guidance on labeling electrical equipment.
 - 3. Review and approve single-line diagrams, arc flash assessments, and Electrical Hazardous Area Classification drawings when changes are made.

5.4. Team Leaders shall:

A. Engage the facility's I&E Engineer before changes are made to the facility electrical system or the electrical classification.

5.5. Asset Operator

A. Determine, from the electrical contractor, who is electrically unqualified and the method the contractor will use to supervise the worker to ensure they do not exceed their training level.

6. General Requirements for Electrical Safety-Related Work Practices

6.1. General

A. This Program provides electrical safety principles, controls, and procedures applicable in all USPL facilities.

6.2. Normal operation

- A. The normal operation of the electrical equipment shall be permitted where all of the following conditions are satisfied:
 - 1. The equipment is installed per the manufacturer's requirements,
 - 2. The equipment is properly maintained,
 - 3. The equipment doors are closed and secured,
 - 4. All equipment covers are in place and secured, and
 - 5. There is no evidence of impending failure.

6.3. Maintenance

- A. USPL has implemented a comprehensive maintenance program that is detailed in the USPL-GP 32-30-1, Inspection and Testing of Equipment in Service. The type and frequency of the electrical equipment maintenance is governed by the appropriate Generic Maintenance Strategy and the criticality defined in USPL STP 35-101, Equipment Criticality Analysis Methodology.
- B. Proper maintenance is critical for power distribution equipment in order to operate properly and safely. If a circuit breaker or a relay does not work properly, the arc flash incident energy can be much higher, and the USPL personnel and contractors could be exposed to incident energy higher than that shown on the equipment's arc flash label.
- C. The recommendations for the electrical risk assessments detailed in this program have considered the electrical equipment to be properly maintained in accordance with the manufacturer's instructions and applicable industry codes and standards. If any deviations are

identified in the field, the electrical equipment condition shall be discussed with the Electrical Technical Authority and the risk assessment be updated accordingly.

6.4. Job Briefing

- A. Before beginning electrical work, the AO / AOD with the Qualified Person shall perform a job briefing per the Permit to Work policies. Additional job briefings shall be held if changes that might affect the safety of employees occur during the course of work.
- B. The briefing shall cover such topics as hazards associated with the job, electrical hazard risk assessments, work procedures involved, special precautions, energy source controls, personal protective equipment (PPE) requirements, and the information on the Permit to Work Checklist, if required. The briefing shall determine if any workers are not fully electrically qualified for the job scope, and if not, how they will be supervised to verify they do not exceed their training qualifications.

6.5. Electrical Safety Auditing

- A. Electrical Safety Program. USPL shall audit this Program to verify that its principles and procedures comply with regulatory requirements. Audits shall be performed when safety-related regulatory requirements are updated or NFPA 70E is revised. The USPL Electrical Technical Authority is responsible for the Electrical Safety Program audit and shall document the findings.
- B. **Field Work.** USPL shall audit field work to verify that the requirements follow the principles and procedures of this Program. The USPL Electrical Technical Authority is responsible for the Field Work audit and shall document the findings. When the audit determines that the principles and procedures of the Program are not being followed, the USPL Electrical Technical Authority shall determine the appropriate corrective actions.
 - 1. The objective of the audit shall be to determine if the Program should be updated, and if USPL employees and contractors adequately understand the principles and procedures of this Program.
 - 2. At least one of the following persons shall participate on the USPL Self Audit team for the electrical audit portion:
 - a) I&E Engineer,
 - b) HSSE Professional,
 - c) The Electrical Technical Authority, or
 - d) Other worker approved by the Electrical Technical Authority.
 - 3. The electrical auditor shall:
 - a) Speak with the USPL employee or contractor performing the procedure or task to gain understanding of the procedure or task.
 - b) Observe how the procedure or task is performed.
 - c) Review recent Permit to Work documentation.
 - d) Review recent Lockouts performed involving electrical equipment.
 - e) Provide feedback and guidance.
 - f) Document the findings and recommendations.
 - 4. Field work audits shall be initiated by the Electrical Technical Authority and performed at intervals not to exceed one (1) year. The Electrical Safety Audit shall be coordinated with USPL Self Audit and if possible, include the same facilities.

6.6. Training Requirements

A. Electrical Safety Knowledge Training

- 1. USPL field-based employees and contractors who may be exposed to electrical hazards shall be trained in Electrical Safety Knowledge. The objectives of this training are for employees who have exposure to electrical hazards, i.e. shock, arc flash and arc blast, to:
 - a) Be familiar with and use USPL safety-related work practices and procedural requirements intended to provide protection from the electrical hazards.
 - b) Know the actual or potential hazards involved with the tasks to be performed.
 - c) Identify and understand the relationship between electrical hazards and possible injury.
 - d) Know how to eliminate any exposure to the hazard or how to mitigate the effects of any hazard that remains while the task is being executed.
 - e) Know and realistically accept the limits of his or her authority, knowledge, and skill.
 - f) Be able to identify situations that may involve unacceptable risk.
- 2. See Appendix V for list of suggested topics.

B. Qualified Person

- 1. A Qualified Person shall be trained and knowledgeable in the construction and operation of equipment or a specific work method and have successfully completed the Electrical Safety Knowledge Training. Training shall include determining the existence of electrical hazards and being familiar with the proper use of the special precautionary techniques such as:
 - a) How to avoid exposure to electrical hazards;
 - b) How to establish an electrically safe work condition;
 - c) How to establish an equipotential zone;
 - d) Be familiar with USPL safety related policies and procedures;
 - e) Knowledge in insulated tools and test equipment;
 - f) Installing and removing safety grounds:
 - g) Skills and techniques necessary to distinguish exposed energized electrical conductors and circuit parts from other parts of electrical equipment;
 - h) Skills and techniques necessary to determine the nominal voltage of exposed energized electrical conductors and circuit parts;
 - Skills and techniques in performing risk assessment (See risk assessment definition in Section 4.);
 - j) Decision-making process necessary to be able to do the following:
 - 1) Perform the job safety planning
 - 2) Identify electrical hazards (shock, arc flash, arc blast etc.)
 - 3) Assess the associated risk
 - 4) Selection and use of PPE for shock hazard
 - 5) Selection and use of PPE for arc flash hazard
 - 6) Identification and selection of the methods of reducing risk: elimination, substitution, engineering controls, warnings, administrative controls
 - k) Use of temporary grounds;
 - I) Effective in communications;

- m) Knowledge to select an appropriate test instrument to verify the absence/presence of voltage, including interpreting indications provided by the device; and
- n) The training program shall also include real-life incidents preferably incidents from within USPL.
- 2. A person may be considered qualified with respect to certain equipment and methods but still unqualified for other tasks, projects, or skills.
- 3. A USPL employee who is undergoing training for the purpose of obtaining the skills and knowledge necessary to be considered a Qualified Person, and who in the course of such training demonstrates an ability to perform specific duties safely at his or her level of training, and who is under the direct supervision of a Qualified Person shall be considered to be a Qualified Person for the purpose of receiving training for those tasks..
- 4. Tasks that are performed less often than once per year shall be reviewed before the performance of the work practices involved. However, each USPL employee shall keep track of their qualifications and work with their supervisor to take steps to ensure that their qualifications do not lapse.
- C. **Unqualified Persons** shall be trained in, and be familiar with, any electrical safety-related practices necessary for their safety as identified in Electrical Safety Knowledge Training above.

D. Electrical Emergency Response Training

- 1. Contact Release
 - Qualified Persons exposed to shock hazards shall be trained in methods of safe release of victims from contact with exposed energized electrical conductors or circuit parts.
- 2. First Aid, CPR, AED
 - a) Qualified Persons and electrical emergency responders shall be trained in contact release, First Aid, and cardiopulmonary resuscitation (CPR) or automated external defibrillator (AED) if the site is equipped with these devices.

E. Documentation

1. For USPL employees, the training shall be documented in My Talent & Learning (MTL)VTA or similar learning management system. At the request of USPL, contractors shall provide documentation of training in ISNetworld.

F. Retraining

- 1. Retraining in safety-related work practices and applicable changes to this Program shall be correlated to this Program's revisions/updates. However, retraining interval shall not exceed 3 years. USPL employees shall receive additional training (or retraining) if any of the following conditions exists:
- a) The annual audits indicate that employees are not complying with the safety-related work practices due to a lack of understanding.
- b) New technology, new types of equipment or changes in procedures necessitate the use of safety-related work practices that are different from those that the employees would normally use.
 - 2. Retraining in electrical emergency response:
- a) Contact Release refresher training shall occur annually.
- b) First Aid, CPR and AED refresher training shall occur with the frequency specified by the training agency under whose authority the training is being provided.

6.7. USPL and Contract Employers' Responsibilities

- A. USPL Responsibilities
 - 1. USPL shall inform the contract employer of:
 - a) Known hazards related to the contractor's work that are covered by this Program; and
 - b) Facility information necessary for the contractor to make assessments to perform work safely.
 - 2. USPL employees shall report observed Program violations as required by the Stop Work and Incident Reporting policies.
- B. Contract Employer Responsibilities
 - 1. The contract employers shall provide qualified employees that have demonstrated skill and knowledge related to the construction and operation of USPL electrical equipment and installation.
 - The contract employer shall instruct its affected employees of the hazards communicated by USPL. The contract employer shall ensure all its employees have the training required by NFPA 70E, OSHA 29 CFR 1910 Subpart S, 1910.269 and 1926 Subparts K and V in relationship with their work environment and assigned tasks.
 - 3. The contract employer shall ensure that each of its employees follow the work practices required by this Program and safety-related work rules required by the USPL HSSE policies.
 - 4. The contract employer shall inform USPL of:
 - a) Any unique hazards presented by the contract employer's work.
 - b) Additional hazards identified during the course of work.
 - c) The measures the contract employer took to correct any violations reported by USPL and to prevent such violation from recurring.
- C. Documentation
 - 1. The meeting between USPL and contract employer discussing the job hazards shall be documented as required by the USPL Control of Work Policies.

