



## County of Henrico Human Resources

| Verification | Originator      | Revised         | Issued          |
|--------------|-----------------|-----------------|-----------------|
| Initials     | Risk Management | Risk Management | Risk Management |
| Date         | 05/01/2015      | 04/19/2017      | 05/01/2018      |

### Safety/Loss Prevention Manual

## Chapter 11 Electrical Safety-Related Work Practices

|                             |   |
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| <b>Area of Application:</b> | County of Henrico General Government & Schools  |
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| <b>Revisions</b>            |   |
| <b>Rev. No.</b>             | <b>Date</b> <b>Description</b>  |
| 001                         | 04/20/2017      Procedural and terminology updates  |
| 002                         |   |

### Purpose:

This chapter establishes procedures that will comply with Virginia Occupational Safety & Health (VOSH) standards 29 CFR 1910.331 – 335: Electrical Safety-Related Work Practices.

### Scope:

This chapter applies to all electrical-related work performed by County of Henrico employees and contractors at all sites throughout the county not covered under other standards or regulations.

### Program Administration:

With guidance from Risk Management, each affected agency will establish written policies that address electrical hazards specific to its operation, as well as outlining how the requirements of this chapter will be met.

### Background:

- A. This chapter shall be followed unless the scope of the work is covered under the County of Henrico Lock Out Tag Out Program. (Refer to Chapter 10 of the County of Henrico Safety Manual).
- B. In addition, employees who work near, but not on, electrical installations must be trained to understand the inherent dangers of electricity.
- C. This chapter addresses electrical safety for persons qualified and unqualified to do the work.
  1. Only qualified/authorized persons who have been trained how to work on, or near, energized equipment or parts safely shall do so. Only authorized persons shall place or remove locks and/or tags.
  2. Unqualified persons are individuals who do not have the training or experience to work on electrical systems but may work near electrical hazards.
- D. Safe electrical work practices covered by this chapter include persons working on, near, or with:
  1. **Premises wiring** – electric equipment located inside or on buildings (or other structures) and outdoor areas such as yards, parking lots and fields,
  2. **Wiring for connection to supply** – installations of conductors that connect to the electrical supply;
  3. **Other wiring** – installation of outside conductors located on the premises;
  4. **Optical fiber cable** – optical fiber cable installation made with electric conductors.
- E. Practices covered by this chapter include work performed by unqualified persons near:
  1. Electric power generation, transmission, and distribution installations;
  2. Communications installations; installations in vehicles; and
  3. Railway installations.
- F. This chapter does not apply to work performed by qualified persons on or associated with:



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1. Generation, transmission, and distribution installations for the generation, control, transformation, transmission, and distribution of electric energy (including communication and metering) located in buildings used for such purposes, or located outdoors.
2. Electrical systems that are an integral part of an electrical generation installation, such as those owned or installed by Dominion Virginia Power.
3. Work on or directly with generation, transmission, or distribution installations including:
  - a. Repairing overhead or underground distribution lines or repairing a feed-water pump for a boiler;
  - b. Line clearance, tree trimming, and utility pole replacement; and,
  - c. Work on electrical utilization circuits in a generating plant provided that:
    - i. The circuits are commingled with power generation equipment or circuits, and
    - ii. The generation equipment or circuits present greater electrical hazards than those posed by the utilization equipment or circuits (exposure to higher voltage or lack of overcurrent protection).
- G. Installations in vehicles such as ships, watercraft, railway, rolling stock, aircraft or vehicles other than mobile homes and recreational vehicles.

### Training:

- A. Any employee at risk of electrical shock because the existing voltage has not been reduced to a safe level as per the National Electrical Code and VOSH standards shall be trained per the requirements of this chapter.
- B. All affected department/agency employees must be trained unless their work, or the work of persons they supervise, does not bring them near enough to exposed electrical circuits operating at 50 volts or more.

