

UNION ELECTRIC MISSOURI ELECTRIC OPERATIONS EQUIPMENT GROUNDING POLICY

AmerenUE

Effective TBD

Purpose

The purpose of this Equipment Grounding Policy is to standardize the method of grounding equipment in a safe and consistent manner in order to prevent injuries to employees and the public, while protecting our equipment. This policy is a mandate to all UE Supervisors and Employees.

Application

All operating functions of UE Missouri Electric Operations.

Policy

This policy sets forth procedures required to increase worker protection from un-insulated portions of aerial equipment that may encroach a ten (10) foot approach distance from distribution primary and sub transmission voltages. For Transmission voltages the policy applies to aerial equipment (both insulated and non-insulated). The encroachment zone for voltages between 100kV and 200kV is fifteen (15) feet and for voltages greater than 200kV is twenty (20) feet.

For Distribution voltages when such encroachment is necessary and/or unavoidable for the work being performed and the equipment cannot be relocated so that the un-insulated portions remain outside of the ten foot approach distance workers must follow the procedures outlined below in the Distribution Section.

For Transmission voltages when encroachment of ANY parts of aerial equipment will be within a fifteen foot zone of voltages less than 200kV or a twenty foot zone of 200kV or above, the operator/crew must ground the truck.

When Equipment Grounding is Required - Distribution

When encroachment of un-insulated parts of equipment such un-insulated aerial booms, easement machines, stringing rigs, etc., will be within a ten foot zone of a distribution primary and/or sub transmission voltages, the operator/crew must choose one of the options below. *These procedures are not required if the un-insulated parts remain outside of a 10' zone. It also does not apply to equipment such as crew trucks or bobcats where contact with an energized conductor is not possible.*

Zone 1 – More than 10' from Energized Distribution Primary or Sub-Transmission Voltage

If the un-insulated portions of the equipment can stay more than 10' away from the energized distribution primary or sub-transmission voltage, then no additional safeguards are required.

Zone 2 – Less than 10' but more than 4' from Energized Distribution Primary or Sub-Transmission Voltage

If the un-insulated portions of the equipment can stay more than 4' away from the energized distribution primary or sub-transmission voltage, but will approach less than 10' away, the workers must implement at least one of the three options below (detailed on the following page):

- 1) Ground Truck and Equipment
- 2) Cover Energized Line
- 3) Use Observer

Zone 3 – Less than 4' from Energized Distribution Primary or Sub-Transmission Voltage

If the un-insulated portions of the equipment will approach less than 4' from the energized distribution primary or sub-transmission voltage, the workers must cover the energized line(s) and ground their truck and equipment.

Observer

The observer shall be a designated employee who is qualified or has been trained to recognize the hazards associated with contacting an electrical distribution system. The designated observer shall give timely warning if the un-insulated portions approach the 4' zone. If the un-insulated portions approach the 4' zone, the boom will have to be lowered outside this zone, or cover-up applied to the exposed primary and equipment grounds applied as detailed in this policy.

Stringing Rigs

Stringing rigs shall be grounded when stringing within a 4' zone of primary distribution voltages and/or subtransmission voltages. Additional safe work rules may apply for stringing rigs.

When Equipment Grounding is Required – Transmission

When encroachment of ANY parts of aerial equipment will be within a fifteen foot zone of voltages less than 200kV or a twenty foot zone of 200kV or above, the operator/crew must ground the truck.

Order of Equipment Grounding

- 1) Ground the equipment to the system neutral or substation ground grid.
- 2) If that is not possible, ground the equipment to a pole ground if the pole ground is connected to the system neutral.
- 3) If neither of these options is available, then barricade and use supplemental equipment grounds.

Barricade

A barricade is a physical obstruction intended to provide a warning about, and to limit access to, an area around the equipment. A physical barricade such as caution tape is required as part of the barricade. In addition to a barricade, two temporary grounds must be installed at least six feet apart and inserted as deep as practical and bonded together, then connected to equipment.