7. Establishing an Electrically Safe Work Condition

- A. USPL requires that energized electrical conductors and circuit parts shall be put into an electrically safe work condition before commencing work if either of the following conditions exists:
 - 1. Crossing the limited approach boundary, or
 - 2. Interacting with electrical equipment where conductors or circuit parts are not exposed, but an increased likelihood of injury from an exposure to an arc flash hazard exists.
- B. If an electrically safe work condition cannot be achieved, the Electrical Technical Authority and Instrumentation & Electrical Engineering Team Lead shall be contacted to provide requirements.
- C. USPL meets the requirements of establishing an electrically safe work condition by application of the *Lockout Policy: The Control of Hazardous Energy*. See the Lockout policy in DRM for USPL-specific requirements.
- D. All electrical circuit conductors and circuit parts shall be considered energized until all six steps listed below are completed and the equipment is in an electrically safe work condition. Only

Qualified Persons trained in accordance with USPL LOTO Policy and this Program are authorized to perform the six steps listed below:

- Determine all possible sources of electrical supply to the specific equipment. Review applicable up-to-date drawings (located in DRM), elementary or schematic diagrams, panelboard schedules, electrical plans, and identification signs and tags. Special consideration shall be provided for equipment fed from multiple sources, such as emergency/standby generators or separate control power sources. If any discrepancies are identified, consult with the I&E Engineer.
 - a) If the circuit is over 1,000V, two qualified persons shall be required to conduct the task of confirming zero energy. One task carried out by two persons. The test is carried out by one person with the second person being a second set of eyes to verify that the PPE is correct, the test equipment is correct for the service and that the correct equipment and part is being tested.
- 2. After properly interrupting the load current, open the disconnecting device(s) for each source. If the rating of the disconnecting device(s) is not sufficient to interrupt the load current, the load shall first be interrupted by other means before opening the disconnecting switch(s).
- 3. If the equipment has an inspection window, visually verify that all blades of the disconnecting device(s) are fully open or that drawout type circuit breakers are withdrawn to the fully disconnected position. If the equipment has no inspection windows, open the door or cover to confirm the status of the disconnecting device(s).
- 4. Apply lockout/tagout devices in accordance with the USPL LOTO procedure.
- 5. Use a properly rated test instrument to test each phase conductor or circuit part to verify that it is de-energized. Before and after each test, determine that the test instrument is operating satisfactorily through verification on a known voltage source, per manufacturer requirements only if additional hazards are not introduced.
 - a) For low voltage systems, test each phase conductor or circuit part both phase-to-phase and phase-to-ground. In an ungrounded system, note that the test instrument may indicate an absence of voltage to ground.
 - b) For medium voltage systems, non-contact test equipment may be used to initially verify an electrically safe work condition. Once the absence of voltage is indicated, a shorting stick shall be used to confirm no voltage.
 - c) The following apply to the test instruments:
 - 1) Test instruments, equipment, and their accessories shall be rated for circuits and equipment where they are used.
 - A Hot Work Checklist shall be issued if the equipment to be tested is opened in a Class I location or the test instrument is not rated for a Class I location (see USPL Hot Work policy).
 - Only Qualified Persons shall perform these tasks, including but not limited to, testing, troubleshooting, and voltage measuring within the Limited Approach Boundary of energized electrical conductors.
 - 4) Test instruments, equipment, and their accessories shall be designed for their intended use and environment.
 - 5) Test instruments, equipment and all associated test leads, cables, power cords, probes, and connectors shall be visually inspected for damage before each use. Defective equipment shall be taken out of service immediately. No person shall use it until it is repaired by a person qualified to perform the repairs.
- 6. To prevent the possibility of induced voltages or stored electrical energy energizing a circuit, the use of shorting sticks and grounding clusters shall be used whenever possible.

- a) Grounding equipment shall be capable of conducting the maximum current that could flow at the point of grounding for the time necessary to clear the fault and an impedance low enough to cause immediate operation of the protective devices in case of accidental energizing of the electrical conductors or circuit parts. Consult with the I&E Engineer for the correct size of grounding equipment.
- b) Grounding equipment shall be placed at such locations and shall be arranged in such a manner as to prevent workers from being exposed to an electrical shock hazard.
- c) Until an electrically safe condition has been established, all work practices shall be identical to working on or near exposed live parts.
- E. Where the disconnect is located inside the panelboard enclosure and is not barriered off (dead front) and the main lugs are energized, the panelboard is considered energized and not considered to be in a de-energized lockout/tagout state.
- F. Diagnostic testing, troubleshooting or measuring voltage on energized electrical installations rated at 50 VAC or 50 VDC and below requires compliance with the electrical safe methods and practices detailed in this policy (such as proper PPE and insulated tools). The capacity of the source and any overcurrent protection between the energy source and the worker shall be considered and if there is an increased exposure to electrical burns or to explosion due to electrical arcs, an Energized Electrical Work Shock & Arc Flash Hazard Assessment may be required. This determination shall be performed by the site Electrical Engineer and the Qualified Person involved.

8. Work Involving Electrical Hazards

8.1. Electrically Safe Work Conditions (ESWC)

- A. USPL requires that energized electrical conductors and circuit parts shall be put into an electrically safe work condition before commencing work if either of the following conditions exists:
 - 1. Crossing the limited approach boundary, or
 - 2. Interacting with electrical equipment where conductors or circuit parts are not exposed, but an increased likelihood of injury from an exposure to an arc flash hazard exists.
- B. To establish an electrically safe work condition, follow the six-step process detailed in Section 7 of this Program.
- C. Warnings shall be affixed to de-energized electrical equipment to indicate it is in a safe state for work, i.e. de-energized, and also to adjacent energized electrical equipment to indicate it is not in a safe state for work, i.e. energized. See Appendix XI for minimum USPL warning signage.

8.2. Work on Energized Electrical Equipment

- A. Repair work on energized electrical equipment is prohibited. Repair is any physical alteration of electrical equipment (such as making or tightening connections, removing or replacing components, etc.)
 - 1. Exemption: Working on batteries (removing or replacing) is allowed when safe work practices are followed and the appropriate PPE is worn for shock protection as batteries cannot be discharged at the time of the work activity.
- B. Diagnostic work on energized electrical equipment is allowed when safe work practices are followed and the appropriate PPE is worn. Diagnostic (testing) is taking readings or measurements of electrical equipment with approved test equipment that does not require making any physical change to the equipment.

1. Examples may include testing, troubleshooting or voltage measuring, thermography, ultrasound, or visual inspections.

8.3. Working While Exposed to Electrical Hazards

- A. Near Electrical Equipment
 - 1. For low voltage, enclosed electrical equipment that has been properly installed and maintained by Qualified Persons, and when the state of the electrical equipment is known to not readily change, is not likely to expose personnel to an electrical hazard.
 - 2. For low and medium voltage, enclosed electrical equipment that has been properly installed and maintained by Qualified Persons, and when the state of the electrical equipment is known to readily change, must be considered as a potential electrical hazard. In most cases, closed doors do not provide enough protection to eliminate the need for arc flash PPE.
 - 3. If the more stringent electrical safety requirements identified in paragraphs A and B above have an impact on the local operation, the local electrical engineer with assistance from Safety Coordinator and the Electrical Technical Authority will work together to develop local procedures that will minimize the impact on operations and maintain the minimum safety required by federally mandated regulations.
- B. Repairing Electrical Equipment
 - The primary strategy shall be to establish ESWC (see six-step process in Section 7). ESWC is a form of safety control from the Hierarchy of Controls by eliminating the hazard (see Section 8.5 B). After ESWC has been established, no additional PPE is required.
 - 2. Only Qualified Persons may perform work on energized equipment within the restricted approach boundary (shock risk assessment) and the arc flash protection boundary (arc flash risk assessment) as identified by an Electrical Shock & Arc Flash Assessment. Safe work practices shall be followed.

8.4. Other Precautions for Personnel Activities

- A. Conductive cleaning materials (such as steel wool, metalized cloth, or silicon carbide) and conductive liquid solutions shall not be used in proximity to energized parts unless procedures are followed to prevent contact with energized parts.
- B. Qualified Persons shall be alert at all times when they are working within the Limited Approach Boundary of energized electric conductors or circuit parts or when electrical hazards might exist.
- C. Qualified Persons shall not be permitted to work within the Limited Approach Boundary on energized equipment or where other electrical hazards exist while their alertness is recognizably impaired due to illness, fatigue, or other reasons.
- D. Qualified Persons shall not reach blindly into areas that might contain exposed energized electrical conductors or circuit parts. Blind reaching is when an employee reaches into an area where lack of illumination or an obstruction impedes direct visual observation of the work to be performed. The use of the mirror to see behind the obstruction is also considered blind reaching.
- E. USPL employees and contractors shall ensure adequate lighting is provided to perform the work safely and shall be included in the risk assessment procedure. Prior to start of work, the work area should be viewed wearing the face shield (if required by the task) to see if additional illumination is necessary.

- F. Conductive articles of jewelry and clothing (such as watchbands, bracelets, rings, key chains, necklaces, metalized aprons, cloth with conductive thread, metal headgear, or metal frame glasses) shall not be worn within the restricted approach boundary.
- G. Qualified Persons shall handle all conductive items in a manner that prevents accidental contact with energized electrical conductors or circuit parts. Objects that do not have a voltage rating shall be considered conductive. Conductive material approaching exposed energized electrical conductor of circuit parts should not be closer than the restricted approach boundary.
- H. Qualified Persons shall use protective shields, barriers or insulating materials to avoid inadvertent contact with energized electrical conductors or circuit parts while in confined or enclosed work spaces.
- I. Doors and hinged panels shall be secured to prevent their swinging into a Qualified Person and causing them to contact exposed energized electrical conductors or circuit parts.
- J. Access to working space near electrical equipment shall be kept clear and unobstructed by following the applicable table below. Working space shall not be used for storage. This space shall be kept clear to permit safe operation and maintenance of electrical equipment.

Nominal Voltage		Minimum Clear Distance	
to Ground	Condition 1	Condition 2	Condition 3
0-150 V	3 feet	3 feet	3 feet
151-600 V	3 feet	3 feet 6 inches	4 feet
601-2500 V	3 feet	4 feet	5 feet
2501-9000 V	4 feet	5 feet	6 feet
9001-25,000 V	5 feet	6 feet	9 feet
25,001 V-75 kV	6 feet	8 feet	10 feet
Above 75 kV	8 feet	10 feet	12 feet

Working Spaces Table

Where the conditions are as follows:

Condition 1 — Exposed live parts on one side of the working space and no live or grounded parts on the other side of the working pace, or exposed live parts on both sides of the working space that are effectively guarded by insulating materials. **Condition 2** — Exposed live parts on one side of the working space and grounded parts on the other side of the working space. Concrete, brick, or tile walls shall be considered as grounded.

