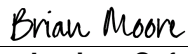
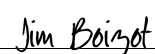


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Owner: HQ Health and Safety Specialist <small>DocuSigned by:</small>  9/30/2019	Original Effective Date: 9/20/2017	
Authority: Safety Manager <small>DocuSigned by:</small>  9/30/2019	Current Effective Date: 10/1/2019	
<small>A94E1064C95C4A2...</small> Review Frequency: Annually	Next Review Date: 10/01/2020	

Purpose:

This procedure defines the work methods necessary to protect from voltages and currents that might develop at a de-energized worksite operation, maintenance and construction of substation lines, cables and equipment. The use of a personal protective grounding system is the primary work method covered by this procedure; however the use of insulation or isolation work methods may be used as an alternative when approved by Platte River Power Authority Management, Safety, and Engineering in some isolated incidences.

Implementing Parties and Assigned Responsibilities:

Safety:

- Annual review of the Personal Protective Grounding Procedures.
- Provide for the training of all PRPA personnel required to hang personal protective grounds.
- Provide assistance and support to employees when questions or concerns arise with regards to personal protective grounds.
- Maintain written records of training.

Supervisors:

- Verify that all employees who install personal protective grounds have been properly trained.
- Ensure that only qualified employees hang personal protective grounds.
- Periodically audit employees installing grounds.
- Ensure that all grounding equipment is tested annually or after a fault has been experienced prior to subsequent use.

Employees:

- Follow all the requirements contained within this procedure.
- Ensure that a pre-job briefing has been conducted.

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- Inspect all grounding equipment prior to use.
- Prior to hanging grounds, ensure all other personnel are in the clear.

Associated Documents:

References:

OSHA 1910.269(m) De-energizing Lines and Equipment for Employee Protection
 OSHA 1910.269(n) Grounding for the Protection of Employees
 IEEE 1048 – 2011 Guide for Temporary Protective Grounding of Power Lines
 IEEE / ESMO Task Force Induction Hazards on De-energized Electric Utility Systems
 Standard Operating Procedure #1 Power System Switching and Clearance Procedures

Introduction

The electric utility industry has three accepted work methods allowing qualified workers to work within the Minimum Approach Distance (MAD) of energized or de-energized lines and equipment. They are:

- Insulation
- Isolation
- The use of Personal Protective Grounding (EPZ)

Insulation – Workers can insulate themselves from any possible potential difference between lines and equipment, and ground using insulated rubber gloves, insulated tools, insulated platforms, etc.

Isolation – Workers can use isolation method when working on lines and equipment by first grounding the lines and equipment using an approved method, then removing the grounds and isolating the lines and equipment. To use the isolation method the lines and equipment must have:

- Been de-energized under the provision of Platte River Power Authority's Power System Switching Procedure
- No possibility of contact with another energized source
- No hazards of induced voltage possible

Note: The isolation method may be acceptable work method in some isolated incidences; however approval from Platte River Power Authority Management, Safety and Engineering is required to use the isolation method on overhead distribution and transmission systems.

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Personal Protective Grounding (EPZ) – Workers can install a personal protective grounding at the work site to limit the voltage difference between any two accessible points within the work site to a safe value.

General Requirements

When lines and equipment are energized, or may be energized, at over 50 volts are removed from service for operation, maintenance, or construction, they shall be considered energized until a clearance has been issued and the lines and equipment have been tested and grounded as specified in this procedure.

Conductors and devices shall be tested and grounded only after proper clearances have been issued as specified in the Platte River Power Authority's Power System Switching Procedures.

A job briefing shall be held with all workers involved before beginning any job to discuss the potential hazards. A Platte River Power Authority's Job Briefing Form (see Appendix A) shall be filled out and signed before work begins. When the work includes grounding of lines and equipment, the use of personal protective grounding shall be discussed and understood by everyone involved with the work.

Grounding equipment shall be connected to "ground" using the substation ground mat.

Only approved temporary protective grounding equipment shall be used when grounding lines and equipment. Temporary Protective Grounding Equipment consists of: Type C grounding clamps, flat – face grounding clamps, with aluminum and copper shrouded and unshrouded ferrules. Ground cable size is # 4/0. Table 1, below specifies the size of grounding cable that shall be used for each system voltage.