### Contents of Training:

- A. Employees shall be properly trained to work on electrical equipment, and shall understand the work practices necessary to perform their job assignments safely.
- B. Employees who may be at risk of electric shock shall be trained to be familiar with any electrically related safety practices not covered by this chapter or VOSH standards; but which are necessary for their safety.
  1. Training shall be completed and documented before an employee is assigned to work on or around energized electrical systems.
  2. Refresher training shall be performed annually and/or whenever an employee has been observed working in an unsafe manner.
- C. Qualified persons who work on energized equipment by direct contact, or indirect contact using tools or other materials, shall be trained to work on or around energized circuits. These employees shall know how to use safe work practices, wear appropriate personal protective equipment, use insulating or shielding materials, and work with insulated tools.
- D. All employee training will comprise both classroom and on-the-job training. The level of training provided will be determined by an employee's potential exposure and his/her working environment.
- E. Employees shall be trained as per written departmental/agency guidelines by a competent person. If requested, Risk Management will provide assistance.
  1. Training records will be maintained by each departmental/agency at a designated location.



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- Training records shall include the date(s) of the training, the instructor(s) name(s), the topic or type of training received, and the names of the employee(s) who attended the session(s).

#### Selection of Work Practices:

- Employee will use approved safe work practices to prevent electric shock or other injuries that could result from either direct or indirect contact with electrical systems.
- Appropriate work practices will be used when work is performed near or on equipment or circuits that may be energized.
- Work practices shall be consistent with the nature of the electrical hazard.
- De-energized Parts:

Live circuits or wiring will be de-energized before employee(s) work on or near the hazard unless:

- It is demonstrated that de-energizing introduces additional or higher hazards or is not possible due to equipment design or operational limitations; or
- Live parts operate at less than 50 volts to ground and there is no potential for exposure to electrical burns or to explosion due to electric arcs.
- Examples of continuous electrical hazards include critical life-support devices, emergency alarm systems, mechanical ventilation in high-hazard locations, or lighting that cannot be turned off for any reason.
- Work that may be performed on or near energized circuits (because de-energizing is not possible) include circuits that can only be tested with the circuit energized, and circuits that comprise an integral part of a continuous process that would otherwise would be shut down to permit work on one circuit or piece of equipment.

- Energized Parts:

- If de-energizing live circuits could increase the hazard, or de-energizing is not possible, then appropriate methods will be used to protect employees from all electrical hazards.
- Work practices must protect employees from direct contact with energized circuits or indirectly through an object capable of conducting current.
- Work practices must be appropriate for how the work is performed and for the voltage of exposed electric conductors or circuits.

#### Overhead Power Lines:

- When work is to be performed near overhead lines, lines shall be de-energized and grounded. If this is not possible, then other protective measures shall be taken before the work is started.
- Arrangements shall be made with the utility that operates or controls the power so that the lines can be de-energized and grounded whenever possible.
  - Precautions such as guarding, isolating, or insulating, shall put in place to prevent direct contact by employees, or indirect contact through conductive materials, tools, or equipment. Only workers from electric utilities or electrical co-operatives shall install insulating devices on overhead power transmission and distribution lines.
  - Employees working on the ground shall not bring any conductive object or insulated object to closer unguarded, energized overhead lines than the distance shown in Table S-1.

**TABLE S-1**

| Voltage to Ground | Minimum Approach Distance                        |
|-------------------|--|
| 50 kV or less     | 10 feet  |
| Over 50 kV        | 10 feet plus 4 inches for every 10 kV over 50 kV |



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C. Personnel working near overhead lines, whether elevated or from the ground, shall not approach energized lines with any conductive object without an approved insulation nearer than the distances allowed in Table S-2 unless:

1. The person is insulated from the energized parts by gloves, with sleeves if necessary, rated for the voltage; or
2. The energized part is insulated from all other conductive objects; or
3. The employee is insulated from all conductive objects at a potential different from the energized part.