Condition 3 — Exposed live parts on both sides of the working space. See NFPA 70, National Electrical Code.

- K. Employees shall not perform housekeeping duties inside the limited approach boundary where there is a possibility of contact with energized electrical conductors or circuit parts, unless adequate safeguards (such as insulating equipment or barriers) are provided to prevent contact. Electrically conductive cleaning materials (including conductive solids such as steel wool, metalized cloth, and silicon carbide, as well as conductive liquid solutions) shall not be used inside the limited approach boundary unless procedures to prevent electrical contact are followed.
- L. Load rated switches, circuit breakers, or other devices specifically designed as disconnecting means shall be used for the opening, reversing, or closing of circuits under load conditions. Cable connectors not of the load-break type, fuses, terminal lugs, and cable splice connections shall not be permitted to be used for such purposes.
- M. After a circuit is de-energized by the automatic operation of a circuit protective device, the circuit shall not be manually reenergized until it has been determined that the equipment and circuit can be safely energized. The repetitive manual reclosing of circuit breakers or reenergizing circuits

through replaced fuses shall be prohibited. When it is determined from the design of the circuit and the overcurrent devices involved that the automatic operation of a device was caused by an overload rather than a fault condition, examination of the circuit or connected equipment shall not be required before the circuit is reenergized.

N. Only Qualified Persons following the requirements for working inside the restricted approach boundary shall be permitted to defeat or bypass an electrical safety interlock over which the person has sole control, and then only temporarily while the Qualified Person is working on the equipment. See USPL Defeated Safety Device Procedure, USP-SAF-001-001, in DRM for USPL specific requirements. The safety interlock system shall be returned to its operable condition when the work is completed.

8.5. Performing Risk Assessment

- A. General
 - 1. Risk assessment is an overall process to identify hazards, estimate the potential severity of injury or damage to health, estimate the likelihood of occurrence of injury or damage to health and determine if protective measures are required.
- B. Hierarchy of Controls
 - 1. To reduce risk, task risk assessments shall consider the hierarchy of controls in the following order:

Controls	Examples	
1) Elimination	Eliminate a hazard and completely eliminate the associated risk, such as conduct task elsewhere, conduct the task during facility turnarounds.	Most Effective
2) Substitution	Substitute something else that has less potential to cause harm.	
3) Engineering Controls	Use Engineering Controls to remove a hazard or place a barrier between the workforce and hazard.	
4) Isolation	Contain the work environment or work process to interrupt the path between the workforce and the risk, e.g., insert blind flange, guards or barriers, set up temporary or permanent enclosures.	
5) Administrative Controls	Reduce the risk by thorough training assuring competency of the workforce, the use of specialist personnel, changing rosters, close supervision, establish policies/standards or procedures such as USPL Control of Work.	
6) Personal Protective Equipment	When you cannot reduce the risk in any other way, use personal protective equipment as the last resort. PPE has limitations and may not protect from all injuries so it should be considered the last line of defense against injury.	▼ Least Effective

2. The hierarchy of controls provides a systematic way to determine the most effective and feasible method to reduce risk associated with the electrical hazard. Electrically Safe Work Condition, eliminate the hazard, is the most effective method of reducing risk. PPE is the least effective method of reducing risk.

When you cannot reduce the risk to an acceptable level using the Hierarchy of Controls, the PPE shall be selected based on the shock risk assessment and the arc flash risk assessment.

- C. Shock Risk Assessment
 - 1. A shock risk assessment shall determine the voltage to which personnel will be exposed, the boundary requirements, electrical safeguards and the PPE necessary in order to minimize the possibility of electric shock to workers.
 - 2. There are two protection boundaries:
 - a) The limited approach boundary, and
 - b) The restricted approach boundary.

- The protective boundaries are applicable where workers are exposed to energized electrical conductors or circuit parts. See Appendix VI, Approach Boundaries to Energized Electrical Conductors or Circuit Parts, for shock protection distances associated with AC and DC System voltages.
- 4. USPL employees and contractors shall adhere to the following shock hazard requirements:
 - a) Unqualified Persons shall not cross the Limited Approach Boundary unless continuously escorted by a Qualified Person while wearing the required PPE. The Qualified Person shall advise the Unqualified Person of the possible hazards.
 - b) If the arc flash boundary is outside the Limited Approach Boundary, the unqualified person also has to be kept outside the arc flash boundary.
 - c) An Unqualified Person shall never cross a Restricted Approach Boundary.
 - d) The Qualified Person may cross the Restricted Approach Boundaries if insulated or guarded from the energized electrical conductors or circuit parts. Energized electrical conductor shall be insulated from the Qualified Person and from any other conductive object at a different potential.
- D. Arc Flash Risk Assessment
 - 1. Arc Flash Risk Assessment shall determine if the arc flash risk exists and the following:
 - a) Determine the appropriate safety related work practices
 - b) The arc flash boundary
 - c) The PPE to be used within the arc flash boundary
 - 2. Be updated at intervals not to exceed 5 years or when the data on the arc flash hazard equipment label is no longer applicable or when new equipment is added that requires an arc flash label.
 - 3. The arc flash risk assessment shall take into consideration the characteristics of the upstream overcurrent device from an arcing event and the condition of the maintenance of the overcurrent protective device. In addition, any signs of impending failure, such as arcing, overheating, loose or bound equipment parts, unusual vibration, unusual smell, visible damage or deterioration shall be corrected before performing work within the arc flash boundary. Where equipment has not been properly installed, maintained, or where there are signs of impending failure, an overcurrent protective device may fail to clear a fault or fail to clear the fault in accordance with the manufacturer's published time current characteristics curves. Under this circumstance, the PPE selection based on incident energy value on the arc flash hazard label may not provide adequate protection from an arc flash hazard. See USPL GP 12-001, Power System Design, for details.
 - 4. At each USPL facility, an arc flash single-line risk assessment shall be developed and shall be stored in DRM. The following information shall be obtained from the arc flash single-line to be used for the arc flash risk assessment:
 - a) Arc flash boundary
 - b) The results of the incident energy analysis shall be used to specify the minimum rating of the PPE
 - c) The selected PPE shall be determined based on the actual thermal energy exposure level at the working distance of the worker's face and chest area. Recognizing that incident energy increases as the distance from the arc flash decreases, additional PPE shall be used for any part of the body that are closer than the distance at which the incident energy was calculated.

- 5. If the Arc Flash Risk Assessment is not available in DRM request the information from the facilities I&E Engineer. In the complete absence of the information, the Electrical Technical Authority or HSSE Safety Advisor shall be consulted.
- E. Labels
 - 1. Electrical equipment such as switchboards, panelboards, industrial control panels, motor control centers, shall be field marked with the label containing the following information (See Appendix II for the examples of USPL Labels):
 - a) Restricted approach boundaries
 - b) Voltage
 - c) Arc flash boundaries
 - d) USPL PPE categories (See Appendix I for USPL PPE Categories)
 - 2. High-Voltage Labels and Warning Signs
 - a) Entrances to all buildings, rooms, or enclosures containing exposed live parts or exposed conductors operating at over 600 volts shall:
 - i. Be kept locked unless they are under the observation of a Qualified Person.
 - ii. Have a permanent and conspicuous warning sign that reads: "DANGER HIGH VOLTAGE–KEEP OUT."
 - 3. Warning labels or signs are required on the following electrical equipment:
 - i. Medium-voltage motor controls centers, stand-alone medium-voltage starters;
 - ii. Low-voltage motor control centers, stand-alone low-voltage starters, grouped low-voltage starters;
 - iii. Medium- and low-voltage switchgear;
 - iv. Transformers (company-owned);
 - v. Panelboards above 250V;
 - vi. Stand-alone switches and circuit breakers above 250V; and
 - vii. Fencing (all sides) and gates for access to substations.
 - a) Appendix III shows required current labels for all electrical equipment operating at 480V, 2400V, 4160V, or higher as well as acceptable obsolete labels. An obsolete label that is already in place may remain, but an update should be considered.

9. Personal and Other Protective Equipment

A. This section sets forth the minimum requirements for PPE selection, use, inspection, testing and maintenance required to protect workers from electrical hazards. This section's requirements are in addition to the requirements listed in the USPL HSSE *Personal Protection Equipment* Policy. See Appendix I for a summary of this Program's PPE requirements. Each USPL facility shall develop a PPE Maintenance Program that ensures the PPE is inspected, tested and maintained in accordance with this Program's requirements.

9.1. General

- A. The proper PPE shall be determined based on the electrical hazard risk assessment (shock and arc flash risk assessments), the severity of the hazard, and comparing the level of hazard with the protection offered by the PPE selected.
- B. PPE has limitations that may not protect from all injuries and should be considered the last line of defense against injury (See Hierarchy of Controls in Section 8.5 B). These PPE requirements do

not address protection against physical trauma other than exposure to shock hazards and the thermal effects of an arc flash (See Appendix I for PPE requirements).

- C. PPE for protection against arc flash hazard shall be based on the arc flash risk assessment. *Note:* The protective characteristic of PPE clothing is identified as the arc thermal performance value (ATPV) rating of the garment. The ATPV is expressed in cal/cm² and shall be higher than the energy calculated using the arc flash risk assessment. Flame resistant clothing (FRC) without an arc flash rating has not been tested for exposure to an electric arc. All arc rated clothing is also flame resistant. ATPV is defined as the incident energy on a material that results in a fifty percent probability that sufficient heat transfer through the material is predicted to cause an onset of second degree skin burns.
- D. PPE for protection against shock hazard shall be based on the shock risk assessment.
- E. See Section 8.5 for Risk Assessments requirements.

