July 15, 2019

Ameren

Ameren Services, Ameren Missouri, and Ameren Transmission

Effective Date – 15 July 2019
Revision 4

Table of Contents Page

1.0 INTRODUCTION

1.1 Purpose

This manual establishes safe work practices for all designated personnel required to work on or around any energized electrical equipment at Ameren Services, Ameren Transmission and Ameren Missouri Energy Delivery and Generation facilities. This manual applies to electrical operations 50 nominal volts or greater unless otherwise specifically discussed in this manual.

1.2 Scope

This document applies to Ameren services, Ameren transmission and Ameren Missouri (nuclear and non-nuclear generation and energy delivery). This document does not apply to Ameren Illinois. The scope of the ESWPM is to comply with 29 CFR 1910.269, 1910 subpart s, national electric safety code, ANSI/ASME and applicable sections of NFPA 70e.

2.0 INFORMATION

2.1 Terms and Definitions

2.1.1 **Ameren Hazardous Risk Categories (AHRC):** A standardized set of electrical PPE used for worker protection based upon varying levels of arc flash exposures.

2.1.2 **Approach Boundaries**

2.1.2.1 **Arc Flash Boundary (AFB):** When an arc flash hazard exists, an arc flash boundary is an approach limit at a distance from a prospective arc source at which there is a likelihood of an onset of a second degree burn at an exposure of 1.2 cal/cm^2. This is a PPE boundary (See Attachment 1, Limits of Approach). Due to a person working on an energy source that could cause an arc flash, the Electrical Qualified employee shall wear the appropriate arc flash protection based on the arc hazard.

2.1.2.2 **Limited Approach Boundary (LAB)**: An approach limit at a distance from an exposed energized electrical conductor or circuit part, within which a shock hazard exists. This is a qualification-only boundary for Class B and E qualified employees (See Attachment 1, Limits of Approach and Attachment 2, Approach Boundaries).

2.1.2.3 **Restricted Approach Boundary (RAB) or Minimum Approach Distance (MAD)**: An approach limit at a distance from an exposed energized electrical conductor or circuit part within which there is an increased likelihood of shock, due to an electrical arc-over combined with inadvertent movement, for personnel working in close proximity to the energized electrical conductor or circuit part. The RAB/MAD is the inner boundary classified as ***"working on"*** an exposed energized and unguarded electrical conductor or circuit part. This is a PPE boundary (See Attachment 1, Limits of Approach and Attachment 2, Approach Boundaries).

2.1.3 **Arc Flash (AF) Hazard:** A dangerous condition associated with the possible release of energy caused by an electric arc. Appropriate Arc Rated PPE shall be utilized within the AFB when any employee or tool breaks the plane of the RAB/MAD or interacts with the equipment. Arc Flash protection starts at 1.2 cal./cm^2

2.1.4 **Arc Rated PPE:** Flame resistant and electric arc resistant clothing.

2.1.5 **Arc Rating:** The maximum incident energy resistance demonstrated by a material (or a layered system of materials) prior to break-open or at the onset of a second-degree skin burn. Arc rating is normally expressed in cal./cm2.

2.1.6 **Barricade:** A physical obstruction intended to provide a warning about, and to limit access to, an area around the equipment.

2.1.7 **Bonding:** A reliable conductor to ensure the required electrical conductivity between metal parts required to be electrically connected.

2.1.8 **Control voltages:** Electrical signals in analog and digital circuits that control mechanical or electrical equipment. Electrical circuits may contain control voltages energized at 240 volts or below even though other parts of the electrical equipment has been de-energized.

2.1.9 **Dead Front:** An electrical panel or device installed to ensure the safety of the operator from accidental contact of exposed electrical energized parts.

2.1.10 **De-energized:** Free from any electrical connection to a source of potential difference and from electrical charge

2.1.11 **Energized:** Electrically connected to, or is, a source of voltage (equipment must be considered energized until proven otherwise).

2.1.12 **Electrically safe work condition:** Establishing those processes that allow personnel to work safely on or around de-energized or energized electrical conductors and circuits.

2.1.13 **Exposed (as applied to energized electrical conductors or circuit parts):** Capable of being inadvertently touched or approached within the RAB/MAD by a person. It is applied to electrical conductors or circuit parts that are not suitably guarded, isolated, or insulated. Inside facilities less than ½ inch opening is considered finger-safe.

2.1.14 **Finger-Safe:** Openings on energized electrical equipment that is less than ½ inch and is not meant for intentional access.

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

2.1.16 **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.

2.1.17 **Incident Energy:** The amount of thermal energy impressed on a surface, a certain distance from the source, generated during an electrical arc event. One of the units used to measure incident energy is calories per centimeter squared (cal./cm^2).

2.1.18 **Hierarchy of Controls**: is a system used to eliminate, minimize or reduce exposure to electrical hazards. The most effective Hierarchy of Control is utilizing “Elimination” to remove the exposure before it even occurs. “Substitution”, which is the second most effective Hierarch of Control, reduces the risk by switching to another process, equipment, material, design, etc. Most of the time this results in a permanent change to how a job is performed. “Engineering Controls” is the third Hierarch of Control. If an electrical hazard can’t be eliminated or there is not alternative that can be instituted, then the next step is to provide engineering controls, which changes the structure of the work area to reduce exposure through safety devices or barriers such as a machine guard.

2.1.19 **Job Briefing Form:** A pre-task document used by the employee in charge to discuss information about existing electrical characteristics and condition of the task. The job briefing outlines the planning of the task, current and potential hazards, tools and procedures needed to safely perform the task, personal protective equipment to be worn, identification of all energy sources, and special precautions or unique processes of the task.

2.1.20 **Live-Dead-Live (LDL):** The Live-Dead-Live method is testing with voltage test equipment (Multi-meter, Wiggins, Proximity Tester, etc.) on a known energized source, then the circuit being checked de-energized and return to the known energized source. The energized source does not need to be of the same voltage as the designed voltage for the circuit being checked de-energized as long as the test equipment is designed for both.

2.1.21 **Lockout/Tagout (LOTO):** Procedure used to de-energize an electric energy source by identifying and disconnecting the source, then preventing the disconnecting means from accidental closure through the use of appropriate tags and lockout devices.

2.1.22 **Not Possible:** The item is not available or there is no safe means to connect.

2.1.23 **Personal Protective Grounds (PPG):** Cables connected to de-energized lines and equipment by jumpering and bonding to a ground source with appropriate clamps, to limit the voltage difference between accessible points at a worksite to safe values if the lines or equipment are accidentally re-energized. Grounds that are used whenever workers perform tasks on electrical circuits or components that may become re-energized for some reason, possibly by the reclosing of switches or circuit breakers.

2.1.24 **Qualified person:** One who has demonstrated skills and knowledge related to the construction and operation of electrical equipment and installations and has received training to identify and avoid the hazards involved.

2.1.24.1 **Electrically Basic (B) qualified persons:** Those persons who have received some Ameren basic electrical training. They are familiar with the electrical safety-related practices that are necessary to work safely around energized equipment or overhead lines. Class (B) qualified persons are those workers who must ***"work around"*** exposed energized electrical conductors. Class (B) qualified persons are those workers who can enter the LAB and areas classified as Cat 0, but cannot cross the AFB or RAB/MAD unless escorted by a Class (E) qualified person.

2.1.24.2 **Electrically (E) qualified persons:** Those persons who are trained to be exposed to unguarded, uninsulated, energized lines or equipment parts operating at greater than 50 volts. Class (E) qualified persons are trained to a greater proficiency level as part of their job classification because they work on or near energized equipment or overhead lines on such a regular

basis that additional personal protective measures beyond simple awareness are required. Not all Class (E) qualified employees can perform the same tasks. As an example, electricians (due to their extensive training) can perform a wider array of Class (E) work than other Class (E) designations. Qualified (E) workers are those who are required to ***"work on or around"*** exposed energized electrical conductors.

2.1.25 **Nonqualified (N) person:** An individual who is not properly trained and experienced to work on or near ***exposed*** energized circuits of greater than 50 volts. This does not exclude personnel from plugging in and using common 120V appliances. Nonqualified (N) employees are required to be escorted by a Class (E) or (B) qualified person anytime they are within a Limited Approach Boundary. Those workers whose duties do not require them to work on or around exposed energized electrical conductors.

2.1.26 **Safety Observer**: A Class (E) qualified person whose main function is to observe electrical work and warn workers of near contact with any exposed energized source.

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

2.1.28 **Substations:** An installation in Energy Delivery that contains electrical equipment capable of interrupting or establishing electrical circuits and changing the voltages, frequency, or other characteristics of the electrical energy flowing in the circuits.

2.1.29 **Switchyards:** An installation in Generation that contains electrical equipment capable of interrupting or establishing electrical circuits and changing the voltages, frequency, or other characteristics of the electrical energy flowing in the circuits.

2.1.30 **Troubleshooting:** A systematic approach to analyzing a circuit and determining what is wrong. Any activity that involves inspecting, testing or adjusting of the equipment.

2.1.31 **Two Person Rule:** Any work inside the RAB/MAD greater than 600 volts, requires two Class E qualified workers present for the duration of the task. Two Person Rule does not apply to:

a. Routine circuit switching, when the employer can demonstrate that conditions at the site allow safe performance of this work,

b. Work performed with live-line tools when the position of the employee is such that he or she is neither within reach of, nor otherwise exposed to contact with, energized parts, and

c. Emergency repairs to the extent necessary to safeguard the general public.

2.1.32 **Workers Protection Assurance (WPA):** Is an operating authority's assurance to a worker (or supervisor) that a given piece of equipment will be held in a required status in order that the worker may safely perform the worker's duties on the equipment.

2.1.33 **Work/Working around (exposed energized electrical conductors):** Any activity between the AFB or LAB, and the RAB/MAD.

2.1.34 **Work/Working on (exposed energized electrical conductors):** Intentionally coming in contact with energized electrical conductors or circuit parts with hands, feet or other body parts with tools, probes or with test equipment, regardless of the PPE a person is wearing. Work inside the RAB/MAD is considered working on.

3.0 RESPONSIBILITIES

3.1 Ameren Business Segments

3.1.1 Ameren Business Segments should either properly label electrical equipment or maintain documentation which will include, but is not necessarily limited to, equipment examined in the Arc Flash Study (See Attachment 3, Heat Energy Incident Table Example). Labels or documentation shall include voltage levels, incident energy levels, and hazard boundary information.

3.1.2 Ameren Business Segments shall provide the following for electrical hazards:

- Suitable work practices to mitigate the hazard.
- PPE appropriate for the incident energy levels of the task being performed.

3.2 Supervisor (or designee)

3.2.1 Supervisors (or designee) shall be responsible for monitoring the electrical safe work practices of personnel when performing C2C or Job Observations. Supervisors (or designee) shall be responsible for ensuring availability of appropriate PPE for employees.