**TABLE S-2**

| <b>APPROACH DISTANCES FOR QUALIFIED PERSONS EXPOSED TO ALTERNATING CURRENT</b> |                                  |
|--|----------------------------------|
| <b>Voltage Range (phase to phase)</b>  | <b>Minimum Approach Distance</b> |
| 300V and less  | Avoid contact                    |
| Over 300V, not over 750V   | 1 ft. 0 in.                      |
| Over 750V, not over 2kV  | 1 ft. 6 in.                      |
| Over 2kV, not over 15kV  | 2 ft. 0 in.                      |
| Over 15kV, not over 37kV   | 3 ft. 0 in.                      |
| Over 37kV, not over 87.5kV   | 3 ft. 6 in.                      |
| Over 87.5kV, not over 121kV  | 4 ft. 0 in.                      |
| Over 121kV, not over 140kV   | 4 ft. 6 in.                      |

### D. Vehicular and Mechanical Equipment

1. A minimum clearance of 10 feet shall be maintained between energized overhead lines and vehicles or mechanical equipment capable of reaching the lines (e.g., cranes, mobile scaffolds, elevating platforms, dump trucks, lift trucks, and flatbed trailer cranes).
2. If the voltage of the overhead line is greater than 50 kV, the clearance shall be increased by 4 inches for every 10 kV over 50 kV.
3. The above clearances may be reduced if:
  - a. The movable sections of utility vehicles in transit are lowered and secured. Moveable section clearance may be reduced to 4 feet when in proximity to energized lines powered at less than 50 kV, or 4 ft. plus 4 inches for every 10 kV over 50 kV.
  - b. Insulating barriers have been installed to prevent contact with power lines. Barriers shall be rated for the voltage.
  - c. The barrier is not attached to the vehicle or any raised structure.
  - d. Clearance has been reduced when the insulating barrier's design allows it.
  - e. An aerial lift is insulated for the voltage, and a qualified person performs the work.
  - f. The clearance between the uninsulated section of a lift and power line can be reduced to distances given in Table S-2.
4. Employees working at ground level shall not contact any vehicle or mechanical equipment, or any attachments, unless:
  - a. The employee uses personal protective equipment rated for the voltage; or
  - b. The equipment is set up so no uninsulated part of its structure can form or complete a conductive path to persons on the ground.



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- c. Equipment is not located more than 10 feet from a power line for voltages less than 50 kV, or 10 feet plus 4 inches for every 10 kV over 50 kV.
  5. When any vehicle or equipment is intentionally grounded, persons may not stand near the point of grounding when there is any possibility of contact with overhead energized lines.
  6. Additional precautions (e.g., such as the use of barricades or insulation) shall be taken as to protect persons from hazards that may develop within a few feet or more outward from the grounding point.
- E. Lighting
1. Personnel may not enter work areas or spaces with exposed energized parts unless adequate illumination enables them to work safely.
  2. Personnel may not perform tasks where any obstruction blocks lighting or prevents employees from seeing the work area. Employees shall not reach into areas that may contain energized parts when darkness prevents employees to work safely or see potential hazards.
- F. Confined or Enclosed Work Spaces
1. Personnel working in confined or enclosed spaces (manholes or vaults with exposed energized parts) shall use protective shields or barriers, or other insulating materials to prevent accidental contact with these energized equipment.
  2. Doors, hinged panels, and the like, shall be secured by an employee or competent person to prevent a door or panel from bumping a worker into exposed energized parts.
  3. Before working within a confined space that may generate airborne hazards (e.g., use of solvents, paints, welding, and so forth) or other hazard(s) defined by the VOSH Confined Space Standard, 29 CFR 1910.146, a competent person or the supervisor must determine whether the County of Henrico Confined Space Entry Program applies to the work being performed. (Chapter 13 of this Safety Manual).
- G. Conductive Materials and Equipment
1. Take precautions to ensure that materials and equipment that conduct electricity never contact any unprotected part of a person's body.
  2. Whenever an employee must carry or handle metal ducts, pipes, rods, etc., in areas with energized parts, insulation, guarding and/or two-person handling techniques will be used.
- H. Portable Ladders
- All portable ladders used where the potential for contact with energized equipment exists, shall have nonconductive side rails.
- I. Conductive Apparel
- Employees shall not wear jewelry or clothing such as watchbands, bracelets, rings, key chains, necklaces, metalized aprons, cloth with conductive thread, or metal headgear near energized equipment. However, such articles may be worn if they become nonconductive by covering, wrapping, or other insulating methods.
- J. Housekeeping
1. Housekeeping shall be performed once safeguards, such as insulating equipment or barriers, are in place.
  2. Conductive cleaning materials, such as steel wool, metalized cloth, and silicon carbide, as well as conductive liquids, shall not be used near energized equipment unless protections are in place to prevent contact.
- K. Interlocks
- Only qualified persons can bypass an electrical safety interlock, and only temporarily while he /she is working on the equipment. Work shall comply with procedures for working on or near exposed energized parts. The interlock system shall be returned to its operable condition when the work is completed.