When the truck or equipment must be accessed, a worker on the ground may not enter the barricaded area until all three of these conditions are met:

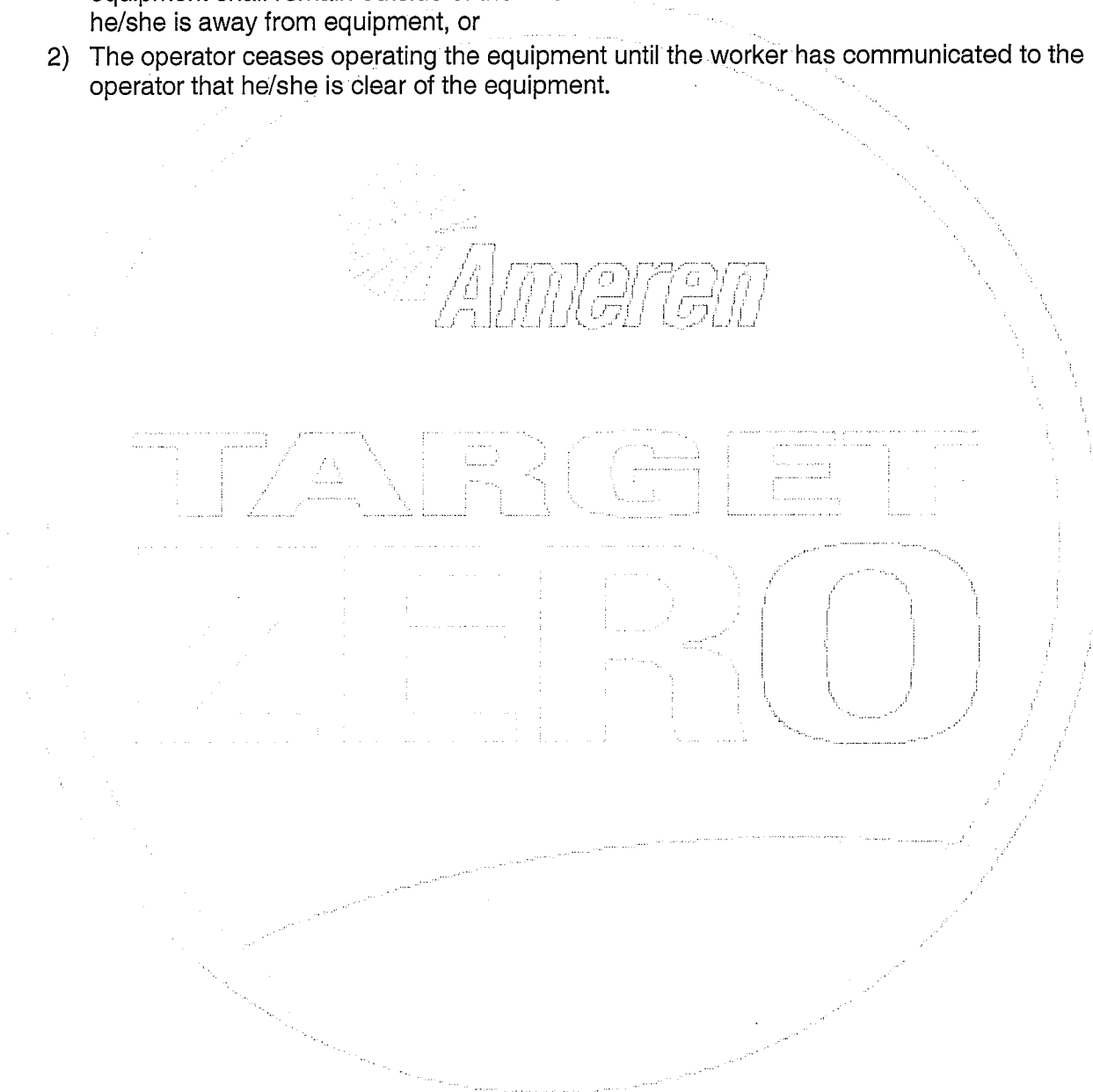
- 1) The boom is outside of the four-foot zone, and
- 2) The operator of the equipment knows that a worker is entering the barricaded area, and
- 3) The operator will not operate the equipment until the worker has exited the barricaded area.