3.2.2 Supervisors (or designee) will be responsible for ensuring a Level 1 Job Briefing is conducted before perform the task.

3.3 Employees

3.3.1 Each employee shall follow the requirements of the ESWPM.

3.3.2 Each employee shall verify that they have and wear the appropriate PPE for the task.

3.3.3 Each employee shall inspect their PPE for good condition before using and ensure they wear their PPE.

3.3.4 Each employee shall understand and adhere to the conditions of the Job Briefing.

3.4 Safety Observer

3.4.1 Present prior to the start of the task

3.4.2 **IF** required, **ENSURE** rescue equipment is available

3.4.3 **Wear** appropriate PPE to facilitate rescue, as required by distance to electrical hazard.

3.4.4 **GIVE** worker being observed your complete attention

3.4.5 **INITIATE** emergency notification. Safety Observer shall ensure that a method of communicating with the control room **OR** emergency services is available and working. **DO NOT** rely on the plant page **OR** other installed equipment unless you physically perform a communication check prior to commencing the work.

3.4.6 The mobile equipment spotter/observer shall be a designated person who is knowledgeable to recognize the hazards associated with contacting an electrical distribution system. The designated spotter/observer shall:

- Follow each business segment's policy/procedures when aerial equipment is working near energized conductors.
- Can act as a spotter.
- Remain focused on mobile equipment performing work.
- Maintain a clear line of communication with the operator.
- Give timely warning if any part of the mobile aerial equipment approaches the RAB/MAD.

3.4.7 The Safety Observer does not need to be First Aid/CPR qualified unless the response time of four minutes can't be achieved.

3.4.8 **Stop** the job if an unsafe act or condition is observed.

4.0 GENERAL GUIDELINES

4.1 Governing Principles

4.1.1 Governing Safety Principles of Electrical Work

An effective electrical safety program is based on rules that are derived from a group of governing principles. The principles that form the basis for the Ameren Electrical Safe Work Practices Manual (ESWPM) are listed below.

4.1.2 Electrical conductors or circuit parts that have been connected to an energy source are considered energized until proven otherwise.

4.1.3 Each location/business segment is to maintain its own WPA and/or LOTO procedures.

4.1.4 Energized parts that operate at less than 50 volts to ground are not required to be de-energized.

4.1.5 Only Class (E) qualified persons may work on energized electrical equipment.

4.1.6 Electrical hazards shall be mitigated using the hierarchy of controls.

4.1.7 When performing work on exposed energized equipment above 600 volts and the Energy Center can't achieve a 4-minute response time in order to perform First Aid/CPR a Safety Observer shall be utilized.

4.2 General Safe Work Practices

4.2.1 Electrical test devices used for personal protection (i.e. Live Dead Live method) must be tested before and after use to ensure the apparatus is working properly and readings are registering accurately.

4.2.2 No bare hand contact is to be made with exposed energized electrical conductors or circuit parts above 50 volts to ground.

4.2.3 Approach distances (boundaries) also apply to any conductive tools, such as equipment, ladders, cranes, man lifts, etc., that personnel may be using in the course of their work.

4.2.4 When available, check up-to-date drawings, diagrams and identification tags

4.2.5 Class (B) qualified persons are **not allowed** to work within the restricted approach distances/MAD (boundaries). Work inside this boundary is considered **working on** live parts. Therefore, *only Class (E) qualified persons are allowed within the restricted/MAD approach distance (boundary)*, since they have received additional extensive training.

- Class (B) qualified persons are allowed to open cubicle doors to observe that a breaker is racked out if it has been verified by WPA procedures.

4.2.6 Class (E) and Class (B) qualified personnel are allowed to momentarily open equipment doors for the purpose of visual observations of the cabinets. When opening equipment doors:

- If there is exposure to energized circuits such as buss bars, rosettes, bare terminals, etc. above the nominal control voltages of 240 volts AC or DC, and entry into the RAB/MAD or AFB (If established) cannot be avoided, then appropriate CAT PPE shall be required.

- If there is no exposure and/or interaction to energized components (excluding control voltages), a minimum of CAT 0 PPE shall be utilized.

4.2.7 Class (E) qualified persons, or Class (B) qualified persons under supervision of Class (E), may defeat an electrical safety interlock for the purpose of maintenance and testing. This may be done only temporarily and while work is being performed on the equipment. When the work is completed, the interlock shall be re-instated.

4.2.8 Employees shall not reach blindly into areas which may contain an energized part.

4.2.9 Employees shall be protected from arc flash hazards. Protective clothing shall match the specific hazard and be inspected and properly maintained.

4.2.10 Ensure all conductive objects (e.g. keys, watches, rings, and change) are removed from person before entering RAB/MAD, whichever is greater. Rings that cannot be removed can be wrapped with vinyl electrical tape. Identification badge lanyards shall be secured by one of the following methods: removed or secured under the outer most flame resistant garment. Business segments may necessitate additional requirements related to wearing of metal or conductive articles.

4.2.11 Use of ladders, conductive or non-conductive shall comply with Ameren Safety Rules where the employee or ladder could contact exposed energized parts (such as work of an electrical nature).

4.2.12 Non-conductive rigging is recommended when working within the RAB/MAD. If conductive slings or rigging are used then energized conductors, circuits or equipment shall be guarded.

4.2.13 When working in areas that contains exposed electrical conductors, there shall be adequate illumination to perform the job safely.

4.2.14 Ground Fault Circuit Interrupters shall be used with electric tools in wet areas or in areas where specifically required.

4.2.15 Ground Fault Circuit Interrupters shall be inspected and tested prior to use for safe operation.

4.2.16 Low voltage lighting or a Ground Fault Circuit Interrupter shall be used in confined spaces.

4.2.17 Never store or leave unauthorized items inside a switchgear cubicle.

4.2.18 Ensure potentially moving equipment (doors, covers, etc.) is secured to prevent them from swinging into you and causing you to contact exposed parts.

4.2.19 When working within RAB/MAD, ensure unauthorized conductive objects will not enter RAB/MAD.

4.2.20 Settings of overcurrent devices shall not be changed without consulting appropriate supervision.

4.2.21 Wipe clean and visually inspect each live-line tool every shift it is used. Remove from service if defects are identified.

4.2.22 Establishing a De-Energized Safe Work Condition

4.2.22.1 A de-energized electrical safe work condition can be achieved when a circuit is verified de-energized using all of the following, as applicable:

a. When possible, visually verify that all blades of the disconnecting device are fully open or withdrawn.

b. Performing a Live Dead Live voltage test on circuit parts being worked on.

c. Where it could be reasonably anticipated that the conductors or circuit parts being de-energized could contact other exposed energized conductors, apply ground connecting devices rated for the available fault current.

d. Follow location's or business segment's WPA or LOTO procedures.

4.2.23 Personnel shall check for voltage before contacting any uninsulated conductors. Proximity voltage detector cannot determine voltage on DC applications.

4.3 Personal Protective Equipment (PPE)

4.3.1 Check expiration dates on all rubber protective insulated goods. Do **not** use the personal protective equipment if the expiration date has passed. Visually inspect gloves to verify expiration date, voltage, and type, as appropriate.

4.3.2 When used, rubber sleeves and gloves shall be electrically rated for the voltages being worked on.

4.3.3 Rubber gloves with leather protectors shall be worn when covering and uncovering or handling all energized conductors or equipment as well as conductors and equipment that may become energized. Protective equipment such as blankets, hose and hoods must be used to cover all energized, exposed conductors, and equipment which could be accidentally contacted in the working area.

4.3.4 Rubber gloving work shall be performed on only one energized primary conductor at a time on a structure.

4.3.5 While performing rubber gloving work on conductors energized above 600 volts, AC electric power tools shall not be used.

4.3.6 While performing work on energized primary conductors with a hydraulic impact wrench, an insulating link shall be used or battery operated tools.

4.3.7 Insulated truck booms shall be electrically tested after being in service for no more than six months. Testing shall be in accordance with ANSI/ ASTM Standards. A decal shall be placed on trucks to indicate that they have passed the electrical test and the date of test. Trucks shall not be used for rubber gloving work on primary voltages if the test decal does not appear on the truck. If trucks are subjected to an unusual incident which causes the electrical integrity to become suspect, the test date decal shall be

removed from the truck and it will not be used for rubber gloving work above 5 kV until retested.

4.4 50 V – Less than 600 V Rubber Gloving

4.4.1 Appropriate rubber gloves shall be worn when performing work on voltages between 50 V – 600 V, such as secondary's and services or open neutral conductors in a break. The only exceptions are:

- When secondary/service conductors have been de-energized, tested, and grounded.
- When secondary/service conductors have been isolated from any other energy source, any backfeed potential is eliminated, induced voltage potential is eliminated and the cable or wire has been checked for voltage and identified.
- New construction work, having never been energized, can be worked without rubber gloves when the employee can verify there is no possibility of contact with other energized sources, induced voltage and/or backfeed.

4.5 600 V – 5 kV Rubber Gloving

4.5.1 While standing on a pole, structure, or in a bucket, rubber gloving work may be done on lines operating up to 5 kV while wearing primary rated rubber gloves with protectors, unless contractually excluded.

4.5.2 When an employee is within the Ameren RAB/MAD for conductors energized at 600 V to 5 kV, he/she shall wear primary rated rubber gloves with protectors. All energized conductors and equipment within the Ameren **RAB/MAD** in Attachment 2 shall be covered, except those *portions* of the energized parts on which work is to be performed.

4.5.3 Any potential grounds such as secondary conductors, services, neutral conductors, primary conductors or other objects at different potential within the work zone must be covered or isolated prior to performing rubber gloving work.

4.6 5.0 kV – 15 kV Rubber Gloving

4.6.1 Properly rated protective equipment may be placed on energized conductors up to 15 kV while wearing primary rated rubber gloves from an insulated bucket.

4.6.2 Rubber gloving may be performed only while standing in an insulated bucket.

4.6.3 The winch line on a digger derrick shall be removed from the insulated portion of the boom and the pole claw shall be pinned back while performing rubber gloving work on energized lines when utilizing a pin-on basket. At least 40” of the fiberglass boom shall be exposed while gloving from a pin-on basket.

4.6.4 When an employee is within the Ameren **RAB/MAD** for conductors energized from 5.0 kV to 15 kV, he/she shall wear primary rated rubber gloves. All energized conductors and equipment within the Ameren **RAB/MAD** in Attachment 2 shall be covered, except those *portions* of the energized parts on which work is to be performed.

4.6.5 Work on energized circuits above 5,000 volts but less than 15,000 volts must be done with Class 2 rubber gloves or live line tools. However, sleeves may be used based on complexity of the job and at the option of crew. Sleeves shall be used if the worker’s upper arms are exposed to contact with uninsulated energized lines, parts, or equipment.