9.2. Personal Protective Equipment

- A. General
 - Qualified Persons working within the restricted approach boundary shall wear PPE in accordance with shock hazard assessment (see Section 8.5 for Performing Risk Assessment). USPL employees and contractors working within the arc flash boundary shall wear protective clothing and other PPE in accordance with the arc flash hazard assessment (see Section 8.5 for Performing Risk Assessments). When arc rated clothing is worn to protect workers, it shall cover all non-rated clothing and shall allow for movement and visibility.
- B. Head, Face, Neck, and Chin (Head Area) Protection
 - 1. USPL employees and contractors shall wear non-conductive head protection in accordance with the HSSE PPE Policy whenever a shock hazard boundary is crossed. This is in addition to the PPE identified by the shock risk assessment.
 - 2. USPL employees and contractors shall wear face, neck and chin protection whenever they cross arc flash boundary when working on electrical equipment. (See PPE requirements in Appendix I)
 - a) USPL employees and contractors shall use an arc rated balaclava with an arc rated face shield when the back of the head is within the arc flash boundary and the anticipated incident energy exposure is greater than 4 cal/cm². An arc rated hood shall be permitted to be used instead of an arc rated face shield and balaclava.
 - b) USPL employees and contractors shall use an arc rated hood when the anticipated incident energy exposure exceeds 12 cal/cm².
 - c) Face shields shall have an arc rating suitable for the arc flash exposure. Face shields with a wrap-around guarding to protect the face, chin, forehead, ears, and neck area shall be used. Face shields without an arc rating shall not be used. Eye protection (safety glasses or goggles) shall always be worn under face shields or hoods.
- C. Eye Protection
 - USPL employees and contractors shall wear protective equipment for the eyes in accordance with Appendix I. Face shield or hoods are considered a secondary eye protection device that shall be used in addition to the primary protective device underneath.
- D. Hearing Protection
 - 1. USPL employees and contractors shall wear hearing protection in accordance with Appendix I.

- E. Body Protection
 - 1. USPL employees and contractors shall wear arc related clothing as determined by the arc flash risk assessment once they cross the arc flash boundary.
- F. Hand and Arm Shock Protection
 - Qualified Persons shall wear rubber-insulating gloves with leather protectors and rubber-insulating sleeves once they cross the restricted approach boundary. Rubber-insulating gloves with leather protectors provide arc flash protection in addition to shock protection. Rubber-insulating gloves shall be rated for the voltage for which the gloves will be exposed. Where insulating rubber gloves are used for shock protection, leather protectors shall be worn over the rubber gloves. The leather protectors worn over rubber insulating gloves provide additional arc flash protection for the hands for arc flash protection exposure.
 - 2. USPL employees and contractors shall wear hand and arm protection once they cross the arc flash boundary, rated as determined by the arc flash risk assessment.
 - Heavy-duty leather gloves are made entirely of leather with minimum thickness of 0.03 in. (0.7 mm), and are unlined or lined with nonflammable, non-melting fabrics. Heavy-duty leather gloves meeting this requirement have been shown to have ATPV values in excess of 10 cal/cm².
 - 4. Electrical protective equipment shall be maintained in a safe, reliable condition. Insulating equipment shall be inspected for damage before each day's use and immediately following any incident that can reasonably be suspected of having caused damage. Insulating gloves shall be given an air test, along with the inspection. Electrical protective equipment shall be subjected to periodic electrical tests.
- G. Rubber-Insulated Equipment
 - 1. Personnel shall use rubber-insulating protective equipment (e.g., insulating blankets, matting, covers, line hoses, gloves, and sleeves) that is:
 - a) Rated for the highest system voltage measured either phase to phase or phase to ground, and
 - b) Manufactured and tested per the specifications in the applicable American Society for Testing and Materials ("ASTM") standard.
 - 2. Rubber-insulating protective equipment shall:
 - a) Be maintained in a safe, reliable condition through proper usage, inspections, cleaning, storage, and testing per manufacturer's requirements;
 - b) Not be used with voltages higher than that for which it was designed;
 - c) Be inspected for damage before each shift's use and after any incident that may have caused damage. (These inspections do not require documentation.);
 - d) Be taken out of service and destroyed if any defect is found that would degrade the equipment's insulating properties;
 - e) Be kept properly cleaned of foreign substances;
 - f) Be stored to protect it from light, temperature extremes, excessive humidity, ozone, and other damaging conditions, such as abrasion and punctures; and
 - g) Be electrically tested in accordance with the requirements of the applicable ASTM standard and at the intervals specified below.

Rubber Insulating Equipment	When to Test	Governing Standard for Test Voltage [*]
Blankets	Before first issue; every 12 months thereafter. Blankets shall be electrically tested within the previous 12 months before they are issued for service	ASTM F479
Covers	If insulating value is suspect	ASTM F478
Gloves	Before first issue; every 6 months thereafter. Gloves shall be electrically tested within the previous 12 months before they are issued for service	ASTM F496
Line hose	If insulating value is suspect	ASTM F478
Sleeves	Before first issue; every 12 months thereafter. Sleeves shall be electrically tested within the previous 12 months before they are issued for service	ASTM F496

*ASTM F 478, Standard Specification for In-Service Care of Insulating Line Hose and Covers; ASTM F 479, Standard Specification for In-Service Care of Insulating Blankets; ASTM F 496, Standard Specification for In-Service Care of Insulating Gloves and Sleeves.

- 3. Insulating equipment failing to pass inspections or electrical tests shall not be used and shall be destroyed immediately except in limited repair situations where it is required to be tagged for out of service. Repaired equipment shall be electrically retested before use.
- 4. Documentation certifying that the equipment has been tested per the requirements shall be maintained by each USPL facility.
 - a) This certification of electrical testing consists of invoices (or the equivalent) identifying the equipment and the test date or purchase date.
 - b) Only the most recent documentation is required to be retained.
- 5. USPL contractors shall maintain their own test records and supply them to USPL upon request.
- H. Foot Protection
 - 1. If an employee's or contractor's foot crosses the restricted approach boundary, then they shall wear dielectric overshoes (boots), use rubber insulating mats, or a combination of these two items. See USPL HSSE PPE Policy for foot protection requirements.
 - 2. Heavy-duty leather footwear provides some arc flash protection to the feet and shall be used in all exposures.
- I. Factors in Selection of Protective Clothing.
 - 1. Clothing and equipment required for the degree of exposure shall be permitted to be worn alone or integrated with flammable, non-melting apparel. Garments that are not arc rated shall not be permitted to be used to increase the arc rating of a garment or of a clothing system.
 - 2. Non-melting, flammable fiber garments shall be permitted to be used as under layers in conjunction with arc-rated garments in a layered system. If non-melting, flammable fiber garments are used as under layers, the system arc rating shall be sufficient to prevent breakopen of the innermost arc-rated layer at the expected arc exposure incident energy level to prevent ignition of flammable under layers. A typical layering system might include cotton underwear, a cotton shirt and trouser, and an arc-rated coverall.

- 3. Garments worn as outer layers over arc-rated clothing, such as jackets or rainwear, shall also be made from arc-rated material.
- 4. Meltable fibers such as acetate, nylon, polyester, polypropylene, and spandex shall not be permitted in fabric under layers (underwear) next to the skin. An incidental amount of elastic used on non-melting fabric underwear or socks shall be permitted. Arc rated garments are always preferred over flammable garments in a layering system.
- 5. Shirt and coverall sleeves shall be fastened at the wrists, shirts shall be tucked into pants, and shirts, coveralls, and jackets shall be closed at the neck.
- 6. Tight-fitting clothing shall be avoided. Loose-fitting clothing provides additional thermal insulation because of air spaces. Arc-rated apparel shall fit properly such that it does not interfere with the work task.
- 7. The garment selected shall result in the least interference with the task but still provide the necessary protection. The work method, location, and task could influence the protective equipment selected.
- J. Arc Flash Protective Equipment
 - 1. Arc flash suit design shall permit easy and rapid removal by the wearer. The entire arc flash suit, including the hood's face shield, shall have an arc rating that is suitable for the arc flash exposure. When exterior air is supplied into the hood, the air hoses and pump housing shall be either covered by arc-rated materials or constructed of non-melting and nonflammable materials.
- K. Care and Maintenance of Protective Equipment
 - 1. USPL employees and contractors shall maintain their protective equipment in a safe, reliable condition. Workers shall visually inspect the protective equipment before each use. They shall store the equipment to prevent damage from physically damaging conditions and from moisture, dust, or other deteriorating agent according to the manufacturer's instructions.
 - 2. Work clothing or arc flash suits that are contaminated or damaged to the extent that their protective qualities are impaired shall not be used. Protective items that become contaminated with grease, oil, or flammable liquids or combustible materials shall not be used.
 - 3. When arc-rated clothing is cleaned, manufacturer's instructions shall be followed to avoid loss of protection. When arc-rated clothing is repaired, the same arc-rated materials used to manufacture the arc-rated clothing shall be used to provide repairs. When trim, name tags, logos, or any combination thereof, are affixed to arc-rated clothing, follow the ASTM F1506 guidance.
- L. Insulated Tools and Equipment
 - 1. An Electrically Safe Work Condition should be established before repairing electrical equipment.
 - 2. If an Electrically Safe Work Condition cannot be established and Energized Electrical Work is authorized, USPL employees and contractors shall use insulated tools or handling equipment, or both, when working inside the restricted approach boundary of exposed energized electrical conductors or circuit parts where tools or handling equipment might make accidental contact. Requirements for Insulated Tools:
 - a) Insulated tools shall be rated for the voltages on which they are used.
 - b) Insulated tools shall be designed and constructed for the environment to which they are exposed and the manner in which they are used.
 - c) Insulated tools and equipment shall be inspected prior to each use.

- d) Ropes and handlines used within the limited approach boundary or arc flash boundary shall be nonconductive.
- e) Portable ladders shall have nonconductive side rails if they are used within the limited approach boundary or arc flash boundary. Nonconductive ladders shall meet the requirements of the ANSI standards.
- f) Protective shields, protective barriers, or insulating materials shall be used to protect each worker from shock, burns, or other electrically related injuries while an employee is working within the limited approach boundary or arc flash boundary.
- g) Rubber insulating equipment used for protection from accidental contact with energized conductors or circuit parts shall meet the requirements of the ASTM standards.
- Plastic guard equipment for protection of employees from accidental contact with energized conductors or circuit parts, or for protection of employees or energized equipment or material from contact with ground, shall meet the requirements of the ASTM standards.
- i) Physical or mechanical (field-fabricated) barriers shall be installed no closer than the restricted approach boundary.
- M. Live Line Tools
 - 1. Live line tools (e.g. hot sticks, switch sticks, shotgun sticks) shall be wiped clean and inspected before each days use.
 - 2. If any defect or contamination that could adversely affect the insulating qualities or mechanical integrity of the live-line tool is present after wiping, the tool shall be removed from service, examined, and tested before being returned to service.
 - 3. Live-line tools used for primary employee protection shall be removed from service at least every 2 years for examination, cleaning, repair (if necessary), and testing.
- N. Test Instruments
 - 1. Test Instruments and associated leads shall be inspected before each use to ensure insulation integrity.
 - 2. Test Instruments and associated leads that are used to measure 50V or greater via electrical contact shall be removed from service at least every 3 years for examination, testing, and calibration.
 - 3. Test Instruments and associated leads that are used to generate 50V or greater should be removed from service at least every 3 years for examination, testing, and calibration.
- O. Safety Grounding Equipment
 - 1. Personal protective ground cable sets shall be inspected for cuts in the protective sheath and damage to the conductors. Clamps and connector strain relief devices shall be checked for tightness. These inspections shall be made at intervals thereafter as service conditions require, but in no case shall the interval exceed 1 year.
 - 2. Prior to being returned to service, temporary protective grounding equipment that has been repaired or modified shall be tested.
 - 3. Grounding and testing devices shall be stored in a clean and dry area. Grounding and testing devices shall be properly inspected and tested before each use.
- P. Alerting Techniques
 - 1. An Electrically Safe Work Condition should be established before repairing electrical equipment.