Additional Requirements:

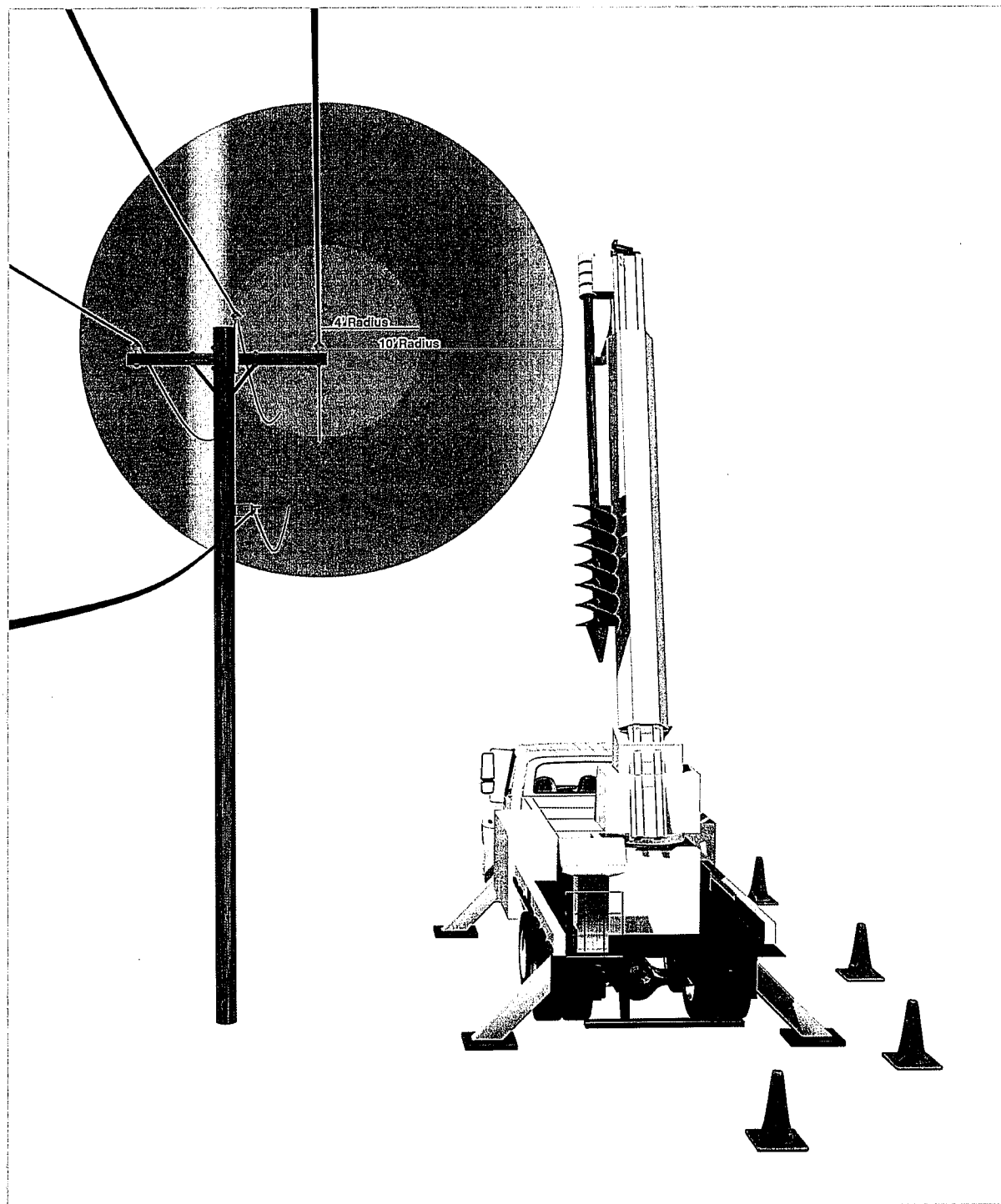
- All equipment ground leads shall be 1/0 copper or larger.
- Connections shall be clean and tight.
- Equipment shall have a grounding stud or other appropriate ground connection.
- Equipment grounds shall not be left coiled while in use. If using a retractable reel, the entire length of cable shall 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.