4.6.6 Work on energized circuits above 15,000 volts must be done with live line tools.

4.6.7 Any potential grounds such as secondary conductors, services, neutral conductors, primary conductors or other objects at different potential within the work zone shall be covered or isolated prior to performing rubber gloving work.

4.7 Care & Inspection of Live Line Tools

4.7.1 Live line tools must be examined before and after each usage for cracks, rough or scarred places and metallic parts securely fastened.

4.7.2 Live line tools shall never be laid out on the ground.

4.7.3 In order to keep live line tools in good condition, they must be cared for in accordance with Overhead Lines Instruction for Live Line Tools.

4.8 Rubber Glove Use & Inspection

4.8.1 ASTM D120-approved, inspected, and tested electrical gloves shall be worn for the maximum rated voltages based upon the following classes:

Glove Class	Maximum Voltage
00	500 Volts
0	1,000 Volts

1	7,500 Volts
2	17,000 Volts

4.8.2 Rubber insulating gloves shall be electrically tested before the first issue and at least every 6 months, thereafter. Energy Delivery requires testing of primary rated rubber gloves to be tested every 3 months. Rubber insulating gloves shall not be used beyond the testing date.

4.8.3 Inspect voltage-rated rubber gloves before each use by performing the following:

- Inflation test.
- Visual inspection for holes, UV damage, embrittlement, cracking or other sign of physical damage.

4.8.4 When the employee is within the RAB/MAD for conductors energized at 50 volts and above, appropriate rated rubber gloves with approved leather protectors shall be worn. Each business segment may have additional requirements for allowing either no leather protectors or one glove operation. Refer to your Business Segment on Rubber Glove Policy.

4.8.5 Class 00 gloves may be worn without leather protectors while working up to 250 V, but only in conditions where dexterity is required. Caution MUST be exercised to avoid damage. Class 00 gloves worn without protectors must be disposed of after use or tested and inspected prior to reuse.

4.8.6 Rubber goods (gloves, mats, blankets, etc.) used as PPE or protections against electrical contact shall be properly stored and protected when not in use.

4.8.7 Primary rated rubber gloves shall be worn when opening or closing energized gang-operated air break switches, unless operated by remote controls.

4.9 Arc Flash

4.9.1 Each facility shall conduct an Arc Flash Study (Assessment) and develop an Arc Flash table similar to the Heat Energy Incident Table shown in Attachment 3.

4.9.2 For equipment ***not included*** in the Arc Flash study, the following must be used:

- 50V-240V exposed circuit breaker operation, racking, or exposure within AFB, Arc Rated Category 2.
- 277V-480 V exposed circuit breaker operation, MCC breaker operation, racking, or exposure within AFB, Arc Rated Category 4.

- Greater than 480 volt – 15 kV circuit breaker operation, racking, or exposure within AFB, Arc Rated Category 4.
    - Arc Rated Category 0 PPE is required.
    - Voltage rated gloves shall be worn if the RAB/MAD is violated with body parts or uninsulated tools or equipment.
- Arc Flash Boundary for equipment **not included** in the Arc Flash study:

50V-240V	19 in.
241V-600V	20 ft.
601V-15kV	40 ft.

4.9.3 Appropriate Arc Rated Category PPE shall be utilized within the AFB when any employee or tool breaks the plane of the RAB/MAD or interacts with the equipment.

4.9.4 Equipment Labels

4.9.4.1 If arc flash labels are used, they should include AFB, incident energy, voltage class, and PPE Categories (See Attachment 4, Equipment Label Example).

4.9.4.2 Where labels are not used, AFB, incident energy, voltage class, and PPE Categories shall be made readily available to personnel.

4.9.4.3 If modifications are made to equipment and renders the data on the label to be inaccurate, the label shall be updated.

4.9.4.4 For equipment where the arc flash rating is the same for each cubicle or compartment, labels may be limited to one on each end cubicle and one in the center placed at eye level, provided there is no distance greater than 12 feet between labels.

4.10 Ameren Hazardous Risk Category & PPE Protection

Category for Arc flash protective gear

4.10.1 FR garments purchased from a vendor are constructed from flame resistant fabrics and components, resist ignition and will not continue to burn when removed from the ignition source. ATPV, EBT, EBTAS, and HRC are all designated as arc rating values.

4.10.2 "Primarily" leather safety footwear means any part of the boot that is not covered by your FR apparel must be leather. This excludes the shoe

strings, eyelets, soles, and tongue. Also acceptable is Ameren provided rubber safety footwear.

4.10.3 If you meet the requirements for any Arc Rated category, then you have met the requirements for any lower rated Arc Rated category, i.e. if the task being perform requires CAT 2 protective equipment, then you also meet CAT 1 and CAT 0.

4.10.4 Business Segments may require higher stringent standards of FR clothing. Refer to your Business Segment's policy on FR use.

4.10.5 When required to wear FR apparel, employees shall wear Ameren-approved FR apparel as their outermost garment above and below the waist.

PPE by Category

- **Category 0 – Non-arc rated PPE**
  Minimum appropriate natural fiber shirt with pants or coverall and safety glasses or goggles.

- **Category 1 - Minimum Arc Rating of 4 cal./cm^2**

  Arc Rated Clothing
  - appropriate arc rated long sleeve shirt and pants or coverall;
  - appropriate arc rated gloves. *Leather gloves with the weight of 12 oz./yd.^{2} can be worn as arc rated hand protection* ;
  - arc rated face shield or flash hood or *arc rated balaclava hood and goggles*;

  Protective Equipment
  - safety glasses;
  - electric rated hard hat;
  - primarily leather safety footwear;
  - hearing protection (ear canal inserts).

- **Category 2 - Minimum Arc Rating of 8 cal./cm^2**

  Arc Rated Clothing
  - Appropriate arc rated long sleeve shirt and pants or coverall;
  - appropriate rated rubber gloves with protectors;
  - arc rated flash suit hood or *arc rated balaclava and face shield or goggles*;

  Protective Equipment
  - safety glasses;
  - electric rated hard hat;

- primarily leather safety footwear;
- hearing protection (ear canal inserts).

Category 3 - Minimum Arc Rating of 25 cal./cm^2

Arc Rated Clothing
- Appropriate arc rated long sleeve shirt and pants or coverall;
- appropriate rated rubber gloves with protectors;
- arc rated flash suit hood or *arc rated balaclava and face shield or goggles*;

Protective Equipment
- safety glasses;
- electric rated hard hat;
- primarily leather safety footwear;
- hearing protection (ear canal inserts).

- **Category 4 - Minimum Arc Rating of 40 cal./cm^2**

Arc Rated Clothing
- Appropriate arc rated long sleeve shirt and pants or coverall;
- appropriate rated rubber gloves with protectors;
- arc rated flash suit hood or *arc rated balaclava and face shield or goggles*;

Protective Equipment
- safety glasses;
- electric rated hard hat;
- primarily leather safety footwear;
- hearing protection (ear canal inserts).

- **Category 5 - Minimum Arc Rating of 100 cal./cm^2**

Arc Rated Clothing
- Appropriate arc rated long sleeve shirt and pants or coverall;
- appropriate rated rubber gloves with protectors;
- arc rated flash suit hood;

Protective Equipment
- safety glasses;
- electric rated hard hat;
- primarily leather safety footwear;
- hearing protection (ear canal inserts).

- **Category 6 (De-Energized Only) - Arc Rating greater than 100 cal./cm^2**

4.11 Insulated Protective Equipment

4.11.1 Check expiration dates on all insulated protective equipment.

4.11.2 Equipment shall not be used beyond expiration date or in the case of test date plus the interval shown in table below.

3 Months	6 Months	12 Months	24 Months
Class 2 Rubber Gloves (ED Only)	Class 2 Rubber Gloves - (Generation Only) Class 0 & 1 Rubber Gloves Booms & Bucket Liners Bucket Trucks	Rubber Blankets	15kV Jumpers Hot Sticks
NOTE: Load break tools shall be replaced after 1,500 operations on the counter.			

4.11.3 Insulated Sheeting

Storage

4.11.3.1 Warehouse - Rolls have up to a five year shelf life. Each roll must be tagged with a five year expiration date.

4.11.3.2 Sheeting stored on trucks expires after 1 year or if fails field inspection.

4.11.3.3 If found in field to be over 1 year old, replace before work starts.

Use/Installation

4.11.3.4 Installed insulated sheeting found in place shall be visually inspected prior to working.

4.11.3.5 The appropriate insulated sheeting application should match the proper voltage of the equipment.

4.11.3.6 Appropriate rated PPE shall be worn.

4.11.3.7 Use scissors when available or when using a safety blade wear hand protection, cut away from body.

4.11.4 When used, insulated protective equipment shall be properly rated for the voltage used.

4.11.5 Voltage-rated blankets shall be inspected for signs of physical damage before each use. If damage or deterioration is noted, it shall be returned for inspection and testing. The blanket must not be used if it is ripped, punctured or abraded. The blanket should also be rejected for use if the material has been stretched to the point of thinning the blanket.

4.11.6 Blankets shall be stored either hanging from a rack or placed in tubes. If stored in tubes, the blankets must be periodically rolled in the opposite direction to prevent stress cracks from forming.

4.11.7 Insulated tools such as live line tools, insulated hand tools, etc. shall be inspected prior to use.

4.12 Fuses

4.12.1 Only Class (E) qualified persons shall remove and install fuses.

4.12.2 Approved hot sticks or fuse pulling tools shall be used to remove and install fuses.

4.13 Personal Protective Grounding

4.13.1 General Grounding Rules

4.13.1.1 Each business segment is responsible for following the functional authority's WPA requirements. Obtain proper functional authority approval before installing or removing grounds.

4.13.1.2 Temporary protective grounding cables shall be installed and removed with ANSI-approved, inspected, and tested live-line tools.

4.13.1.3 All circuits and equipment energized at primary voltages shall be considered energized at full voltage until de-energized, tested and grounded with appropriately assigned WPA.

4.13.1.4 Downed overhead conductors shall be considered energized unless WPA can be obtained; conductors tested and grounded. The practice of using rubber gloves while standing on the ground to cut, position, clean, attach, or in any way contact an ungrounded conductor over 600 volts by hand shall not be permitted.

4.13.1.5 Circuits or electrical equipment shall be considered energized unless properly grounded. If the employee can demonstrate that

the installation of a ground is impracticable then the lines and equipment may be treated as de-energized provided all the following conditions are met.

- The lines and equipment have been de-energized under the compliance of OSHA.
- There is no possibility of contact with another energized source.
- The hazard of induced voltage is not present.
- Equipment never been energized.