- 2. Where there is evidence that electric equipment could fail and injure workers, alerting techniques shall be used to protect workers. Alerting techniques include:
- 3. Safety Signs and Tags

Safety signs, safety symbols, or accident prevention tags shall be used where necessary to warn workers about electrical hazards that might endanger them.

4. Barricades

Barricades shall be used in conjunction with safety signs where it is necessary to prevent or limit worker access to work areas containing energized conductors or circuit parts. Use non-conductive barriers. Barricades shall be placed no closer than the limited approach boundary as determined by the shock hazard risk assessment. Where the arc flash boundary is greater than the limited approach boundary, barricades shall not be placed closer than the arc flash boundary.

5. Attendants

If signs and barricades do not provide sufficient warning and protection from electrical hazards, an attendant shall be stationed to warn and protect workers. The primary duty and responsibility of an attendant providing manual signaling and alerting shall be to keep Unqualified Persons outside a work area. An attendant shall remain in the area as long as there is a potential for workers to be exposed to the electrical hazards.

6. Look-Alike Equipment

Where work performed on equipment that is de-energized and placed in an electrically safe condition exists in a work area with other energized equipment that is similar in size, shape, and construction, one of the altering methods listed above shall be employed to prevent the workers from entering look-alike equipment.

10. ADDITIONAL ELECTRICAL SAFETY REQUIREMENTS IN USPL FACILITIES

10.1. Energizing Circuits After Protective Device Operation

Circuit breakers shall not be manually reset when a circuit is de-energized by the automatic operation of a circuit protective device, until it has been determined by a Qualified Person that the equipment and circuit can be safely energized. The repeated reclosing of circuit breakers or reenergizing circuits through replaced fuses is prohibited. A determination shall be made from the design of the circuit and the overcurrent devices if the automatic operation of a device was caused by an overload rather than a fault condition, then examination of the circuit or connected equipment shall not be required before the circuit is reenergized. In almost every situation, comprehensive troubleshooting is required to understand the cause of the protective device's operation. Consult an I&E Engineer if it is unclear as to the cause of the operation.

10.2. Portable Electrical Equipment

The following procedures shall apply to the use of portable electrical equipment.

- A. Portable equipment shall be stored, used, or handled in accordance with the manufacturer's instructions and safety warnings.
- B. Electrical cords shall not be used for raising or lowering equipment and shall not be fastened by staples or otherwise hung in a manner that could cause damage to the outer insulation.
- C. Extension cords, cord caps and cords on equipment shall be visually inspected before use or at the beginning of each shift to determine whether they are defective or damaged (e.g., loose parts, deformed or missing pins, damage to the outer cover or insulation, or pinched/crushed outer jacket). A visual inspection is not required if equipment and cords remain connected and are not exposed to damage. All defective or damaged cords, cord caps and equipment shall be removed from service immediately until repaired and tested by a person qualified to perform such repairs and testing.
- D. If there is a defect or evidence of damage that might expose an employee to injury, the defective or damaged item shall be removed from service, and no employee may use it until repairs and tests necessary to render the equipment safe have been made.
- E. Grounding type cords shall be used with grounding type equipment. Receptacles and plugs shall not be altered in a manner that would prevent proper continuity; adapters that defeat the grounding connection of equipment may not be used.
- F. Only equipment and cords approved for use in wet locations may be used at job locations where personnel are likely to come in contact with conductive liquids.
- G. Hands shall be dry when plugging or unplugging energized equipment. If energized plugs or receptacles are wet or could otherwise provide a conducting path, only insulating protective equipment may be used for handling the connection devices.
- H. Energized plug and receptacle connections may be handled only with insulating protective equipment if the connection could provide a conducting path to the worker's hand (if, for example, a cord connector is wet).
- I. Adapters shall not be used that interrupt the continuity of the equipment grounding connection.
- J. Locking type connectors shall be properly locked after connection.
- K. Check for the proper orientation of an attachment plug that is to be connected to a receptacle (including an on a cord set) to ensure that they are of proper mating configurations. Attachment

plugs and receptacles may not be connected or altered in a manner that would prevent proper continuity. Additionally, these devices may not be altered to allow the grounding pole of a plug to be inserted into slots intended for connection to the current-carrying conductors.

10.3. Work Near Overhead Power Lines

- A. The requirements for working near energized power lines are:
 - 1. All overhead power lines shall be treated as live and operating at high voltage until verified as otherwise.
 - 2. A determination shall be made by a Qualified Person to determine if overhead lines are properly insulated for the lines' operating voltage.
 - 3. De-energized lines shall be grounded at the point of work. Protective measures, such as guarding, isolating, or insulation, shall prevent each worker from contacting such lines directly with any part of their body or indirectly through conductive materials, tools, or equipment.
 - 4. While working in locations containing uninsulated, energized overhead lines that are not guarded, safety measures shall be taken to prevent employees from coming in contact with the overhead lines with any unguarded parts of their body or indirectly through conductive materials, tools, or equipment. Where contact with uninsulated energized overhead lines is possible, the lines shall be de-energized and visibly grounded at the point of work or suitably guarded.
 - 5. When an Unqualified Person is working in an elevated position or on the ground, near any unguarded, energized overhead line, the person may not approach or take any conductive object closer to the energized parts (See Appendix VI) than:
 - a) For voltages to ground 50 kV or below: **10 feet**
 - b) For voltages to ground over 50 kV: 10 feet plus 4 inches for every 10 kV over 50 kV

Note: Objects are considered conductive if they do not have an insulating rating for the voltage of the overhead power lines.

- 6. If work is to be performed closer than the limits listed above, USPL employees and contractors shall consult the USPL HSSE Safety Advisor or Electrical Technical Authority for the proper safety-related practices.
- B. Vehicular and Mechanical Equipment
 - 1. If moving equipment (e.g., track hoe, extension boom, etc.) is being used within the distance of the maximum reach plus 20' of a power line, on-the-ground warning signs shall be placed at the site to alert all personnel of the overhead hazard (*See* Appendix IV).
 - 2. Any vehicle or mechanical equipment capable of having structural parts elevated near energized overhead lines of 50 kV or less shall be operated so that a clearance of 10 feet is maintained. If the voltage is greater than 50 kV, the clearance shall be increased 4 inches for every 10 kV. The following conditions may reduce these clearance requirements:
 - a) If adequately rated insulating barriers are installed to prevent contact with the lines and are not part of or attached to the vehicle or its raised structure, the clearance may be reduced to a distance within the designed working dimensions of the insulating barrier. This scenario needs approval from the HSSE Safety Advisor or the Electrical Technical Authority.
 - b) If an aerial lift is insulated for the appropriate voltage and if work is performed by a Qualified Person, the clearance may be reduced to the restricted approach boundary as determine by the shock risk analysis.

- c) If any vehicle or mechanical equipment capable of having parts of its structure elevated near energized overhead lines is intentionally grounded, employees and contractors 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. Additional precautions, such as the use of barricades or insulation, shall be taken to protect employees from hazardous ground potentials, depending on earth resistivity and fault currents, which can develop within the first few feet or more outward from the grounding point.
- C. Tree Trimming
 - 1. The following work practices shall apply to tree-trimming activities around overhead power lines.
 - 2. When tree-trimming work is performed by Unqualified Persons:
 - a) Follow all the requirements listed in sections 10.3 A and 10.3 B;
 - b) Work shall stop during adverse weather conditions; and the
 - c) Limbs shall not be dropped onto lines.

10.4. Underground Electrical Lines and Equipment

A. The requirements of the Excavation policy shall be followed to prevent contact with underground electrical lines and equipment.

10.5. Cutting or Drilling

- A. Before cutting or drilling where the likelihood of contacting energized electrical lines or parts exists, workers shall:
 - 1. Identify the location of any possible sources of energized conductors, cables or equipment.
 - 2. Create an electrically safe work condition.
 - 3. If an electrically safe work condition cannot be achieved:
 - a) Perform an electrical risk assessment in conjunction with Hierarchy of Controls to reduce risk to an acceptable level, and
 - b) Identify and use appropriate PPE.

10.6. Electrical Control Panels

- A. The following procedures shall apply to work on electrical control panels:
 - 1. Follow all the safety procedures identified in this Program
 - Enough space shall be provided around electric equipment to allow ready and safe access, operation and maintenance of the equipment as required by Section 8.4 K "Working Spaces Table."
 - 3. When operating the control or main switch, never stand in front of or look at the electrical panel. Always stand off to the side of the panel to operate the switch. If the panel is subject to an arc flash/blast event, this procedure will keep your eyes and body from being in a direct line with the explosion.
 - 4. Before operating switches or breakers, make sure all protective panels are closed and fastened.
 - 5. To disconnect the electrical power from the equipment, always move the control switch to the "Off" position before moving the main switch to the "Off" position.