- If more than one piece of 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 he is carrying to contact both pieces of equipment simultaneously, only one piece of equipment needs to be connected to the system neutral or pole ground. The other pieces of equipment shall be connected to the first piece of equipment. This should eliminate or reduce any chance of differences of potential between pieces of equipment.
- When equipment is grounded, workers on the ground shall not come into contact with the equipment until the following conditions are met:
 - 1) The equipment has been moved out of the 4 foot zone by the operator and the equipment shall remain outside of the 4 foot zone until the worker communicates that he/she is away from equipment, or
 - 2) The operator ceases operating the equipment until the worker has communicated to the operator that he/she is clear of the equipment.

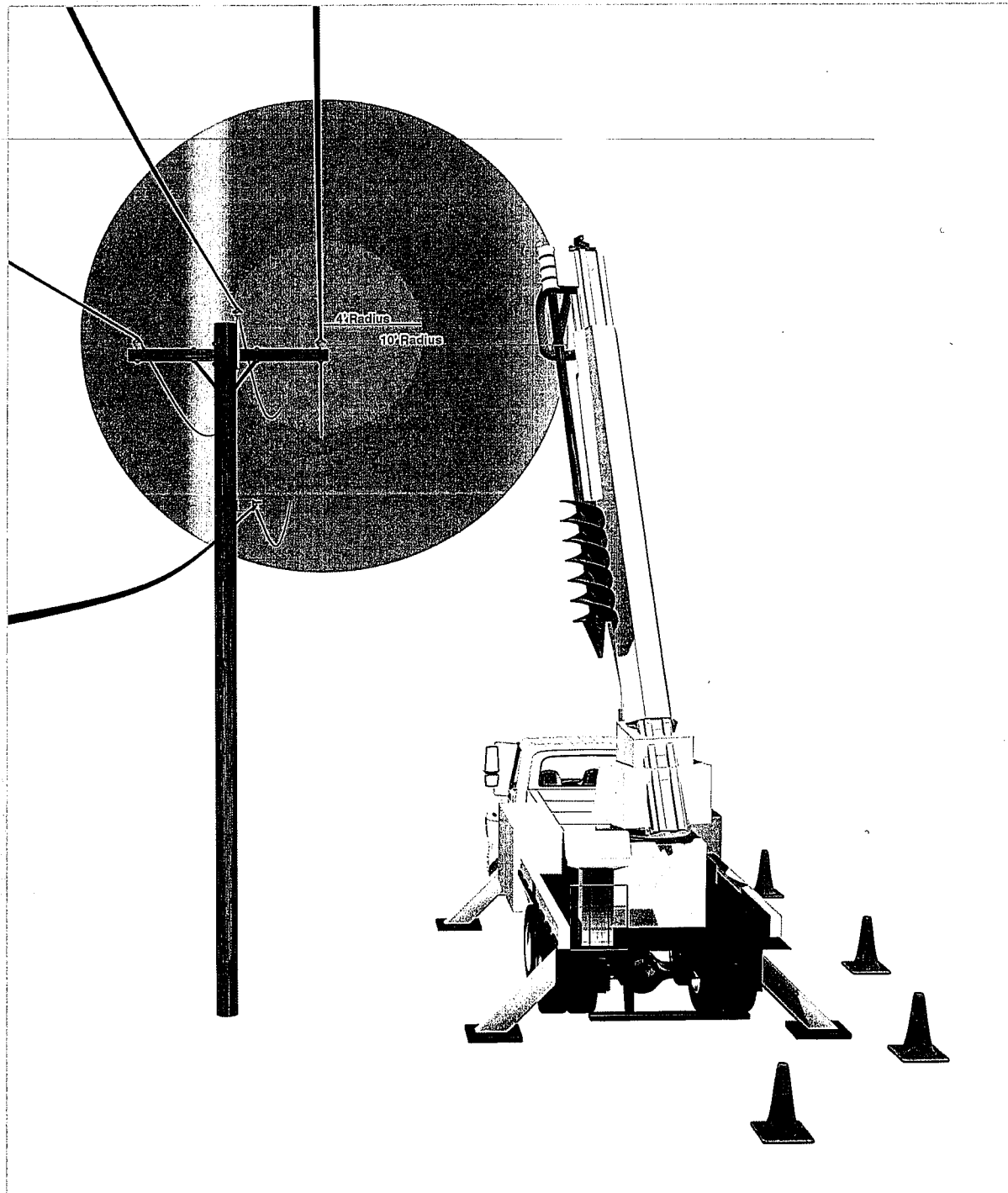


GROUNDING ZONE ONE – MORE THAN 10'



If the equipment can stay more than 10' away from the energized distribution primary or sub-transmission voltage, then no additional safeguards are required.

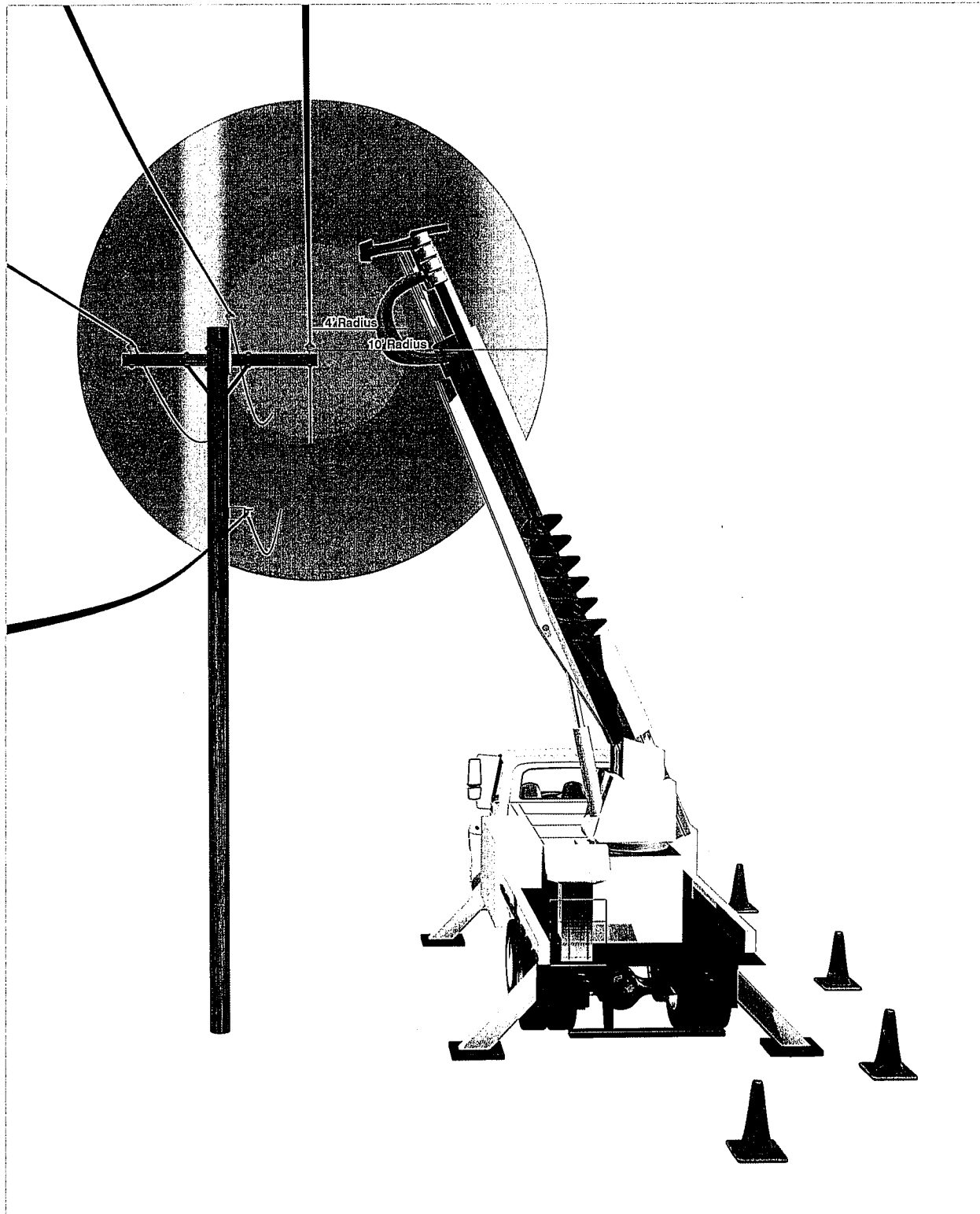
GROUNDING ZONE TWO – MORE THAN 4', BUT LESS THAN 10'