4.13.1.6 Personal protective grounds shall be visually inspected before each use. Visual inspection of personal protective grounds shall consist of the following:

- Check for broken cable strands, particularly in the area of the ferrule.
- Check the clamps for cracks, splits, or other defects.
- Verify the clamps operate smoothly.
- Inspect the cables at the point of connection to the clamps.
- Contact points where grounds are to be placed must be cleaned and connections must be tight.

4.13.1.7 Prior to grounding, employees shall ensure a clean, secured connection (free from corrosion and paint) between the temporary protective grounding clamps, copper ground cable/strap or conductors.

4.13.1.8 Always ground to a common neutral conductor if available.

4.13.1.9 When grounding to a static, ensure that a continuous connection is present from the static to the system neutral or substation ground grid. Note: Steel static wire may only be used for grounding on transmission voltages over 100kV.

4.13.1.10 Grounds shall be placed between the work location and all known normal sources of energy, e.g. tie switches or open loop-overs primary voltage or higher. Grounds shall be placed as close as practical but never more than 5280 feet (1 mile) apart on overhead open wire circuits. On any circuit without a distribution neutral, such as a delta system or sub-transmission circuit without under-build or static, supplemental grounding and Class 2 primary gloves shall be worn.

4.13.1.11 When grounding, the ground connection shall be made first. In making the ground connection to the circuit, the conductor to be grounded first shall be the one least hazardous to connect.

(Usually this will be the nearest conductor). The other conductors shall then be grounded in turn. The reverse procedure shall be followed when removing the grounds. That is, the ground shall be removed from the most remote conductor first, then the other conductors and finally the ground connection shall be removed last. Ground sets shall be installed and removed with live-line tools.

4.13.1.12 Conductors on steel towers shall be grounded to the steel of the tower being worked on using a clamp which is designed for grounding to a steel tower member. Tower grounding connections and leads are inspected and in good condition. Rubber gloves are not required while working on the grounded conductors.

4.13.1.13 Personal protective grounds shall be either:

- Purchased from a vendor and be ANSI-approved for the rated voltage, fault current and clearing times.
- Manufactured and assembled in-house in accordance with ANSI Standard F855, and tested every two years.

4.13.2 Overhead Transmission & Distribution

4.13.2.1 Personal Protective grounds on 600 volts and less

Single Phase Secondary Conductors:

- Isolate secondary from Ameren source – lift secondary transformer connection, remove transformer primary connection, or open primary fuse.
- Test for voltage.
- Connect grounding jumper (minimum 1/0 copper) neutral to phase and another grounding jumpers phase to phase connections.

Three Phase Secondary Conductors #2 copper or 1/0 aluminum or smaller (larger conductors shall be worked with appropriately rated rubber gloves):

- Isolate secondary from Ameren source – lift secondary transformer connection, remove transformer primary connection, or open primary fuse.
- Test for voltage.
- Connect grounding jumper (minimum 1/0 copper) neutral to phase and phase to phase.

4.13.2.2 Personal Protective grounds on voltages over 600 volts

- When working on a continuous portion of a conductor, a single grounding set may be placed as close as practical to the work location but never more than 50 feet away. Once a conductor is no longer continuous (broken, opened, cut, damaged, etc.) each portion must be grounded separately.

- Use ground leads of 1/0 copper, except that manufactured grounds of #2 copper may be used downstream of an overhead protective device, such as a fuse or recloser. Never use ground leads smaller than #2 copper.

- High visibility flags or ground tags shall be placed where grounds are installed on overhead lines or equipment when:
  a) Grounds will be left in place for more than one shift.
  b) During storm restoration efforts.
  c) At the discretion of the crew leader during normal day-to-day operations.

4.13.3 Installation of Personal Grounds Inside Switchyards/Substations

4.13.3.1 Size of personal protective grounds shall be based on fault currents and clearing times. If an analysis has not been completed to determine appropriate size of grounds, the facility shall use double 4/0 grounds.

4.13.3.2 In addition to Personal Protective Ground requirements, the Business Segments may need to install grounds to remove or eliminate static charge or induced voltage

4.13.3.3 Grounds shall be placed as close as practical on both sides of the work being performed but never more than 50 feet away. Always connect grounds to a ground grid.

4.13.3.4 Grounding tags shall be placed where grounds are installed on overhead lines or equipment inside energy center's switchyards.

4.13.4 Grounding of Mobile Aerial Equipment

4.13.4.1 Zone 1 – Less than 10' but more than 4' from conductors energized at voltages less than 100 kV. If the un-insulated parts of the mobile equipment will be less than 10’ away and will stay more than 4’ away from the conductors energized at voltages less than 100 kV, the workers must implement at least one of the three following options:

1) Cover the energized conductors and/or energized components

2) Ground the mobile equipment

3) Use an observer/spotter

4.13.4.2 Zone 2 – 4’ or less from conductors energized at voltages less than 100 km If the un-insulated parts of the mobile equipment will be 4’ or less from the conductors energized at voltages less than 100 kv, the workers must

1) Cover the energized conductors and/or energized components; AND

2) Ground the mobile equipment.

4.13.4.3 Zones

- Employees, working alone, delivering or picking up material may ground to a pole ground when operating mobile equipment in Zone 1, provided that the mobile equipment shall never enter Zone 2 without an additional qualified employee(s) to meet the adequate protection required in Zone 2.

- When the un-insulated parts of the mobile equipment are outside of Zone 2 and handling material that will enter Zone 2, either the energized conductors or the material being handled must be covered (insulated) along the full length of exposure to contact plus 4 feet. Grounding the mobile equipment is strongly recommended.

- When a conductor is held by a winch line with an appropriate insulating device between winch line and conductor the zone will be measured from the conductor to the nearest point of contact of the boom being used.

4.13.4.4 Observer - The observer shall be a designated employee who is qualified to recognize the hazards associated with contacting an electrical system. The designated observer must remain focused on the un-insulated parts of the mobile equipment, maintain a clear line of communication with the operator and shall give timely warning if the un-insulated parts of the mobile equipment approach Zone 2. Before the un-insulated parts of the mobile equipment enter Zone 2, cover must be applied to the exposed, energized conductors AND mobile equipment

grounds attached as detailed in these procedures. The observer may do other work if the mobile equipment movement ceases or the mobile equipment moves outside Zone 1.

4.13.4.5 When encroachment of ANY parts of aerial equipment will be within a fifteen foot zone of 138 kV phase to phase or above, the operator/crew must ground the mobile equipment.

4.13.4.6 Order of Preference for Grounding Mobile Equipment

- Ground the mobile equipment to the substation/switchyard ground grid; if that is not possible,
- Ground the mobile equipment to the system neutral; if that is not possible,
- Ground the mobile equipment to a pole ground if the pole ground is connected to the system neutral; if that is not possible,
- Barricade and use supplemental equipment grounds.

4.13.4.7 All mobile equipment ground leads shall be 1/0 copper or larger.

4.13.4.8 Connections shall be clean and tight.

4.13.4.9 Mobile equipment shall have a grounding stud or other appropriate ground connection.

4.13.4.10 Mobile equipment grounds shall not be left coiled while in use. If using a retractable reel, the entire length of cable shall be pulled off the reel and not allowed to form coils on the ground and the retracting mechanism of the reel shall be defeated to prevent the reel from inadvertently retracting while grounds are in place.

4.13.4.11 If more than one piece of mobile equipment needs to be grounded at the job site and they are close enough to each other to allow an employee or any conductive object to contact both pieces of mobile equipment simultaneously, only one piece of mobile equipment needs to be grounded. The other piece(s) of mobile equipment shall be connected to the grounded mobile equipment. This should eliminate or reduce any chance of differences of potential between pieces of mobile equipment.

4.13.4.12 If two ground sets must be connected together (daisy chained) to reach from the mobile equipment to the ground connection point, a piece of copper conductor of the same size or larger than the ground sets shall be used. The grounding clamp shall connect to the cable of the other ground set not connected clamp to clamp.

4.13.4.13 When mobile equipment is grounded, workers on the ground shall not come into contact with the mobile equipment until they have communicated to the d conditions are met.

- The mobile equipment has been moved out of Zone 2 (more than 4 feet) by the operator and the mobile equipment shall remain outside of Zone 2 until the worker communicates that he/she is clear of the mobile equipment,
- The operator ceases operating the mobile equipment until the worker has communicated to the operator that he/she is clear of the mobile equipment.

4.13.4.14 Mobile equipment being driven through or parked in a substation facility is exempt from this policy/procedure. All other mobile equipment and vehicle operating rules and procedures do apply. If the equipment is being used to perform work in the substation facility this policy/procedure is applied in its entirety.

4.13.5 Grounding of Equipment Inside Energy Centers

4.13.5.1 Grounded equipment to be worked on shall be de-energized and tested for all energy sources. This may require opening switches.

4.13.5.2 Steps shall be taken to remove any stored energy, prior to attaching personal protective grounds.

4.13.5.3 A protective tag shall be installed onto the equipment or as near as possible to the location of the ground to identify personal protective ground(s) are in place.

4.13.5.4 Personal protective grounds shall be placed on exposed terminals or bushings where work is being performed.

4.13.5.5 When grounds are placed, they shall be placed such that they can be visibly verified.

4.13.5.6 When grounding a Ground Test Device (GTD):

- The GTD shall be racked in the connected position in the breaker and verify a de-energized state.
- The GTD shall be racked down to the test position (out of the cubicle).
- Grounding cables shall be connected to the terminals and ground connection. Installation of the cables shall be performed using appropriate protective gloves.
- Rack the GTD up and into the connected position within the breaker.

4.13.6 Underground Grounding

4.13.6.1 When preparing to work on cables below 600 volts, Class 0 or primary rated rubber gloves are required, except when:

a) Secondary/service conductors have been de-energized, tested, and grounded.
b) Secondary/service conductors have been isolated from any other energy source, any backfeed potential is eliminated, induced voltage potential is eliminated and the cable or wire has been checked for voltage and identified.
c) New construction work never having been energized can be worked without rubber gloves when the employee can verify there is no possibility of contact with other energized sources, induced voltage and/or backfeed.

4.13.6.2 Circuit or apparatus operating above 600 volt shall abide by the following grounding procedures.

4.13.6.3 Cable shall be disconnected from all known sources of energy at the nearest practical termination.

4.13.6.4 The cable or apparatus shall be tested to determine whether or not it is de-energized.

4.13.6.5 Grounds shall be installed immediately after testing is completed.

4.13.6.6 If the conductor is open, as in a break, the above tests shall be made on each side of the break at the terminal pole, transformer or switchgear.

4.13.6.7 Grounding cables shall be of a size large enough to operate the protective device supplying the conductor. In no case shall the grounding cable be less than # 2 AWG copper or equivalent.

4.13.6.8 A capacitance charge can remain in an underground cable after it has been disconnected from the circuit.

4.13.6.9 A cable that is energized at or above 600 volts is to be cut following testing and grounding procedures, the cable shall be cut with a remote cutter with non-conductive hoses or an 8' ANSI approved live line tool with attached hot cutters.