Table 1

System Voltage (kV)	Maximum Fault Current (kA)	Cable Size
230	20	4/0
115	20	4/0

Temporary protective grounding equipment shall be visually inspected each day before use. This includes visually checking grounding jumpers for broken or loose fittings, and chafed or cut insulation. The grounding clamp jaws shall be clean and the cable ferrules tightened each day. The grounding clamp jaws should be wire brushed with inhibitor before each use. If any damage is found, repair or replace the equipment.

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Temporary protective grounding equipment shall be tested for resistance yearly by Platte River Power Authority's current testing and inspection contractor.

Do not ground through fuses, transrupters, power circuit breakers, switches, power transformers and other types of devices.

When work is done out of an insulated aerial lift where the worker can contact the structure or equipment, the lines and devices shall be grounded using the personal protective grounding method.

If work is done out of an un-insulated aerial lift where the worker can contact the structure or equipment, the lines and devices shall be grounded using personal protective grounding method and a bonding jumper shall be installed between the un-insulated aerial basket and the line or device being worked.

Refer to vehicle grounding section for proper grounding of utility vehicles.

Temporary protective grounding equipment can make violent whipping actions when energized with fault currents exceeding 25,000 A. When system fault currents exceed 25,000 A, grounding jumpers should be short as possible and routed to ensure they do not injure workers if energized. Any excess grounding jumper length should not be coiled, but tied off to a structure with rope.

A Platte River Power Authority's approved voltage detector, rated for the system voltage, shall be used to verify the line or equipment is de-energized. "Fuzzing" the line is NOT an approved method of testing lines or equipment. The voltage detector shall be tested before and after each use to ensure the device is working properly.

The ground-end clamp of the grounding cable shall always be connected to the ground first and removed last. The conductor end of the ground cable shall be connected and disconnected with hot-line tools.

Workers on the ground may be exposed to step and touch potentials when all types of protective grounding procedures are used. While work is in progress, ground personal should stay a minimum of 10 feet from the structure being worked and any driven ground rod.

Not all work at Platte River Power Authority's substations will allow the procedures detailed below to be used. If the work requires applying alternative work methods, the person-in-charge shall receive approval from Platte River Power Authority's management, engineering and the safety department before making any revisions to these procedures.

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Personal Protective Grounding in Substations

Personal Protective Grounding of a Substation Bus

Obtain a clearance as specified in Platte River Power Authority's Clearance and Switching Procedures.

Test the bus to ensure it is de-energized using a Platte River Power Authority approved voltage detector.

Ensure the personal protective grounds are installed as close to the worksite as possible. When the worker contacts the conductor while positioned on the structure, a conductive loop is developed and the voltages generated can be as much as three times the normal voltage.

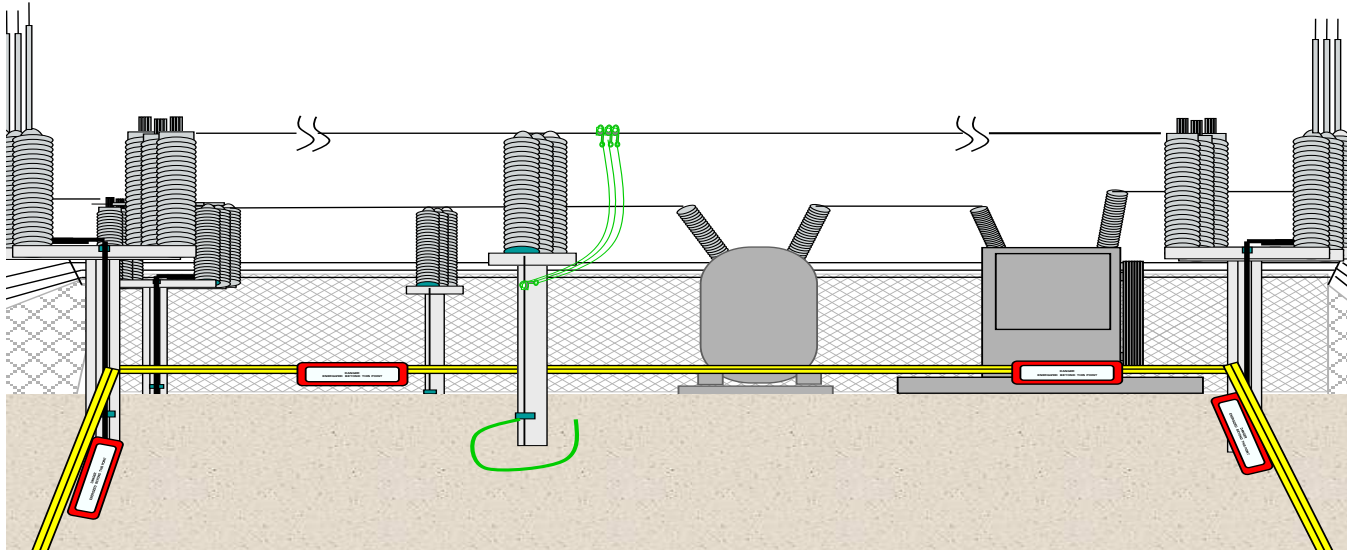
Wire brush the ground mat conductor at the grounding location. Wire brush the bus using a wire brush attached to an insulated tool at the location ground clamps are to be installed.