If the un-insulated portion of the equipment can stay more than 4' away from the energized distribution primary or sub-transmission voltage, but will approach less than 10' away, the workers must implement at least one of the three options below:

- 1) Ground Truck and Equipment
- 2) Cover Energized Line
- 3) Use Observer

GROUNDING ZONE THREE – LESS THAN 4'



If the un-insulated portion of the equipment will approach less than 4' from the energized distribution primary or sub-transmission voltage, the workers must cover the energized line(s) and ground their truck and equipment.

Frequently Asked Questions

Why do we need to have an equipment grounding policy?

Over the last four years, Energy Delivery has experienced a number of electrical contacts between un-insulated parts of equipment and energized primary sources. Safety has published several incident summaries due to electrical contacts in the recent past. In addition to these documented reports, there have been additional electrical contacts.

In the last four years alone, these contacts have resulted in one fatality and two lost work day away cases. The lost workday cases involved burns and an amputation of a finger.

It is estimated that we experience at least 1.25 electrical contacts per year between un-insulated parts of equipment and primary sources. This policy is part of the protection measure aimed at the elimination of these contacts.

Why does the policy read, “a four foot approach distance for distribution primary and sub-transmission voltages?” What do I do if I am working near a 345 kV line?

The focus of this policy is with the normal primary distribution and sub-transmission voltages within Union Electric. If the job at hand is near a voltage above 69 kV, then a number of factors will need to be considered in order to perform that work safely. What is the minimum approach chart say? Where is the work located in relation to that higher voltage line? Can an outage be taken and grounds applied to the transmission line? Can I position my truck to stay out of a certain zone of that line and what is the proper zone?

In these cases, work with a supervisor and safety staff member to make sure that the proper clearances are maintained in order that the work be performed safely and in compliance with existing safe work practices.

Is equipment grounding above and beyond the OSHA standard?

No. There are some equipment grounding provisions within parts of the OSHA standard, but the main OSHA requirement for equipment grounding is found in OSHA's General Duty Clause which states:

5 (a) Each employer -- (1) shall furnish to each of his employees employment and a place of employment which are free from recognized hazards that are causing or are likely to cause death or serious physical harm to his employees;

Given our history noted above, there is a recognized hazard when working with un-insulated equipment near energized primary voltages and the employer is required to ensure a safe-guard against such 'known' hazards. To this end, insulation and isolation remain the number one precaution when working with energized equipment around primary sources. The equipment grounding policy has been implemented to eliminate further hazards.

Does this put Ameren at risk of greater liability if we set safety rules above and beyond the minimum requirements?

No. OSHA holds us accountable to only their standards, not company standards. For example, if OSHA requires 20 hours training and we as a company require 30, we will not be penalized if employees receive only 25 hours. Also, several of our work rules already exceed the OSHA standard -- most recently, the rubber glove policies established across Energy Delivery. OSHA establishes the minimum requirements for worker protection and going above OSHA's thresholds increases the level of safety on a given job.

Why set the rule for un-insulated booms at four feet?

The guiding principle on any job should be, "where are the energized exposures and where is the un-insulated boom portion?" If the two could come into contact due to the job at hand, position of materials, inattention, inadvertent movement, equipment failure, lack of focus, etc., the equipment must be grounded per the policy. These discussions need to take place after the equipment is positioned for work and before the work begins.