4.13.6.10 On three phase conductor cables, proper procedures will be employed to ensure each cable is identified prior to cutting and

splicing. If it cannot be identified, it will be treated as energized. Only one conductor shall be cut at a time.

4.13.7 Testing Performed on Grounded Systems

4.13.7.1 Grounds may be temporarily removed from equipment for testing. Obtain proper WPA (restraint) before applying test voltage or current. Personal Protective Grounds shall be replaced immediately following testing.

4.13.7.2 If accessible to personnel conducting tests, the chassis, instruments and all conductive parts of test vehicles or trailers used to conduct high voltage or high power tests, shall be grounded.

4.13.7.3 High capacitance equipment shall be discharged prior to attaching grounds.

4.13.7.4 Test leads shall be applied to the grounded circuits or equipment to be tested. If necessary to complete the test and using an ANSI-approved live-line tool, protective grounds can be removed.

4.13.8 Driven Grounds

4.13.8.1 Where neither a common neutral or a static wire which can be used is available, screw-type or driven grounds shall be used. Two ground rods shall be installed as deep as practical and at least six (6) feet apart.

4.13.8.2 The two screw-type or driven ground rods must be bonded together with an approved manufactured ground and the ground lead connected to either of the rods.

5.0 GENERATION

5.1 Electrical Safety Plan

5.1.1 An Electrical Safety Plan is documented and approved by a management representative or designee justifying the need to work on exposed energized electrical conductors greater than 50 volts or applying grounds. Determination of the following information constitutes formulation of the electrical safety plan for work on energized circuits. The electrical safety plan must be discussed in the pre-job brief (See Attachment 5, Sample Electrical Safety Plan). The electrical safety plan (or an equivalent

document) will include the following at a minimum:

- Means of maintaining the worker's isolation from energized parts.
- Determine if a safety person is necessary and have applicable rescue plans outlined (for example, retrieval devices, communications established between the worker and the safety person).
- The need for additional guards and/or barriers.

5.1.2 LDL, taking voltage or amperage readings with insulated test meters, breaker racking, breaker switching, removing or installing fuses does not require an electrical safety plan.

5.1.3 Main Generator Brush Inspection

5.1.3.1 Generator doghouse will be visually inspected for signs of arcing through viewing window prior to entry.

5.1.3.2 Brush inspections will be CAT 0

5.1.3.3 The exciter or generator field shall be checked to determine whether a ground condition exists. The brushes may not be changed while the generator is energized if a ground condition exists.

5.1.4 Equipment and electrical circuits shall be de-energized prior to performing work, unless de-energizing is infeasible (i.e. troubleshooting, testing). Infeasibility should be determined by the supervisor or designee.

5.1.5 When working on energized circuits, approved insulated tools shall be used. When guarding is removed from energized electrical conductors, or when exposed conductors are left unattended, physical barriers shall be installed.

5.2 Battery Rooms

5.2.1 Battery rooms have exposed energized conductors. An engineering analysis shall be conducted to determine short circuit current for the appropriate size and number of batteries being worked on.

- If the hazard can be mitigated to prevent short circuiting, such as placing properly rated rubber blankets or mats over one output terminal, CAT PPE 0 can be worn.

- If taking voltage reading across the battery and the use of insulated leads are being used, CAT PPE 0 can be worn.

- If the hazard can't be mitigated, the following chart shall be used to identify the arc flash PPE and boundaries:

Battery Room Maintenance
Arc-Flash Hazard PPE Categories & Arc-Flash Boundary

Equipment	Arc Flash PPE Category	Arc-Flash Boundary
Storage batteries, dc switchboards, and other dc supply sources Voltage < 100 V	0	Not Applicable
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 @ (18 in.)		
Short-circuit current < 4 kA	1	3 ft.
4 kA ≤ short-circuit current < 7 kA	2	4 ft.
7 kA ≤ short-circuit current < 15 kA	3	6 ft.
Short-circuit current > 15 kA	4	8 ft.
Storage batteries, dc switchboards, and other dc supply sources 250 V ≤ Voltage ≤ 600 V Parameters: Voltage: 600 V Maximum arc duration and working distance: 2 sec @ (18 in.)		
Short-circuit current 1.5 kA	1	3 ft.
1.5 kA ≤ short-circuit current < 3 kA	2	4 ft.
3 kA ≤ short-circuit current < 7 kA	3	6 ft.
7 kA ≤ short-circuit current < 10 kA	4	8 ft.

5.2.2 Chemical protective clothing may be worn over FR clothing.

5.3 Barricades

5.3.1 When uncontrolled access to an arc flash boundary, barricades shall be utilized. The AFB or LAB, whichever is greater, must be barricaded to warn personnel who may be in the vicinity of the electrically energized hazard. A sign or tag must be posted on the barricade tape, which provides the following information or equivalent.

Example:
Warning: Flash or Shock Boundary
Only electrically qualified personnel may proceed past this point with proper PPE.
Flash and\or Shock Hazard present.

5.3.2 A temporary barrier typically does not offer appropriate protection to prevent arc flash or shock. Under specific conditions a temporary barrier that is constructed to withstand arc flash or shock hazards can be utilized upon completion of an engineering analysis.

5.3.3 When guarding is removed from exposed de-energized electrical conductors and left unattended, workers performing the work will guard the area with barricade tape and appropriate signage. Post a sign with the following information or equivalent:

- Circuit verified De-energized
- No Electrical Hazard Present

5.4 Test Areas

5.4.1 High Voltage Test Areas (e.g., electrical test areas in maintenance shop, remote locations):

5.4.1.1 Test areas shall be guarded or barricaded to prevent unauthorized personnel from entering the test area when electrical testing is being conducted. Barriers should be installed and signs placed indicating that tests are in progress. A door that is closed and appropriately labeled is considered guarded.

5.4.1.2 Prior to conducting initial testing, inspect test area to ensure:

- All equipment is properly grounded, if required.
- The area is free of clutter and in a safe condition.
- All barriers/guards are in place (Arc Flash or Limited Approach Boundary clearly defined when unattended).
- All measuring and test equipment is in good working order.
- Do not run any test leads or cables outside test area.
- Ensure all test conductors and equipment are securely restrained and routed to avoid damage or accidental test interruption.
- Do not leave the test area unattended, without being barricaded and signage attached, while tests are in progress.
- Remove temporary barriers/guards when the testing is completed or no longer needed for the protection of employees.

5.5 Grounding of Test Equipment

5.5.1 All conductive parts accessible to personnel conducting high potential tests shall be maintained at ground potential unless it is isolated and guarded.

5.5.2 All ungrounded terminals of test equipment shall be treated as energized unless tested and verified de-energized.

5.5.3 High capacitance equipment shall be discharged prior to attaching grounds.

5.6 Low Power Exposure

5.6.1 For work on voltages up to 5000 vac/vdc with current output less than or equal to 20 uA, CAT 0 PPE shall be worn.

5.6.2 For work on voltages greater than 5000 vac/vdc with current output greater than 20 uA but less than or equal to 100 mA, CAT 0 PPE plus appropriate rated gloves with leather protectors shall be worn.

5.6.3 For low power equipment and equipment calibration (such as M&TE test equipment, etc.) not covered within the voltage/current ranges listed above or where they are not known but manufacture has provided safety guidance and/or PPE requirements, electrical safety guidelines and PPE provided by the product manufacturer/vendor manual or instruction shall apply.

6.0 SUBSTATION, RELAY & SWITCHYARD ACTIVITIES

6.1 General

6.1.1 Class (N) employees shall be escorted by a Class (B) or Class (E) qualified person.

6.1.2 Appropriate CAT PPE shall be worn when grounding, operating disconnects or local operation of breakers and working within the RAB/MAD.

6.1.3 Where practical, testing equipment shall be grounded prior to its use. If testing equipment is set up in the back of a vehicle for the purpose of making a test, the equipment shall be bonded to the vehicle and the vehicle grounded to the substation ground system.

6.1.4 Non-electrical work activities in generation switchyards only require the use of a Class (E) spotter for equipment movement.

6.1.5 Upon entering a substation where other employees are present, all crews shall exchange safety and job task information.

6.1.6 When working in an energized substation that is accessible by the public, gates shall be kept closed.

6.1.7 Damage to fences or missing signs shall be reported immediately to the supervisor.

6.1.8 When materials must be stored under energized busses they shall not be closer or nearer than:

a) 50kV or less – 10 feet

b) >50 kV – 10 feet plus 4 inches for every 10kV over 50kV

6.1.9 When leaving a substation or switchyard employees shall close and latch all doors, lock all outside gates.

6.1.10 Equipment and electrical circuits shall be de-energized prior to performing work, unless de-energizing is infeasible (i.e. troubleshooting, testing). Infeasibility should be determined by the supervisor or designee.

6.1.11 When working on energized circuits, approved insulated tools shall be used. When guarding is removed from energized electrical conductors, or when exposed conductors are left unattended, physical barriers shall be installed.

6.2 Barriers

6.2.1 Barriers or flagging devices shall be employed to distinctly outline working area limits to opened, unmanned excavations.

6.2.2 The flagging devices employed will vary, depending on the location and the type of equipment being worked on. These devices or markers shall be left in place until work is completed.

6.2.3 Protective guards, such as properly rated insulated barriers or protective rubber cover, shall be used to isolate the employee against energized electrical circuits and equipment that is within the RAB/MAD during performance of work.

6.2.4 Whenever busses, conductors or equipment are to be de-energized and cleared for work, the Business Segment's shall follow their specific Workman's Protection Assurance program.

6.3 Work on Energized Lines

6.3.1 On meter, control and relay circuits less than 600 volts, work may be done without rubber gloves if insulated tools are used.

6.3.2 Work on energized circuits above 600 volts to ground must be done with live line tools unless a greater hazard would exist, than appropriate rated rubber gloves with protectors can be worn.

6.3.3 Rubber gloves with leather protectors shall be worn when covering and uncovering or handling all energized conductors or equipment over 5000 volts as well as conductors and equipment that may become energized. Protective equipment such as blankets, hose and hoods must be used to cover all energized, exposed conductors, and equipment up to 5,000 volts, which could be accidentally contacted in the working area.

6.3.4 Work on energized circuits above 5,000 volts to ground must be done with live line tools.

6.3.5 Workers must wear rubber gloves with leather protectors when using live line tools, except when installing temporary protective grounds while standing at ground elevation.

6.3.6 Live line tools shall be used in the rain only in emergencies or to put a started job in a safe condition so that tools can be removed.

6.3.7 A worker shall not change position on the ladder or structure without first making certain that your new position will place you in the clear and not before informing your fellow workers as to what you intend to do. Work will stop until you have reached the new position and belted in.