6. To connect the electrical power, *always* make sure all control switches are off *before* engaging the main switch.

10.7. Switchgear, MCCs, and Motor Controllers

- A. The following procedures shall apply to work on electrical switchgear, MCCs, and motor controllers:
 - 1. Follow all the safety procedures outlined in this Program.
 - 2. Enough space shall be provided around electric equipment to allow ready and safe access to operation and maintenance of the equipment. See Working Spaces Table in Section 8.4 K.
 - 3. Never open switches or other circuit isolating devices when the circuit is loaded (e.g., a pump motor while in operation, shed as much load as practical). Loads should be shed as close to the device itself through normal operational controls. (e.g., open/disconnect branch circuits before opening/disconnecting a main)
 - 4. Determine the operating condition (amount of load applied to circuit, removal of protective grounds, etc.) of the circuit before opening or closing any switch. This precaution protects you and other personnel in case the circuit is faulty.
 - 5. Only load-rated switches, circuit breakers, or other devices specifically designed as disconnecting means shall be used for opening, reversing, or closing circuits under load conditions.
 - 6. Open and close switches completely. Switches left in a partly open position may cause an arc or flashover with damaging results to the switch and possibly serious burns to the operator. Lock and tag switches in the desired position to prevent accidental operation if necessary.
 - 7. When operating high-voltage knife-blade switches or fused cutouts, use the appropriate hot stick of the correct length.

10.8. Substations

- A. Work in substations shall conform to the following work practices:
 - 1. Follow all the safety procedures outlined in this Program
 - Enough space shall be provided around electric equipment to allow ready and safe access to, operation and maintenance of the equipment. See Working Spaces table in Section 8.4 K.
 - 3. Draw-out-type circuit breakers shall be inserted and removed while the breaker is in the open position.
 - 4. Conductive fences around substations shall be grounded.
 - 5. Specifically identified areas in a substation are subject to the following rules:
 - a) They shall be enclosed to minimize entry of Unqualified Persons.
 - b) Warning signs shall be displayed.
 - c) Entrances not under the observation of an attendant have to be locked.
 - d) Unqualified Persons are not allowed to enter these areas while equipment is energized.
 - e) When any work is being done in the fenced area, all gates shall be fully opened prior to any work commencing to facilitate immediate exit if warranted.

6. Live parts operating at more than 150V nominal shall be guarded (by physical guards or by location) or insulated.

10.9. Electrical Installations in Hazardous Classified Areas

- A. The following procedures shall apply to all electrical installations in hazardous classified areas.
 - 1. Electrical Hazardous Area Classification drawings are required for all facilities that have classified areas. These drawings shall be used to determine the proper type of electrical equipment to be installed.
 - 2. Only equipment approved for that application shall be used in areas designated as a hazardous (classified) location.
 - 3. Equipment installed in classified areas shall be legibly marked by the manufacturer or testing agency indicating the areas for which it is approved.
 - 4. The use of electrical equipment that is not appropriately rated for that hazard class shall not be allowed unless a Hot Work Checklist has been issued.
 - 5. Any work in classified areas that may contain an ignition source shall be performed under a Hot Work Checklist.

10.10. Underground Electrical Manholes or Vaults

- A. The following work practices shall apply to work in underground electrical manholes or vaults:
 - 1. Confined space entry standards as outlined in Confined Space Entry policy shall be followed.
 - 2. Access to such installations shall be by ladder or another approved means; stepping on cables or hangers is prohibited.
 - 3. Equipment may not be lowered into a manhole until all personnel inside are clear.
 - 4. Entry into a manhole or vault with energized equipment requires an attendant trained in CPR.
 - 5. If duct rods are used, they shall be installed in the direction presenting the least hazard to personnel. A person shall be stationed at the far end to make sure minimum clearance is maintained.
 - 6. If multiple cables are present, the proper cable shall be positively identified before work begins.
 - 7. An energized cable shall be inspected prior to moving. A defective cable shall be de-energized prior to work. If not possible to de-energize, an electrical risk hazard assessment shall be performed. Sheath continuity shall be maintained, and unshielded cable shall be treated as energized.

Appendix I - USPL Arc Flash Poster bp USPL Arc Flash Safety Awareness Identifying risk to reduce harm to people An Arc Flash is a short circuit through air that flashes over from one exposed live conductor to another, or to ground. A lightning bolt is a demonstration of an Arc Flash. USPL PPE Category **Personal Protective Equipment (PPE) Table** Arc Rating WARNING Arc-Rated Clothing, Minimum Arc Rating of 8 cal/cm² ** Arc-rated long-sleeve shirt and long pants for arc-rated covera Arc-rated face shield or arc flash suit hood Arc-rated face shield or arc flash suit hood Arc Flash and Shock Hazard Appropriate PPE Required 0 **USPL** Policies are Personal Protective Equipment Restricted Approach Distance Volts AC Arc Flash Boundary Protective Equipment Located in DRM Protective Equipment • Hard Hat • Safety Glasses or Safety Goggles • Hearing protection (ear canal inserts) • Heavy duty leather gloves • Leather work shoes Always follow BP USPL Electrical WARNING 1 Safety and Control of Work (COW) sh and Shock Hazar priate PPE Required 1 Policies when performing work on or 1 Personal Protective Equip ches Restricted Approach Dist VAC Volts AC ches Arc Flash Boundary Arc-Rated Clothing, Minimum Arc Rating of 8 cal/co • Same as USPL PPE Category 0. around electrical equipment, whether 4 cal/cm² Protective Equipment Same as USPL PPE Category 0. energized or de-energized. WARNING 2 Arc-Rated Clothing, Minimum Arc Rating of 8 cal/cm² Same as USPL PPE Category 0. Additionally, arc-rated balaclava when using face shield. Flash and Shock Has propriate PPE Requir 2 2 Personal Protective Equipmer 12 inches Restricted Approach Distance 208 VAC Volts AC 235 inches Arc Flash Boundary Protective Equipment Same as USPL PPE Category 0. 8 cal/cm² Any Point on Energized Conductor or Circuit Part PL PPE Category 3 Arc-Rated Clothing selected so the system Arc Rating meets the required Minimum Arc Rating of 25 cal/cm³ Arc-rated long-sleeve shirt and long pants (or arc-rated Arc-rated arc flash suit jacket and pants WARNING 3 Arc Flash and Shock Haza Appropriate PPE Require its for arc-rated co Arc Flag 3 Personal Protective Equipmer Restricted Approach Distance Volts AC Arc Flash Boundary Arc flash suit hood Arc-rated gloves Arc-rated jacket, parka, rainwear, or hard hat liner (as ne 25 cal/cm² Activate jacket, parka, rainwear, or ha **Protective Equipment** Hard Hat Safety Glasses or Safety Goggles Hearing protection (ear canal inserts) Leather work shoes 0 rotec WARNING riate PPE Re 4 l Protective Equipmen ed Approach Distance PL PPE Category 4 Arc-Rated Clothing selected so the system Arc Rating meets the required Minimum Arc Rating of 40 cal/cm² • Same as USPL PPE Category 3. Volts AC Arc Flash Boundary Protective Equipment Same as USPL PPE Category 3. DANGER Crossing the Restricted Approach No safe PPE available! • DANGEROUS- DO NOT WORK ON EQUIPMENT • Follow Lock-Out/Tag-Out (LOTO) policy Arc Flash and Shock Hazard NO SAFE PPE AVAILABLE Boundary requires an Energized onal Prote ctive Equip Electrical Work Permit unless testing, Volts AC Arc Flash Boundary troubleshooting or voltage measuring. ** While calculated incident energy is less than 8 cal/cm³ this is the minimum rating per the 8P USPL PPE policy. **Restricted Approach** Limited Approach Boundary Approach Nominal AC System* Boundary; Voltage Range, boundaries to Includes Inadvertent Exposed Movable Exposed Fixed Phase to Phase Movement Adder energized electrical Conductor Circuit Part conductors for <50 V Not specified Not specified Not specified 50 V-150 V 10ft Oin 3ft 6in Avoid contact shock protection 151 V-750 V 10ft Oin 3ft 6in 1ft Oin

10ft Oin

10ft Oin

10ft Oin

10ft Oin

10ft 8in

5ft Oin

6ft 0in

8ft Oin

8ft 0in

8ft Oin

re information, contact your facility I&E Engineer

 Revision Date: August 24, 2020
 Effective Date

 Next Review Date: August 24, 2025
 The controlled version of this document can be found in DRM in the HSSE Policies folder.

751 V-15 kV

15.1 kV-36 kV

36.1 kV-46 kV

46.1 kV-72.5 kV

72.6 kV-121 kV

electrical conductors, see electrical safety policy.

2ft 2in

2ft 7in

2ft 9in

3ft 3in

3ft 4in

Appendix IA - USPL PPE Category Expanded

USFL	Demonstration Environment
PPE	Personal Protective Equipment
Category	
0 <1.2 cal/cm2	Arc-Rated Clothing, Minimum Arc Rating of 8 cal/cm2 ** • Arc-rated long-sleeve shirt and long pants (or arc-rated coverall) • Arc-rated face shield or arc flash suit hood • Arc-rated jacket, parka, rainwear, or hard hat liner (as needed) Protective Equipment • Hard Hat • Safety Glasses or Safety Goggles • Hearing protection (ear canal inserts) • Heavy duty leather gloves • Leather work shoes
1 4cal/cm2	Arc-Rated Clothing, Minimum Arc Rating of 8 cal/cm2 ** • Same as USPL PPE Category 0. Protective Equipment • Same as USPL PPE Category 0.
2 8 cal/cm2	Arc-Rated Clothing, Minimum Arc Rating of 8 cal/cm2 • Same as USPL PPE Category 0. • Additionally, arc-rated balaclava when using face shield. Protective Equipment • Same as USPL PPE Category 0.
3 25 cal/cm2	 Arc-Rated Clothing selected so the system Arc Rating meets the required Minimum Arc Rating of 25 cal/cm2 Arc-rated long-sleeve shirt and long pants (or arc-rated coverall) Arc-rated arc flash suit jacket and pants Arc flash suit hood Arc-rated gloves Arc-rated jacket, parka, rainwear, or hard hat liner (as needed) Protective Equipment Hard Hat Safety Glasses or Safety Goggles Hearing protection (ear canal inserts) Leather work shoes
4 40 cal/cm2	Arc-Rated Clothing selected so the system Arc Rating meets the required Minimum Arc Rating of 40 cal/cm2 • Same as USPL PPE Category 3. Protective Equipment • Same as USPL PPE Category 3.
Exceeds 40 cal/cm2	No safe PPE available! • DANGEROUS - DO NOT WORK ON EQUIPMENT • Follow Lock-Out/Tag-Out (LOTO) policy