Install three properly sized and correct length grounding jumpers to the ground mat. Install the other end of each grounding jumper to each bus using hot-line tools.

Another method is to install a ground to the ground grid and then install a grounds to A-phase then to B-phase and then to C-phase.

Remove grounding jumpers after the work is complete in the reverse order.

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Disconnect Switches, Power Circuit Breakers and Transformers

Obtain a clearance as specified in Platte River Power Authority's Clearance and Switching Procedures.

Test the substation bus on both sides of the device to ensure it is de-energized using a Platte River Power Authority approved voltage detector.

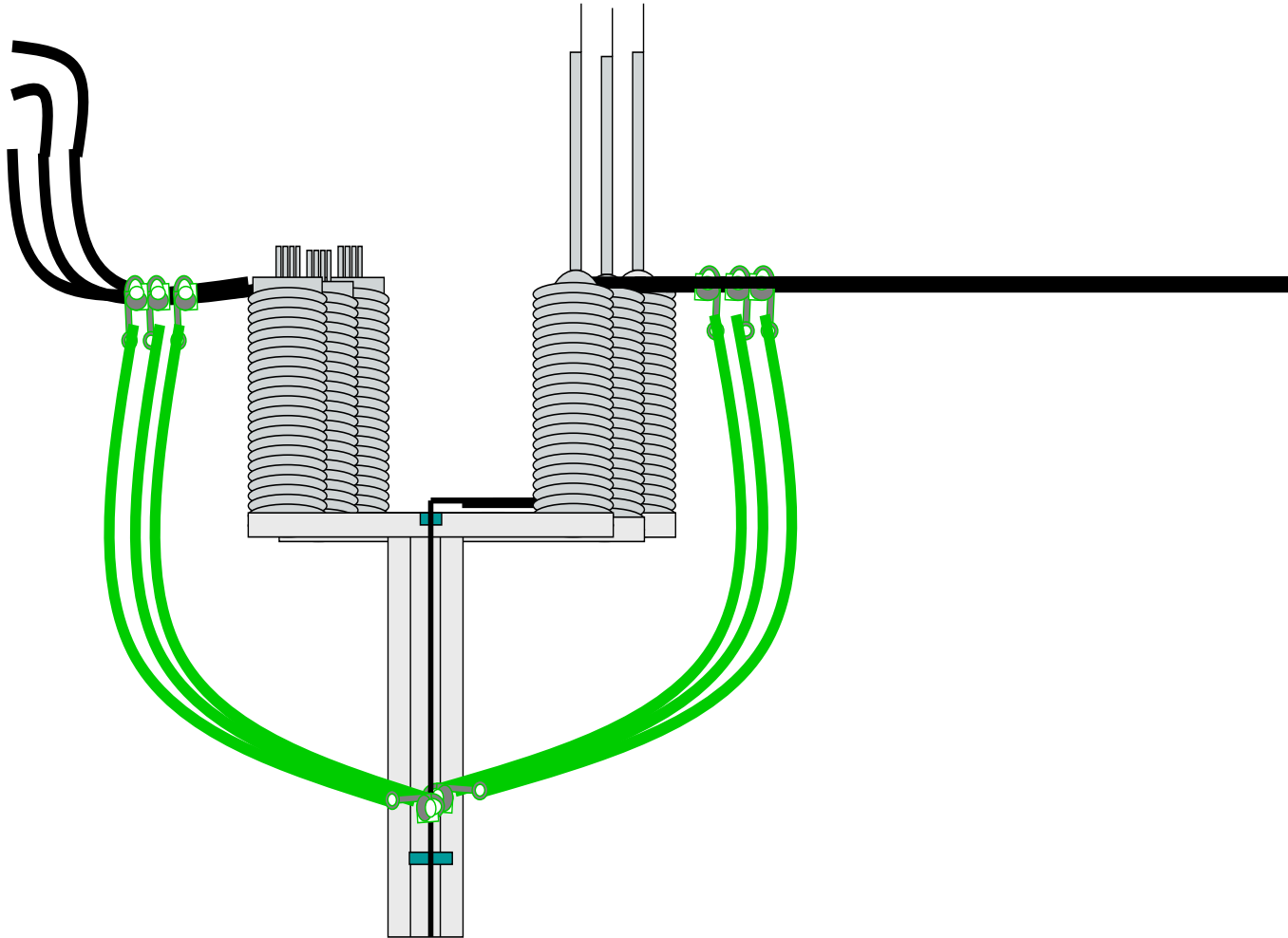
Wire brush the ground mat conductor at the grounding location. Wire brush the bus using a wire brush attached to an insulated tool at the location ground clamps are to be installed.