6.4 Use of the Test Sets

6.4.1 The power supply for the test sets shall be of proper voltage range and frequency. The power source shall be properly protected against short circuits by fusing or other accepted means.

6.4.2 When using test plugs or jacks, links shall be secure and in their proper locations before inserting the plug or jack in the test device to prevent backfeed.

6.5 High Potential Testing

6.5.1 The portable test set is equipped with a Remote Safety Interlock switch. The person responsible for the operation of the safety switch shall be positioned in such manner as to have full view of the test area, adhere to minimum clearance distances as specified in the RAB/MAD table, and shall be responsible for discontinuing the test by releasing the Safety Interlock switch should any unsafe condition occur. In no case shall the Remote Safety Interlock switch be bypassed.

6.6 Power Factor Insulation Testing

6.6.1 The Doble Power Factor test sets are equipped with two safety switches: one for use by the test set operator and the other for use by the person

handling the test cable. Under no condition shall the test set be operated with either safety switch bypassed.

6.6.2 Since the safety switches are subject to failure, their operation shall be tested and verified before starting a series of tests. The hook shall be considered energized until properly tested to assure that it is de-energized and appropriately rated rubber gloves with protectors shall be worn.

6.6.3 Upon completion of each test, the hook should touch to ground to verify a de-energized condition. Appropriate primary rated rubber gloves with protectors shall be worn when making or breaking a test connection or holding the test cable while test voltage is being applied. During power factoring testing the **RAB/MAD** for the test voltage used shall be maintained.

6.6.4 Before energizing the test set, the operator shall have all employees in the clear and the metallic ground conductor securely connected from the test case to a station ground grid riser or other adequate ground.

6.6.5 When testing on suspected faulty transformers, the combustible gas content of the nitrogen blanket shall be checked before applying test voltages. Under no circumstances are test voltages to be applied when the combustible gas content is greater than 2% TCG (Total Combustible Gas).

6.7 Capacitors

6.7.1 Work shall not be done on a capacitor until it has been disconnected from the line and discharged. A capacitor, its switches and lead shall be considered energized, even after the fuses have been opened, until it has been discharged by short-circuiting and grounded with an approved live line tool. Employees shall wait for at least five minutes after opening the switches before short-circuiting the capacitor.

6.7.2 Be sure all terminals are shorted to each other and left shorted (except while testing) before work is started and until work has been completed, as well as while in storage or transport.

6.7.3 Capacitors in the low voltage range of 120/240 volts must also be worked on using a high degree of precautionary measures. These capacitors have the same operating characteristics as the high voltage capacitors insofar as retaining their electrical charge.

6.7.4 However, because of the lower voltage being handled, the secondary capacitors can safely be shorted out after a three-minute wait.

6.7.5 Never open the secondary of an energized transformer on which capacitors are connected without first opening the primary side of the transformer and allowing time for the secondary capacitor to discharge.

6.7.6 Capacitor banks with normally energized frames supporting multiple-series capacitor cells must be temporarily grounded for employee protection both at the line and at the frame.

6.8 Circuit Breakers

6.8.1 When work is to be done on the operating mechanism of a circuit breaker, the breaker shall be in the open position (neutral position for spring operated breakers), all control circuits shall be de-energized, and the proper lockout tagout procedures shall be used. On pneumatically or hydraulically operated breakers, the main valve controlling the operating forces shall be fully closed.

6.8.2 When a circuit breaker is to be operated for test or other reasons, all personnel in the nearby area shall be warned and shall be out of danger before the operation is performed.

6.8.3 C.B. tanks shall be considered energized unless connected to the substation ground grid.

6.8.4 No circuit or equipment where power connections have been cut, separated or changed shall be put in service until a test for correct phase rotation and phase connection has been made.

6.8.5 Any device operated by stored energy (such as hydraulic, pneumatic or spring-operated circuit breakers) shall have the stored energy drained, blocked or otherwise restrained to prevent injury from the unexpected movement when needed during maintenance activities per proper lockout-tagout procedures.

6.9 Reclosers

6.9.1 All reclosers, except when adequately grounded, shall be considered to be energized until completely disconnected on both the source and load sides. This may be done either with disconnecting switches or by removal of hot line clamps.

6.10 High Voltage Bushings

6.10.1 High voltage bushings shall be discharged before handling after they have been in service due to the possibility of a static charge.

6.11 Transformers & Regulators

6.11.1 Regardless of the equipment being used, there shall be no contact with transformer bushings and their connections while test potential is applied.

6.11.2 No person shall attempt to stand on top of or make any test on a transformer while a vacuum is being pulled.

6.12 Transformer Ratio and Polarity Testing

6.12.1 Before starting to set up the test equipment, all high voltage conductors to the transformer shall be de- energized and properly isolated under the proper Workman's Protection Assurance. Before applying a test voltage, all windings shall be clear of ground.

6.12.2 Normally the ratio and polarity tests on power transformers are made with a Transformer Turns Ratio (TTR) test set. Voltages encountered when testing with this device are nominal; however, there shall be no contact with the high voltage bushings of the transformer while test potential is being applied.

6.12.3 The test equipment and the equipment being tested shall be adequately guarded to prevent anyone from coming into contact with the high voltage terminals or conductors while the test voltage is applied.

6.13 Regulators

6.13.1 Control circuit supply switches shall be opened and motor supply fuses pulled before doing maintenance work on the controls of a regulator while in service.

6.13.2 When placing voltage regulators in service or removing them from service using bypass switches, the regulators must be in the neutral position and turned off.

6.13.3 Two indications of neutral position shall be utilized prior to bypassing a step voltage regulator.

7.0 OVERHEAD DISTRIBUTION AND TRANSMISSON

7.1 General

7.1.1 When opening gang operated load break disconnecting switches, it shall be done with one continuous quick motion. After opening, employees

shall visually check to make sure that arcing horns are in the clear and that all blades are open.

7.1.2 Switches with removable solid blades or fuses shall have the blade removed if WPA has been issued and the switch left unattended.

7.1.3 Any open pole grounds or unbonded pole grounds shall be handled with appropriate primary rubber gloves with protectors until reconnected.

7.1.4 All disconnect or fuse cutout switches, etc., shall be operated with approved live-line tools.

7.2 Capacitors

7.2.1 Work shall not be done on a capacitor until it has been disconnected from the line and discharged. A capacitor, including its switches and leads shall be considered energized, even after the fuses have been opened, until it has been discharged using a live line tool. Employees shall wait for at least five minutes after opening the switches before discharging the capacitor.

7.2.2 Verify all terminals are shorted to each other and left shorted (except while testing) before work is started and until work has been completed, as well as while in storage or transport. Before employees handle the units, the employer must short circuit each unit in series-parallel capacitor banks between all terminals and the capacitor case or its rack; and, if the cases of capacitors are on ungrounded substation racks, the employer must bond the racks to ground.

7.3 Regulators

7.3.1 Control circuit supply switches shall be opened and motor supply fuses pulled before doing maintenance work on the controls of a regulator while in service.

7.3.2 When placing voltage regulators in service or removing them from service using bypass switches, the regulators shall be in the neutral position and turned off.

7.3.3 Two indications of neutral position shall be utilized prior to bypassing a step voltage regulator.

7.4 Connecting Conductors

7.4.1 When it becomes necessary to tie two circuits together after modification or repair to circuits of more than 1 phase, tests shall be made for

identification of correct phase relation by use of a phasing voltmeter, potential transformer, or other approved means.

7.4.2 When tying or untying energized circuits from different sources, a switch shall be used. If no switch is readily available, a temporary switch with load break capability shall be used.

7.5 Installing and Removing Conductors

7.5.1 A rolling ground shall be used and all equipment and attached vehicles shall be grounded per MO Customer Ops Equipment Grounding Policy.

7.5.2 If there is a possibility of contact with an energized conductor or equipment and the operator can contact the ground and stringing equipment at the same time, the employee shall wear appropriate rubber gloves and stand on a rubber blanket.

7.5.14 When wire is strung perpendicular to energized conductors, adequate guard structures shall be erected and/or protective cover shall be placed on the existing energized conductors to prevent contact.

7.5.15 If the energized conductors being crossed are in excess of 600 volts and if the design of the circuit-interrupting devices protecting the lines so permit, the automatic-reclosing feature of these devices shall be made inoperable.

7.5.16 All new wire shall be grounded and the grounds left in place until installation is completed between the dead-ends. However, no grounds are required if there is no chance of induced voltage or contact with energized equipment.

7.6 Pole Erection or Removal

7.6.1 When erecting or removing poles within the Ameren Missouri **minimum approach distance** of energized lines or equipment the following shall be required:

7.6.1.1 Protective equipment with the proper voltage rating, such as blankets, line guards, or pole guards, shall be placed on the energized parts and/or the pole to be set to the extent necessary to protect against incidental contact with energized lines or equipment energized above 600 volts.

7.6.1.2 Employees handling poles with hands shall wear primary rated rubber gloves with protectors, when exposed to energized lines or equipment above 600 volts. Class 0 rubber gloves with

protectors are acceptable when exposed to voltages less than 600 volts.

7.6.1.3 Ground wires on existing poles shall be removed before the pole is pulled near energized conductors. On new poles, the ground wire shall not be installed until after the pole is set if there is the potential for contact with an energized conductor.

7.7 Pole/Structure Work

7.7.1 When working as a crew, a second set of climbing tools shall be ready for use near the pole being climbed, in case of an emergency.

7.7.2 All taglines and handlines used near energized lines and equipment shall be nonconductive.

7.7.3 Taglines shall be used to control loads being hoisted where it is necessary to prevent hazards to employees or damage to equipment or material.

8.0 UNDERGROUND ELECTRIC

8.1 De-energizing of Primary Cables

8.1.1 All underground cables and apparatus at voltages above 600 volts shall be de-energized with a visual open before beginning work on them.

8.1.2 Whenever any cable or equipment above 600 volts is to be de-energized and cleared for work, Worker's Protection Assurance shall be obtained.

8.1.3 During switching operations that requires the use of a liveline tool, a minimum 8-ft. hot stick shall be used. Longer hot sticks may be required on higher voltages and arc rating.

8.1.4 Primary rated rubber gloves with protectors shall be worn during switching operations including externally operated switch handles.

8.1.5 Underground utilities shall be located and staked or marked prior to excavating. When digging near such facilities, hand or vacuum excavating shall be used within 24” of the located utilities to avoid damage.

8.1.6 Before digging, when there is a primary cable fault in a ditch, all direct buried primary cables in the same ditch shall be de-energized until the fault is located and isolated.

8.1.7 Primary cables stubbed above ground shall be de-energized and grounded at both ends, where practicable. However, in all cases the terminated ends of any newly installed cable shall always be grounded if the cable can be tied to an energy source.