** While calculated incident energy is less than 8 cal/cm2 this is the minimum rating per the BP USPL PPE policy.

Appendix II - USPL Field Labels

A WARNING 0	A WARNING 1		
Arc Flash and Shock Hazard Appropriate PPE Required	Arc Flash and Shock Hazard Appropriate PPE Required		
0 Personal Protective Equipment 12 inches Restricted Approach Distance 480 VAC Volts AC 27 inches Arc Flash Boundary	1 Personal Protective Equipment 12 inches Restricted Approach Distance 208 VAC Volts AC 71 inches Arc Flash Boundary		
Hazard-Risk Category 0 PPE is required.	Hazard-Risk Category 1 PPE is required.		
A WARNING 2	A WARNING 3		
Arc Flash and Shock Hazard Appropriate PPE Required	Arc Flash and Shock Hazard Appropriate PPE Required		
2 Personal Protective Equipment 12 inches Restricted Approach Distance 208 VAC Volts AC 235 inches Arc Flash Boundary	3 Personal Protective Equipment 12 inches Restricted Approach Distance 480 VAC Volts AC 201 inches Arc Flash Boundary		
Hazard-Risk Category 2 PPE is required.	Hazard-Risk Category 3 PPE is required.		
A WARNING 4	A DANGER		
Arc Flash and Shock Hazard Appropriate PPE Required	Arc Flash and Shock Hazard NO SAFE PPE AVAILABLE		
 4 Personal Protective Equipment 12 inches Restricted Approach Distance 480 VAC Volts AC 121 inches Arc Flash Boundary 	Dangerous!Personal Protective Equipment26 inchesRestricted Approach Distance34500 VACVolts AC634 inchesArc Flash Boundary		
Hazard-Risk Category 4 PPE is required.	Hazard-Risk Category No Safe PPE Available!		

Appendix III - High Voltage Danger Signs



OBSOLETE HIGH-VOLTAGE SIGN







EXAMPLES OF NEW ANSI DESIGNS

Appendix IV - Sample Overhead Power Line Signs

If moving equipment (e.g., track hoe, extension boom, etc.) is being used within the distance of the maximum reach plus 20' of a power line, on-the-ground warning signs shall be placed at the site to alert all personnel of the overhead hazard. Examples of signs include:





Appendix V - Electrical Safety Knowledge Training -Suggested Topics

- A. The purpose of the Electrical Safety Knowledge Training for USPL employees is to build understanding of electrical hazard and includes, but is not limited to, the following:
 - 1. The effect of current flow in human body;
 - 2. The effects of human tissue exposure to arc flashes;
 - 3. Impedance of human tissue;
 - 4. Impedance of human contact;
 - 5. Concept and implementation of the shock hazard analysis;
 - 6. Flashover distances at various voltages;
 - 7. Concept and implementation of the arc flash hazard analysis;
 - 8. Electrical equipment labeling
 - 9. Hazard associated with testing circuits;
 - 10. Effective construction of safety grounds;
 - 11. Hazards associated with grounding;
 - 12. Effects of pressure on an enclosure;
 - 13. Care and inspection of a voltmeter;
 - 14. Effects of voltage on current flow;
 - 15. Effects of voltage on the arc flash;
 - 16. Unknown electrical hazards;
 - 17. Relationship of exposure to hazards and injury;
 - 18. Protective characteristics of personal protective equipment;
 - 19. Construction and operation of electrical equipment;
 - 20. Visual indications of an electrical hazard;
 - 21. Different types of electrical hazards;
 - 22. Importance of communications; and
 - 23. Existence and content of the USPL safety related policies.

Appendix VI Approach Boundaries to Energized Conductors or Circuit Parts

Limited Approach Boundaryb

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

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

^a For single-phase systems above 250V, select the range that is equal to the system's maximum phaseto-ground voltage multiplied by 1.732.

^b The energized electrical conductors or circuit part operating at 50 volts or more are insulated from the qualified person and from any other conductive object at a different potential.

^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 120V nominal.

Approach Boundaries to Energized Electrical Conductor	ors or Circuit Parts for Shock Protection,
Direct-Current Voltage Systems	

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

Note: All dimensions are distance from exposed energized electrical conductors or circuit parts to worker.

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

Appendix VII Maintaining the Minimum Approach Distance



Effective Date: August 24, 2020

Appendix VIII - Arc Flash Risk Assessment based on PPE Categories Method

- A. This section details the determination of the arc flash boundary and arc flash PPE based on the PPE Categories Method. This method shall be used only under Electrical Technical Authority supervision and shall be applied under the following conditions:
 - 1. The Arc Flash Analysis (Incident Energy Analysis Method) is not available
 - 2. The parameters listed in the Table VIII.2 and VIII.3 apply to the site and have been confirmed by on-site verification.
 - 3. This method shall not be combined with the Incident Energy Analysis Method on the same piece of equipment.
- B. The PPE Categories Method requires the following steps to be followed:
 - 1. Determine if arc flash PPE is required from Table VIII.1. This table is based on NFPA 70E, 2015 Edition, Table 130.7(C)(15)(A)(a).
 - The arc flash boundary shall be determined based on Table VIII.2 for AC systems and based on Table VIII.3 for DC Systems, when the parameters of these tables apply. These tables are based on NFPA 70E, 2015 Edition, Table 130.7(C)(15)(A)(b) for AC Systems and 130.7(C)(15)(B) for DC systems.
 - When arc flash PPE is required, Table VII.2, VIII.3 and VII.4 shall be used to determine the required PPE, when the parameters of these tables apply. These tables are based on NFPA 70E, 2015 Edition, Table 130.7(C)(15) and 130.7(C)(16).
- C. When these tables are used, the current and clearing times included in the equipment category/rating headings must be checked on site to confirm that use of the tables is permitted.
- D. Method to determine the total clearing time:
 - 1. The determination of a value for arcing current is made based on a determination of the probable available three-phase symmetrical fault current.
 - 2. For estimating total clearing time for an overcurrent protective device where arcing currents are involved determine the estimated arcing current and then plot that arcing current on the protective device's time-current characteristic curve, thereby determining its tripping time.
 - 3. Another method for estimating total clearing time for 480 Volt nominal system is to estimate the short-circuit current with reasonable accuracy, and then use 38 percent of the value to determine the total clearing time.
 - 4. For medium voltage systems, a reasonable approach for estimating the tripping time may involve using a value of 90 to 95 percent of the short-circuit current for the arcing current, and then using 85 percent of that value to determine the total clearing time.
 - 5. For relay operated circuit breakers, the relay curves show only the relay operating time in the time-delay region. For relays operating in their instantaneous region, allow 16 milliseconds on 60 Hz system for operation. The circuit breaker opening time needs to be added to the tripping time determined from the time-current characteristic. Below are the IEEE recommended power circuit t breaker operating times. (The table does not include the external relay trip time).

Circuit breaker rating and type	Opening time at 60 Hz (cycles)	Opening time (seconds)
Low voltage (molded case) (< 1000 V) (integral trip)	1.5	0.025
Low voltage (insulated case) (< 1000 V) power circuit breaker (integral trip or relay operated)	3.0	0.050
Medium voltage (1–35 kV)	5.0	0.080
Some high voltage (> 35 kV)	8.0	0.130

- E. The arc flash PPE Categories Method shall not be used, and the Incident Energy Analysis method should be used instead for the following:
 - 1. Task not listed in Table VIII.1
 - 2. Power system with greater than the estimated maximum available short-circuit current
 - 3. Power system with longer than the maximum fault clearing times
 - 4. Tasks with less than the minimum working distance

Table VIII.1 - Arc Flash Hazard Identification for Alternating Current (ac) and Direct Current (dc) Systems

Direct Current (dc) Systems		
Task	Equipment Condition*	Arc Flash PPE Required
Reading a panel meter while operating a meter switch	Апу	No
Normal operation of a circuit breaker (CB), switch, contactor, or starter	All of the following: The equipment is properly installed The equipment is properly maintained All equipment doors are closed and secured All equipment covers are in place and secured There is no evidence of impending failure	No
	One or more of the following: The equipment is not properly installed The equipment is not properly maintained Equipment doors are open or not secured Equipment covers are off or not secured There is evidence of impending failure	Yes
For ac systems: Work on energized electrical conductors and circuit parts, including voltage testing	Any	Yes
For dc systems: Work on energized electrical conductors and circuit parts of series-connected battery cells, including voltage testing	Any	Yes
Voltage testing on individual battery cells or individual multi-cell units	All of the following: The equipment is properly installed The equipment is properly maintained Covers for all other equipment are in place and secured There is no evidence of impending failure	No
	One or more of the following: The equipment is not properly installed The equipment is not properly maintained Equipment doors are open or not secured Equipment covers are off or not secured There is evidence of impending failure	Yes
Removal or installation of CBs or switches	Any	Yes
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	All of the following: The equipment is properly installed The equipment is properly maintained There is no evidence of impending failure	No
	Any of the following: The equipment is not properly installed The equipment is not properly maintained There is evidence of impending failure	Yes
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.	Апу	Yes

Table 130.7(C)(15)(A)(a) Arc Flash Hazard Identification for Alternating Current (ac) and Direct Current (dc) Systems

(continues)

Table VIII.1 - Continued

Task	Equipment Condition*	Arc Flash PPE Required
Removal of battery intercell connector covers	All of the following: The equipment is properly installed. The equipment is properly maintained Covers for all other equipment are in place and secured There is no evidence of impending failure	No
	One or more of the following: The equipment is not properly installed The equipment is not properly maintained Equipment doors are open or not secured Equipment covers are off or not secured There is evidence of impending failure	Yes
Opening hinged door(s) or cover(s) (to expose bare energized electrical conductors and circuit parts)	Апу	Yes
Perform infrared thermography and other noncontact inspections outside the restricted approach boundary. This activity does not include opening of doors or covers.	Any	No
Application of temporary protective grounding equipment after voltage test	Апу	Yes
Work on control circuits with exposed energized electrical conductors and circuit parts, 120 volts or below without any other exposed energized equipment over 120 V including opening of hinged covers to gain access	Any	No
Work on control circuits with exposed energized electrical conductors and circuit parts, greater than 120 V	Any	Yes
Insertion or removal of individual starter buckets from motor control center (MCC)	Any	Yes
Insertion or removal (racking) of CBs or starters from cubicles, doors open or closed	Any	Yes
Insertion or removal of plug-in devices into or from busways	Апу	Yes
Insulated cable examination with no manipulation of cable	Апу	No
Insulated cable examination with manipulation of cable	Апу	Yes
Work on exposed energized electrical conductors and circuit parts of equipment directly supplied by a panelboard or motor control center	Апу	Yes
Insertion and removal of revenue meters (kW-hour, at primary voltage and current)	Any	Yes
For dc systems, insertion or removal of individual cells or multi-cell units of a battery system in an enclosure	Апу	Yes
For dc systems, insertion or removal of individual cells or multi-cell units of a battery system in an open rack	Any	No