The footage measurement is inserted as a 'stop all' number to help guide the crew leader, operator and/or designated person observing operations.

Finally, OSHA obviously references the minimum approach distances for electric maintenance type work however in the construction standard OSHA simply uses the word 'near.' For added safety, consistency with current Missouri policies, and for better compliance with the OSHA standard, four feet has been established for distribution and subtransmission voltages. Note that this distance would be higher if working near transmission voltages.

What is the prime means of protection for Ameren's employees in regards to energized overhead parts and equipment exposed to overhead primary?

Ameren is protecting our workers from electrical exposure by exercising the insulating and isolating elements of OSHA 1910.269 (p) (4) (iii) A and B. In that if we have a primary exposure, we need to cover the exposure with the appropriately rated cover or relocate the equipment so that the un-insulated parts cannot come within four feet of the primary exposure. That being said, a grounding policy would put us in line with about 25%-35% of the public utilities in the United States that have an official grounding policy and is a secondary means of protection should equipment become energized.

Why don't we need supplemental grounds for equipment grounding but still require them for Personal Protective Grounding in some locations?

Ameren Standards was involved from the engineering side to assure that the means of equipment grounding as outlined in the policy is adequate protection. In addition to their in-house calculations, the Ameren Standards group referenced studies from IEEE to assure that the equipment grounding methods outlined will keep possible exposure below the voltage and current limit thresholds.

For personal protective grounding, some work rules require supplemental grounding based on certain factors such as primary neutral size. Those rules still apply and stem from an extensive personal protective grounding study by Jerry Bishop in 1990. Ameren Standards is reviewing those work rules and any changes will be communicated.

Why should we uncoil our ground cables?

Coiled conductors create greater magnetic fields for the same current magnitude compared to un-coiled conductor, and during fault conditions will generate much greater mechanical forces. If energized, those greater forces will create a much more violent reaction on the conductor resulting in greater potential for injury.

In addition, this electrical property of conductors also will add some impedance (resistance) to the grounding path and lower the amount of current flowing. We strongly desire that an intentional grounding path should provide the least impedance as practical and to achieve that objective, conductors shall be as straight as practical and certainly not coiled in any manner.

Why are driven grounds required in addition to barricading?

It is always best to set up a system that will relay a protective device in order to stop the current flow. On Delta Systems or other rare cases where the system neutral is not available, driven grounds are the best system available to achieve this end.

What is the responsibility of a designated person?

If the boom is expected to encroach the 10-foot zone for the work at hand but will remain outside of the 4-foot zone, the designated person option may be used. In that case, the designated person, one qualified or trained to understand the hazards and give timely warning, shall observe boom movement and activity and give timely warning if the un-insulated portions of the boom encroach the 4-foot zone. Upon timely warning, boom activity shall stop until the boom is clear of the 4-foot zone or primary cover and equipment grounds are applied.

The designated person must maintain focus on the boom activity and a clear line of communication with the operator.

A designated person may stop observing if the primary exposure is covered with insulating cover, boom movement is ceased, or when un-insulated parts are outside of the 10' zone.

I'm an SLD, how does this affect me?

This policy applies to un-insulated parts of equipment and not job titles, so it fully applies to SLDs if they are operating a boom within the 10-foot zone of distribution primary and subtransmission voltages.

In some cases, because of the location of primary overhead wires, an SLD may need to deliver poles to an alternative location and the crew will have to move the pole into final position.

In other cases, the SLD driver may chose to ground his truck to a pole ground and work within the 10-foot zone but remain outside of the 4-foot zone.

Finally, other times the SLD may need to call for a troubleman or other qualified employee to assist as a designated person. Keep in mind, in all cases, the un-insulated portions must remain outside of the 4-foot zone unless the primary is effectively covered and equipment grounds in place.

How do we treat Boom truck winch lines and Material Handler winch lines ?

If the boom truck winch line will breach the 10' zone, employees must follow the same rules as they apply to the un-insulated portion of the boom. In addition, if winch line is 4' or closer Gloving Policy rules must be followed.

If a Material Handler winch line breaches the 4' zone, employees must comply with the Gloving Policy rules.