8.2 Working on Conductors or Apparatus

8.2.1 Rubber gloves with protectors are required while working on exposed or uninspected energized equipment in all underground enclosures.

8.2.2 When working on cables below 600 volts, appropriate rated rubber gloves are required, except when:

8.2.2.1 Secondary/service conductors have been de-energized, tested, and grounded.

8.2.2.2 Secondary/service conductors have been isolated from any other energy source, any backfeed potential is eliminated, induced voltage potential is eliminated and the cable or wire has been checked for voltage and identified.

8.2.2.3 New construction work never having been energized can be worked without rubber gloves when the employee can verify there is no possibility of contact with other energized sources, induced voltage and/or backfeed.

8.3 Entering Manholes or Vaults

8.3.1 All Business Segment entry requirements under confined or enclosed spaces shall be followed.

8.3.2 Employees working alone may enter a manhole for brief periods of time for the purpose of inspection, housekeeping, taking readings, or other similar work, provided the employee will be protected from electrical hazards. If a hazard exists, employees shall immediately exit the space.

8.3.3 A ladder shall be used to enter and exit any manhole or vault 4 feet deep or greater.

8.4 Padmount Transformers and Switchgear

8.4.1 If work will occur within an enclosure or section of a piece of equipment (for example a compartment of a switch gear, live front transformer etc.) which contains exposed parts energized above 600 volts:

8.4.1.1 The work shall be done using hot sticks. Or

8.4.1.2 For dead front transformers all exposed primary sources shall be effectively covered or barricaded with appropriately rated materials.

- Barriers shall be installed before work begins and placed in position using hot sticks.
- For single phase live front transformers the work will be done de- energized.
- For three phase live front transformers the work will either be performed with the primary compartment closed or the work will be done with the unit de-energized.

8.4.2 When opening and closing a padmount transformer or a switchgear containing energized conductors above 600 volts, appropriate primary rated rubber gloves with protectors shall be worn.

8.4.3 Installing/removing energized elbows shall be done with ANSI approved live line tool designed for the pulling and controlling of these devices.

8.4.4 Removal of phase-to-phase barriers shall only be permitted when switchgear is de-energized, tested and grounded.

8.4.5 At no time in a switchgear shall there be an exposure to live parts at primary voltage, either directly or through a tool, cable or material in one's hand or in contact with one's body. If such exposure exists, work shall be done with live line tools or by de-energizing and grounding. If the switchgear is dead front, cover up equipment is an option to remove the exposure.

8.4.6 Energized equipment at ground level which is accessible to the public, such as pad mounted transformers, shall be closed and secured with a locking device before leaving the area. This equipment may be left unsecured for qualified contractors to install customer owned cable or conduit for as long as necessary to complete their work. Equipment shall not be left unsecured overnight unless contractor is present.

8.4.7 When working in energized dead front transformers, appropriate primary rated rubber gloves with protectors shall be worn while working on the secondary side, unless the energized primary elbows are covered with rubber blankets or other approved cover-up devices. Workers shall wear appropriate rated rubber gloves while working on exposed parts operating up to 600 volts.

8.5 Secondary Enclosures

8.5.1 When opening or closing any enclosure containing conductors energized up to 600 volts, appropriately rated rubber gloves with protectors shall be worn. The enclosure may be unlocked and locked without rubber gloves.

9.0 METERING

9.1 General/PPE

9.1.1 Verify voltage at meter socket or test switch before proceeding with work.

9.1.2 Class O or appropriately rate primary rubber gloves with protectors shall be worn when working on or within an energized meter base.

9.1.3 Stand to the side of the meter base when setting or pulling meters.

9.1.4 Never reuse any electric meter once it has been exposed to an overcurrent situation (such as a lightning strike) or taken out of service for other reasons until it has been tested and returned to service.

9.1.5 On meters with a bypass, do not pick up or drop load with this switch. The bypass switch shall only be closed long enough to change the meter.

9.1.6 All meter parts shall be considered energized until the proper tests have been completed.

9.2 Meters, Electric-Setting, Working With

9.2.1 Prior to inserting a self-contained meter into a meter base where wiring modifications have been done or for new installations, employees shall test the meter base using a voltmeter or other approved test instrument.

9.2.2 On all CT/PT rated meter installations, all meter installations shall be completed prior to energizing.

9.2.3 When connections must be made where opposite phases or potential may contact each other, the phases shall be covered or the hazard eliminated.

9.2.4 Connections to the service or test instruments shall not be opened or shifted while test load is energized.

9.2.5 Open and energized meter bases shall not be left unattended.

9.2.6 Current transformers shall be shunted when taken out of service.

9.3 Meter Shops, Electric and Gas

9.3.1 Electric ground connections shall be made first and removed last. This is particularly important in temporary meter test setups.

10.0 FACILITIES

10.1 General

10.1.1 Each Business Segment shall abide by their own LOTO policy/procedure.

10.1.2 LOTO shall be the preferred method of personnel protection, unless the scope of work falls within the following list of exceptions to this protocol:

- Work on cord and plug connected electric equipment for which exposure to the hazards of unexpected energization or start-up of the equipment is controlled by the unplugging of the equipment from the energy source and by the plug being under the exclusive control of the employee performing the servicing or maintenance.
- Troubleshooting or calibration of equipment that requires the equipment remain on and running. If defective components are found and require maintenance, then the equipment shall be de-energized and the Business Segment's LOTO policy shall apply.
- If work must be done on energized equipment, documented procedures and/or protection measures that provide equivalent protection shall also be referenced and followed. The type of work shall dictate the appropriate procedure to follow.

10.1.3 Equipment or circuits should be de-energized before initiating work. When equipment must be worked energized, electrical safe work practices in Section 4.0 shall be followed.

10.1.4 When it is necessary to work on energized equipment:

10.1.4.1 An Electrical Work Permit shall be completed and approved by the supervisor or their designee.

10.1.4.2 Barricades, cones, tape or other suitable barrier shall be used to restrict access into the LAB.

10.1.5 Only Class (E) employees that are also authorized under LOTO shall perform work on energized electrical equipment.

10.1.6 Abandoned wires should be removed, if possible, or properly protected and labeled appropriately.

10.1.7 When replacing fuses, validate the circuit load is disconnected.

11.0 TRAINING

11.1 Establishing Training

11.1.1 Each Business Segment is responsible for establishing qualified person training requirements and ensuring adequate training is conducted.

11.2 Qualified Class E Training

11.2.1 Employees shall be trained in and be competent with the electrical safety-related work practices, safety procedures, and other safety requirements that pertain to their respective job assignments. Personnel shall also be trained in and competent with any other safety practices, including applicable emergency procedures (such as pole top and manhole rescue), that are not specifically addressed by this section but that are related to their work and are necessary for their safety.

11.2.2 A qualified Class (E) employee will have undergone and passed an electrical training program and be proficient in the scope of work on:

11.2.2.1 The skills and techniques necessary to distinguish exposed live parts from other parts of electric equipment,

11.2.2.2 The skills and techniques necessary to determine the nominal voltage of exposed live parts,

11.2.2.3 The RAB/MAD specified in this manual corresponding to the voltages to which the qualified employee will be exposed,

11.2.2.4 The proper use of the special precautionary techniques, personal protective equipment, insulating and shielding materials, and insulated tools for working on or near exposed energized parts of electric equipment.

11.2.3 Apprentices who are undergoing "on-the-job" training are considered to be Qualified Class (E) employees if they have demonstrated an ability to perform duties safely and if they are under an immediate supervision or qualified journeyman Class (E) employee.

11.3 Qualified Class B Training

11.3.1 Must know and understand what is and is not safe to touch in the specific areas they will be entering.

11.3.2 Must know and understand the maximum voltage of the area.

11.3.3 Must know and understand the LAB, RAB/MAD for the maximum voltage within the area.

11.3.4 Must be trained in the recognition and proper use of protective equipment that will be used to provide protection for them and in the work practices necessary for performing their specific work assignments within the area. (**Note:** Only Class (E) qualified employees may install insulating equipment on energized parts.)

11.3.5 Class (B) qualified employee can enter into a substation/switchyard without being escorted by a Class (E) qualified employee.

11.3.6 When working in the RAB/MAD, a Class (B) qualified employee has to be escorted and work under the direction of a Class (E) employee.

11.3.7 Each facility is responsible for establishing qualified person training requirements in their procedures and ensuring adequate training is conducted.

12.0 RECORDS

Training and testing records shall be maintained in accordance with Ameren retention policy.

13.0 REFERENCES

13.1 Source Requirements

13.1.1 NFPA 70E (2015)

13.1.2 OSHA 29 CFR 1910

13.1.3 ANSI

13.1.4 ASTM

13.1.5 NESC

13.2 Development References

13.2.1 Ameren Generation Facilities Rules to Live By

13.2.2 Power Operations Safe Work Rules Handbook

13.2.3 Ameren Missouri WPA Implementation Manual for the Fossil Fired Energy Centers

13.2.4 Power Operations FR Personal Protective Apparel Policy

13.2.5 Callaway Energy Center Safe Work Practices Manual

13.2.6 Ameren Records Management Procedure

14.0 ATTACHMENTS

14.1 Attachment 1, Limits of Approach

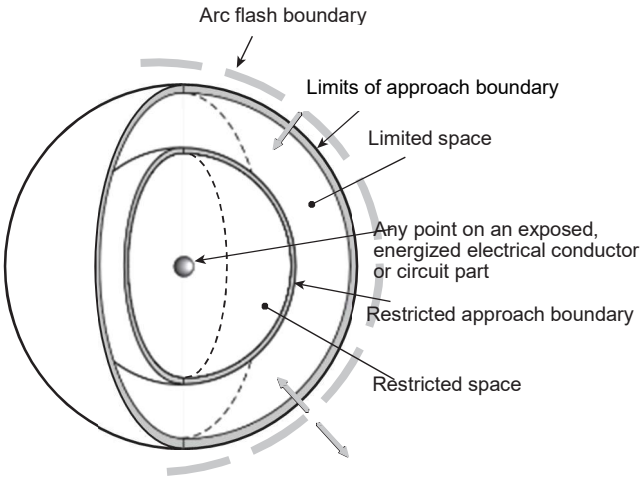
14.2 Attachment 2, Approach Boundaries

14.3 Attachment 3, Heat Energy Incident Table Example

14.4 Attachment 4, Equipment Label Example

14.5 Attachment 5, Sample Electrical Safety Plan

ATTACHMENT 1 – Limits of Approach



Note: All boundaries are spherical in nature, not just single plane.