Table VIII.1 - Continued

Task	Equipment Condition*	Arc Flash PPE Required
For dc systems, maintenance on a single cell of a battery system or multi-cell units in an open rack	Any	No
For dc systems, work on exposed energized electrical conductors and circuit parts of utilization equipment directly supplied by a dc source	Any	Yes
Arc-resistant switchgear Type 1 or 2 (for clearing times of <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, tested in accordance with IEEE C37.20.7:	All of the following:	
 Insertion or removal (racking) of CBs from cubicles Insertion or removal (racking) of ground and test device Insertion or removal (racking) of voltage transformers on or off the bus 	The equipment is properly installed The equipment is properly maintained All equipment doors are closed and secured All equipment covers are in place and secured There is no evidence of impending failure	No
	One or more of the following: The equipment is not properly installed The equipment is not properly maintained Equipment doors are open or not secured Equipment covers are off or not secured There is evidence of impending failure	Yes
Opening voltage transformer or control power transformer compartments	Any	Yes
Outdoor disconnect switch operation (hookstick operated) at 1 kV through 15 kV	Any	Yes
Outdoor disconnect switch operation (gang-operated, from grade) at 1 kV through 15 kV	Any	Yes

Note: Hazard identification is one component of risk assessment. Risk assessment involves a determination of the likelihood of occurrence of an incident, resulting from a hazard that could cause injury or damage to health. The assessment of the likelihood of occurrence contained in this table does not cover every possible condition or situation. Where this table indicates that arc flash PPE is not required, an arc flash is not likely to occur.

*The phrase *properly installed*, as used in this table, means that the equipment is installed in accordance with applicable industry codes and standards and the manufacturer's recommendations. The phrase *properly maintained*, as used in this table, means that the equipment has been maintained in accordance with the manufacturer's recommendations and applicable industry codes and standards. The phrase *evidence of impending failure*, as used in this table, means that there is evidence of arcing, overheating, loose or bound equipment parts, visible damage, deterioration, or other damage.

Table VIII.2 - Arc-Flash Hazard PPE Categories for Alternating Current (ac) Systems

Equipment	Arc Flash PPE Category	Arc-Flash Boundary
Panelboards or other equipment rated 240 V and below		485 mm
Parameters: Maximum of 25 kA short-circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.)	Ι	(19 in.)
Panelboards or other equipment rated >240 V and up to 600 V		900 mm
Parameters: Maximum of 25 kA short-circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.)	2	(3 ft)
600-V class motor control centers (MCCs)		1.5 m
Parameters: Maximum of 65 kA short-circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.)	2	(5 ft)
600-V class motor control centers (MCCs)		4.3 m
Parameters: Maximum of 42 kA short-circuit current available; maximum of 0.33 sec (20 cycles) fault clearing time; working distance 455 mm (18 in.)	4	(14 ft)
600-V class switchgear (with power circuit breakers or fused switches) and 600 V class switchboards		6 m
Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.5 sec (30 cycles) fault clearing time; working distance 455 mm (18 in.)	4	(20 ft)
Other 600-V class (277 V through 600 V, nominal) equipment		1.5 m
Parameters: Maximum of 65 kA short circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.)	2	(5 ft)
NEMA E2 (fused contactor) motor starters, 2.3 kV through 7.2 kV		12 m
Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)	4	(40 ft)
Metal-clad switchgear, 1 kV through 15 kV		12 m
Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)	4	(40 ft)
Arc-resistant switchgear Type 1 or 2 [for clearing times of < 0.5 sec (30 cycles) with a perspective fault current not to exceed the arc-resistant rating of the equipment], and metal-enclosed interrupter switchgear, fused or unfused of arc-resistant-type construction, tested in accordance with IEEE C37.20.7, 1 kV through 15 kV	N/A (doors closed)	N/A (doors closed)
Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)	4 (doors open)	12 m (40 ft)
Other equipment 1 kV through 15 kV		12 m
Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)	4	(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.

Table VIII.3 - Arc-Flash Hazard PPE Categories for Direct Current (dc) Systems

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

Note: Apparel that can be expected to be exposed to electrolyte must meet both of the following conditions: (1) Be evaluated for electrolyte protection in accordance with ASTM F1296, *Standard Guide for Evaluating Chemical Protective Clothing*

(2) Be arc-rated in accordance with ASTM F1891, Standard Specification for Arc Rated and Flame Resistant Rainwear, or equivalent

Table VIII.4 - Personal Protective Equipment (PPE)

PPE tegory	PPE
1	Arc-Rated Clothing, Minimum Arc Rating of 4 cal/cm ² (see Note 1)
	Arc-rated long-sleeve shirt and pants or arc-rated coverall
	Arc-rated face shield (see Note 2) 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)
	Leather footwear (AN)
2	Arc-Rated Clothing, Minimum Arc Rating of 8 cal/cm ² (see Note 1)
	Arc-rated long-sleeve shirt and pants or arc-rated
	coverall
	Arc-rated flash suit hood or arc-rated face shield (see
	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)
	Heavy duty leather gloves (see Note 3)
	Leather footwear
3	Arc-Rated Clothing Selected so That the System Arc Rating Meets the Required Minimum Arc Rating of 25 cpl/cm ² (see Note 10)
	Arc-rated long-sleeve shirt (AR)
	Arc-rated pants (AR)
	Arc-rated coverall (AR)
	Arc-rated arc flash suit packet (AK) Arc-rated arc flash suit pants (AR)
	Arc-rated arc flash suit hood
	Arc-rated gloves (see Note 1)
	Arc-rated jacket, parka, rainwear, or hard hat liner (AN)
	Hard hat
	Safety glasses or safety goggles (SR)
	Hearing protection (ear canal inserts)
4	Arc-Rated Clothing Selected so That the System Arc Rating Meets the Required Minimum Arc Rating of
	40 cal/cm ² (see Note 1) A no roted large discussibility (Λ D)
	Arc-rated nong-sleeve shift (AK) Arc-rated parts (AR)
	Arc-rated coverall (AR)
	Arc-rated arc flash suit jacket (AR)
	Arc-rated arc flash suit pants (AR)
	Arc-rated gloves (see Note 1)
	Arc-rated jacket, parka, rainwear, or hard hat liner (AN)
	Protective Equipment
	Hard hat Safety glasses or safety googles (SP)
	Hearing protection (ear canal inserts)
	Leather footwear

AN: as needed (optional). AR: as required. SR: selection required. Notes:

(1) Arc rating is defined in Definitions.

(2) Face shields are to have wrap-around guarding to protect not only the face but also the forehead, ears, and neck, or, alternatively, an arc-rated arc flash suit hood is required to be worn.

(3) If rubber insulating gloves with leather protectors are used, additional leather or arc-rated gloves are not required. The combination of rubber insulating gloves with leather protectors satisfies the arc flash protection requirement.

Appendix IX - Risk Assessment Procedure

- A. Under special circumstances, as determined by the Electrical Technical Authority, the Risk Assessment Procedure as detailed in NFPA 70E, 2015 Edition, Informative Annex F, may be used in order to assess the risk associated with a task.
- B. Risk assessment is composed of risk estimation and risk evaluation. Under direct supervision of the Electrical Technical Authority, an iterative process of risk reduction may be undertaken until an acceptable risk level is attained.
- C. This Risk Assessment Procedure requires application of the hierarchy of health and safety controls, as outline in this Program Section 8.5.B.1, from the highest level to the lowest level of controls in order to reduce the risk to an acceptable level for the task.
- D. Risk assessment includes a comprehensive review of the hazards, the associated foreseeable tasks, and the protective measures that are required in order to maintain a tolerable level of risk, including the following:
 - 1. Identifying and analyzing electrical hazards
 - 2. Identifying tasks to be performed
 - 3. Documenting hazards associated with each task
 - 4. Estimating the risk for each hazard/task pair
 - 5. Determining the appropriate protective measures needed to adequately reduce the level of risk.
- E. The Risk Assessment Procedure requires the coordinated effort of multiple groups and individuals working as a team. Under the leadership of the Electrical Technical Authority, the risk assessment team may include qualified process and electrical engineers, safety and environmental representatives, operations and maintenance. The team will be constituted by the Electrical Technical Authority in collaboration with the HSSE Safety Advisor.

Appendix X - 1910.269 Flow Charts

Application of 1910.269 and Subpart S to Electrical Safety Related Practices



¹ This flowchart applies only to the electrical safety-related work practice and training requirements in §1910.269 and §§1910.332 through 1910.335.

² See §§1910.269(a)(1)(ii)(B) and 1910.331(b) and (c)(1).

³ This means commingled to the extent that the electric power generation, transmission, or distribution installation poses the greater hazard.

Application of 1910.269 and 1910.333 to Hazardous Energy Control Procedure



¹If a generation, transmission, or distribution installation conforms to §§1910.302 through 1910.308, the lockout and tagging procedures of §1910.333(b) may be followed for electric-shock hazards.

²This means commingled to the extent that the electric power generation, transmission, or distribution installation poses the greater hazard.

³Paragraphs (b)(2)(iii)(D) and (b)(2)(iv)(B) of §1910.333 still apply.

⁴Paragraph (b) of §1910.333 applies to any electrical hazards from work on, near, or with electric conductors and equipment.

Application of 1910.269 and Subpart S to Tree Trimming Operations



¹ 3.05 meters (10 feet) plus 0.10 meters (4 inches) for every 10 kilovolts over 50 kilovolts.

Note: Paragraph (t) of §1910.269 contains additional requirements for work in manholes and underground vaults.

Appendix XI – Warning Signs to Apply to Electrical Equipment

A. Sign for electrical equipment within LOTO scope.



B. Sign for electrical equipment within LOTO scope but energized for testing.



C. Sign for adjacent electrical equipment not within LOTO scope.