Install three properly sized and correct length grounding jumpers to the ground mat on each side of the device. Install the other end of each grounding jumper to each bus using hot-line tools.

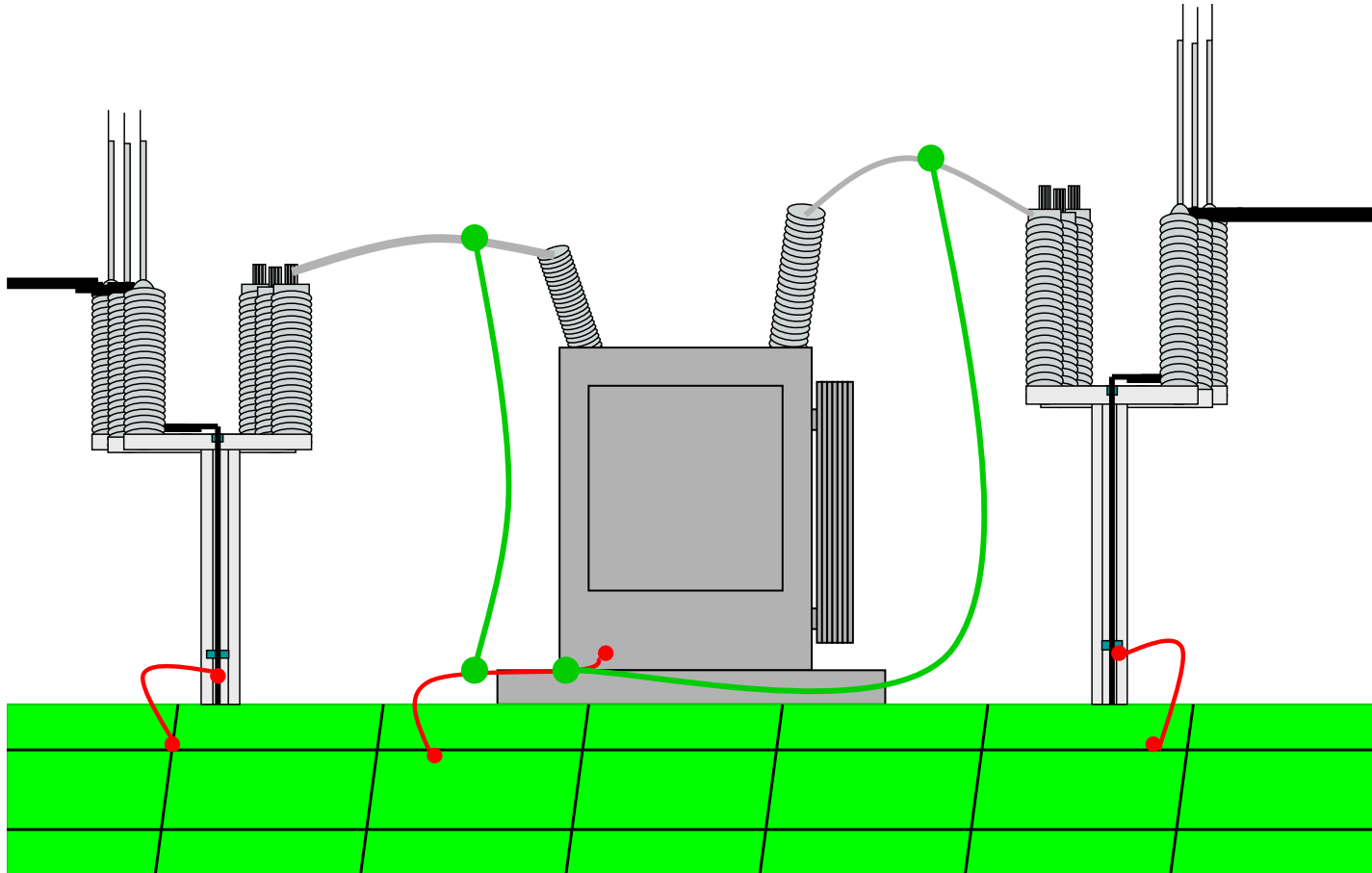
Repeat the step above on the other side of the device.