ATTACHMENT 2 – Approach Boundaries

APPROACH BOUNDARIES

Approach Boundaries to Live Parts for Shock Protection

Nominal System Voltage Range, Phase to Phase	Limited Approach Boundary		Restricted Approach Boundary/Minimum Approach Distance, Includes Inadvertent Movement Adder
	Exposed Overhead line Conductors	Exposed Fixed Circuit Part	
0 to 50	not specified	not specified	not specified
51 to 300	10ft. 0in.	3ft. 6in.	avoid contact
301 to 750	10ft. 0in.	3ft. 6in.	1ft. 2in.
751 to 5kV	10ft. 0in.	5ft. 0in.	2ft. 1in.
5.0 to 15kV	10ft. 0in.	6ft. 0in.	2ft. 2in.
15.1 to 36 kV	10ft. 0in.	6ft. 0in.	2ft. 7in.
36.1 to 46 kV	10ft. 0in.	8ft. 0in.	2ft. 10in.
46.1 to 72.5 kV	10ft. 8in.	8ft. 0in.	3ft. 4in.
72.6 to 121 kV	12ft. 4in.	8ft. 0in.	3ft. 9in.
121.1 to 145 kV	13ft. 0in.	10ft. 0in.	3ft. 10in.
145 to 169 kV	14ft. 0in.	10ft. 0in.	4ft. 4in.
169.1 to 242.0 kV	16ft. 0in.	12ft. 0in.	5ft. 8in.
242.1 to 362 kV	22ft. 0in.	15ft. 4in.	8ft. 6in.

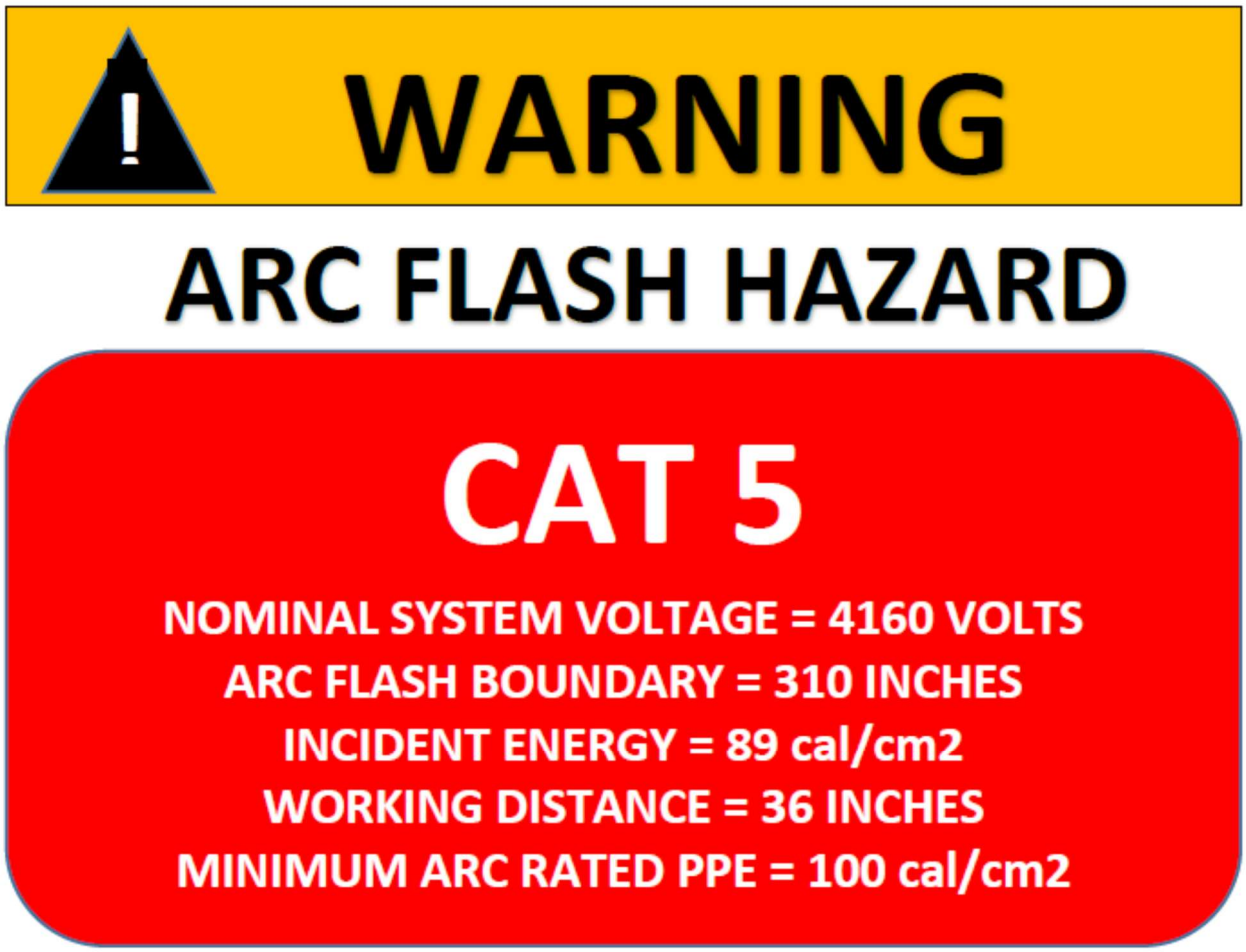
NOTE: *Exposed overhead conductor* describes a condition in which the distance between the conductor and a person is not under the control of the person. The term is normally applied to overhead line conductors supported by poles.

ATTACHMENT 3 – Heat Energy Incident Table (EXAMPLE)

Energy Center - Ameren Hazardous Risk Categories for Arc Flash Exposure - EXAMPLE						
Bus Name	**Protective Device Name**	**Bus kV**	**Arc Flash Boundary (in)**	**Working Distance (in)**	**Incident Energy (cal/cm²)**	**Ameren Hazardous Risk Category**
4160V BUS 1A (51-1A LineSide)	51-9H	4.16	366	36	**124**	**CAT 6**
4160V BUS 2A	51-2A	4.16	310	36	**89**	**CAT 5**
BUS CAPC-ATS1	NX125	0.480	193	18	**40**	**CAT 4**
CAPC-MCC-1	BOP XFER	0.480	110	18	**17**	**CAT 3**
480V BUS 4C	4C-1	0.48	41	18	**4.1**	**CAT 2**
4APC-MCC-1	MCC4 MAIN	0.480	35	18	**3.1**	**CAT 1**
GEN1 SPACE HTR	MC1-7E	0.480	13	18	**0.00**	**CAT 0**

Ameren Hazard Risk Categories	**Arc Flash PPE Legend**
Ameren Hazardous Risk Category	**Minimum PPE requirements**
CAT 0 <1 **cal/cm²**	Non-arc rated PPE Appropriate natural fiber shirt with pants or coverall and safety glasses or goggles.
CAT 1 1-**4 cal/cm²**	Minimum Arc Rating of 4 cal/cm² Appropriate arc rated long sleeve shirt and pants or coverall; appropriate arc rated rubber gloves. Leather gloves with the weight of 12 oz./yd2 can be worn as arc rated hand protection; arc rated face shield or flash hood or arc rated balaclava hood and goggles; Protective equipment: safetyglasses or goggles, electric rated hard hat; leather safety footwear; and hearing protection (ear canal inserts).
CAT 2 >**4-8 cal/cm²**	Minimum Arc Rating of 8 cal/cm² Appropriate arc rated long sleeve shirt and pants or coverall; appropriate rated rubber gloves with protectors; arc rated flash suit hood or arc rated balaclava and face shield or goggles. Protective equipment: safety glasses or goggles; electric rated hard hat; primarily leather safety footwear; and hearing protection (ear canal inserts).
CAT 3 >**8-25 cal/cm²**	Minimum Arc Rating of 25 cal/cm² Appropriate arc rated long sleeve shirt and pants or coverall; appropriate rated rubber gloves with protectors; arc rated flash suit jacket; arc flash suit pants; arc flash suit hood or arc rated balaclava and face shield or goggles; Protective equipment: safety glasses or goggles; electric rated hard hat (arc rated liner as required); primarily leather safety footwear; and hearing protection (ear canal inserts).
CAT 4 >**25-40 cal/cm²**	Minimum Arc Rating of 40 cal/cm² Appropriate arc rated long sleeve shirt and pants or coverall; appropriate rated rubber gloves with protectors; arc rated flash suit jacket; arc flash suit pants; arc flash suit hood or arc rated balaclava and face shield or goggles. Protective equipment: safety glasses or goggles; electric rated hard hat (arc rated liner as required); primarily leather safety footwear; and hearing protection (ear canal inserts).
CAT 5 >**40-100 cal/cm²**	Minimum Arc Rating of 100 cal/cm² Appropriate arc rated long sleeve shirt and pants or coverall; appropriate rated rubber gloves with protectors; arc rated flash suit jacket; arc flash suit pants; arc flash suit hood; Protective equipment: safety glasses or goggles; electric rated hard hat (arc rated liner as required); primarily leather safety footwear; and hearing protection (ear canal inserts).
CAT 6 over 100 cal/cm²	DO NOT WORK ENERGIZED
NO ASSESSMENT	IF THERE IS NO ASSESSMENT DATA AVAILABLE FOR ELECTRICAL EQUIPMENT FOLLOW DIRECTION FROM ELECTRICAL SAFE WORK PRACTICES MANUAL

ATTACHMENT 4 – Equipment Label (EXAMPLE)



ATTACHMENT 5 – Sample Electrical Safety Plan

Part I: TO BE COMPLETED BY THE REQUESTER: Job Request (JR) Number _____

(**1**) Description of circuit/equipment/job location: _____

(**2**) Description of work to be done: _____

_____

(**3**) Justification why the circuit/equip. cannot be de-energized or the work deferred until the next scheduled outage:

---

(4) Will CPR/FA be available within 4 minutes? **YES** / **NO** **(5)** Will a Safety Person be needed? **YES** / **NO**

_____ _____
Requester/Title Date

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

(1) Description of the Safe Work Practices to be employed: _____

(2) Shock Hazard Analysis: Voltage Level _____

Approach Boundaries: Limited (LAB) _____ Restricted (RAB) _____

(3) Results of Flash Hazard Analysis: Arc Flash Boundary: _____ (Assumed or Calculated)

Ameren Hazardous Risk Category (CAT) _____ **OR** Calculated Flash Hazard at 18" _____

(4) Additional PPE beyond CAT and rescue equipment for worker and safety person, if needed, to safely perform the assigned task: _____

(5) Means employed to restrict the access of unqualified persons (Class N) from the work area, i.e. guarding/barriers: _____

(6) Did the assigned crew member conduct a job briefing: _____ Yes _____ No

(7) Do you agree the above described work can be done safely? **YES** / **NO** (circle: If *no* return to requester)

_____	_____	_____	_____
Electrically Qualified Person (s)	Date	Electrically Qualified Person (s)	Date
_____	_____	_____	_____
Designated Safety Person(s)	Date	Management Representative	Date

Additional Electrically Qualified Person (s) or information can be added to the backside of this form.