Remove grounding jumpers after the work is complete in the reverse order.

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Protective grounding equipment may be removed temporarily during testing. The use of test equipment may require removal of grounds, and can charge conductors and equipment. After testing, grounds shall be reapplied before coming in contact with the conductors or equipment. When grounds are removed for testing, insulating equipment, hot line tools shall be used to isolate all workers from the lines and devices.

Operating Utility Vehicles Near Energized Lines and Equipment

The insulated portion of an aerial lift operated by a qualified employee in the lift is exempt from this section if the MAD, is maintained between the un-insulated portions of the aerial lift and exposed energized lines and equipment.

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During the job briefing such factors as the task to be performed, length of the boom, stability of the ground supporting the equipment, wind and other weather conditions, skill of the operator, responsiveness of the mechanical equipment's controls, and type of winch line, wire or rope, shall be considered to determine if an additional distance should be added to the MAD.

When utility vehicles are operated between the ten feet and the MAD, each employee shall be protected from the hazards that might arise from accidental equipment contact with the exposed energized lines and equipment by the use of at least one of the following:

1. The exposed energized lines and equipment exposed to contact shall be covered with insulating protective material that will withstand the type of contact that might be made during operations. Adequate insulating protective material shall be installed so that the mechanical equipment does not enter the MAD.
2. The equipment shall be insulated for the voltage involved. The un-insulated portions of the mechanical equipment shall not approach the exposed energized lines and equipment any closer than the MAD.
3. The equipment shall be grounded to the approved "ground", as specified above to minimize the time the exposed lines and equipment remains energized, and at least one of the following practices shall be used.
 - (A) Permanent or temporary insulated platforms, conductive grids or mats bonded to the equipment chassis, shall be installed at points where employees need to contact the equipment.
 - (B) The mechanical equipment shall be barricaded to prevent employees from contacting the equipment.

When any two or more pieces of mechanical equipment at a work site, having a boom near exposed energized lines and equipment are positioned in a way that can allow both vehicles to be contacted by workers at one time, both shall be bonded together to minimize potential differences.

Where the general public could contact mechanical equipment operating near energized lines and devices, barricades should be used to keep the general public away from the mechanical equipment.

Workers on the ground may be exposed to step and touch potentials if the mechanical equipment contacts energized lines and devices. While work is in progress, ground

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personal should stay at a minimum of three feet from the utility vehicle unless protected as described above.

Definitions and Acronyms:

Barrier

An insulating device rated for the voltage involved (line hose, plastic cover-up).

Barricade

A physical obstruction made from cones 28 inches or taller, A-Frame barricades, or other structures connected with continuous barricade tape providing a warning and limiting access to a potentially hazardous area.

Bond

An electrical interconnection of conductive parts designed to maintain a common electrical potential.

Bonding Jumper

A jumper used to bond conductive parts together (switch handle to a temporary ground mat, jumper across an open neutral, etc.).

Bracket Grounding

A grounding method where temporary protective ground sets are installed on both sides of a worksite.

Cable Isolation

Isolating cable from accidental energization by disconnecting the cable and its concentric neutral from the system neutral. Jacketed cable can be considered isolated if bare concentric neutral ends of the cable are isolated from all ground sources.

Clearance

The certification by the system operator that a specified line or equipment de-energized from all normal sources of electrical energy, a clearance tag has been placed at all clearance points, and the transfer of authority from the system operator to the clearance holder has been completed.

Cluster Bar

A terminal temporarily attached to a structure to support (it may assist to establish an equipotential zone) and provide a bar that will accommodate grounding cables.

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De-Energized

Disconnected from all intentional sources of electrical supply by opening switches, jumpers, taps, elbows, or other means. De-energized lines and equipment could be electrically charged or energized through various means, e.g. induction from energized circuits, portable generators or lighting. De-energizing lines and equipment does not allow workers to enter MAD unless the work methods in this procedure are followed.

Electric Field Induction (Capacitive Coupling)

The process of generating a voltage or current in an isolate conductive object or electric circuit by means of time-varying electric fields.

Electro-Magnetic Field Induction

The process that employs both electric and magnetic fields to generate a circulating current between two grounded sites of a line due to the proximity of an adjacent or nearby energized line.

Energized

Electrically connected to a source of potential difference, or electrically charged so as to have a potential different from that of the earth.

Equi-potential zone

The state of maintaining a near identical electrical potential between two or more items, as compared to the nominal voltage present, abbreviated EPZ.

Exposure Voltage

The voltage impressed across a worker's body, either hand-to-hand, or hand –to-foot, when the worker comes in contact with objects at the worksite that are not at the same potential.

Ground Mat

A vinyl mat with copper mesh sewn in a rectangular configuration. The device is positioned at the location where workers will be standing during work with grounded underground cables and devices. The ground mat is connected using temporary protective grounding jumpers to the concentric neutral of the cable being worked. The ground mat, when used, creates an equipotential zone for workers in contact with grounded underground cable devices.

Ground (Ground Source)

Earth or a conductive body of relatively large extent that serves in place of earth. Ground normally provides a reference to zero (0) volts, no voltage, for electrical circuits. Under fault conditions ground may raise in voltage to level above zero volts near an intentional or accidental connection of an electric circuit to ground.

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Grounded (Grounding)

A means of connecting an electrical circuit or electrical equipment to Ground (see the definition of ground) whether intentional or accidental.

Insulated Aerial Lifts

Mechanical equipment employing insulated booms, tested for the voltage involved, used to position workers in an elevated position.

Minimum Air Insulation Distance (MAID)

The shortest distance in air between an energized line or equipment, and a worker's body at different potential. This distance does not take into account a floating electrode in the gap, or any factor for inadvertent movement.

Minimum Approach Distance (MAD)

The minimum air insulation distance (MAID) plus a factor for inadvertent movement.

Neutral Bonding Jumper

A jumper installed on the concentric neutral bridging all location, on the cable which is to be cut. The neutral bonding jumper ensures the concentric neutral (common neutral) is not opened.

Personal Grounds

The combination of a cluster bar, or ground mat, a grounding jumper from the cluster bar to the worksite ground source.

Personal Protective Grounding

The combination of tripping grounds and personal grounds installed in a method that bonds the de-energized lines and equipment with all other conductive objects within the worksite, including the structure, limiting the exposure voltage to a safe value.

Qualified Workers

One knowledgeable in the construction and operation of the electric power generation, transmission, and distribution equipment involved, along with the associated hazards. An employee must have the training required by OSHA 1910.269(a)(2)(ii) in order to be considered a qualified worker.

Temporary Protective Grounding Equipment

A system of ground clamps, ferrules, cluster bar(s) and cables designed and suitable for carrying fault current as specified in ASTM F855.


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Utility Vehicles

Mechanical equipment including un-insulated lifts, digger / derricks, boom trucks, pulling and tensioning equipment used in stringing conductors, cable pulling equipment, etc.

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Appendix A

 Platte River Power Authority	Substations/Facilities Job Safety-Tailgate Form	
	Date:	WO#:
Job Supervisor:		
Names:		
Job Description & Location:		
Work Procedures:		
Job Hazards:		
Hazard Mitigation:		
PPE Requirements:		
Energy Source Controls: Address any energy sources that apply to the job, if an item doesn't apply then mark it: NA		
Clearance #:	Clearance Holder:	Grounds:
Low Voltage (50-600V) Isolations:		
Lock/Tag Locations:		
Mechanical or Stored Energy Isolations:		
Lock/Tag/Block Points:		
<input type="checkbox"/> 1: Make notifications (<i>if not under clearance: PSO may need notified</i>). <input type="checkbox"/> 2: Turn off and lock or tag. <input type="checkbox"/> 3: Clear personnel= <u>dissipate</u> stored energy & <u>verify</u> dissipated (<i>if applicable</i>). <input type="checkbox"/> 4: Perform work. <input type="checkbox"/> 5: Unblock equipment & ensure safety devices are in place (<i>if applicable</i>). <input type="checkbox"/> 6: Clear workers & equipment & <u>keep area clear</u> . <input type="checkbox"/> 7: Remove locks &/or tags. <input type="checkbox"/> 8: Ensure area is clear & restart/energize. <input type="checkbox"/> 9: Make notifications.		
<u>Use Reverse Side of Page For Additional Notes If Needed</u>		
Employees Initials:		