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### Use of Equipment

This section applies to the use of cord-and-plug-connected equipment, including flexible cord sets such as extension cords.

#### A. Handling

1. Handle all portable equipment so that the unit(s) is not damaged.
2. Never use the flexible power cord to raise or lower equipment.

#### B. Visual Inspection

1. Inspect power cords for defects at the beginning of the work day or shift. Defects include loose parts, deformed and missing plug pins, damage to the outer covering or insulation, and/or possible internal damage, such as a pinched or crushed outer jacket.
2. Cord and plug connected equipment and flexible cords that remain connected once they are put in place and are not exposed to damage need not be visually re-inspected until they are relocated.
3. Prior to connecting the plug to a receptacle, ensure the plug and receptacle contacts mate properly.
4. If a power cord becomes worn, or damaged in any way, the unit shall be taken out of service until the cord is replaced. If the damage is beyond reasonable repair, discard the unit and purchase a new one.
5. Linking together power strips ("daisy chain") is prohibited.
6. Extension cords shall not be used as permanent wiring.

#### C. Grounding Equipment

1. Flexible cords used with grounding-type equipment must contain an equipment-grounding conductor.
2. Plugs and receptacles may not be connected or altered so that proper continuity of the ground at the point where plugs are attached to receptacles is disrupted.
3. Plugs and receptacles may not be altered to allow the grounding pin to be inserted into current connector slots.
4. Adapters that interrupt the equipment grounding connection shall not be used.

#### D. Conductive Work Locations.

All portable electric equipment and flexible power cords that are used in locations that are, or may be damp or wet, or where other conductive liquids may be present, shall be approved for use in those locations.

#### E. Plugs, Cords, and Wet Environments

1. If equipment is energized, employees' hands must be dry when plugging and unplugging flexible cords and/or while touching the cord-and-plug-connection.
2. If cord connectors become damp or wet, or the connection may provide an energized path to employees' hands, the plug and receptacle shall be handled only with insulated protective equipment.
3. Locking-type connectors shall be properly secured after connection.

### Electrical Power and Lighting Circuits

#### A. Routine Opening and Closing of Circuits.

Only load rated switches, circuit breakers, or other devices specifically designed to disconnect a circuit may be used. Fuses, terminal lugs, and cable splice connections may not be used for opening, reversing, or closing circuits under load conditions except in an emergency.

#### B. Re-closing Circuits after Protective Device Operation.



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After a circuit is de-energized by any protective device, the circuit shall not be reenergized until the equipment and circuit can be safely energized. Repetitive manual closing of circuit breakers or reenergizing circuits with new fuses is prohibited. If the design of the circuit and the overcurrent device indicates the automatic operation of a device was caused by an overload rather than a fault condition, no examination of the circuit or connected equipment is needed before reenergizing the circuit.

#### C. Overcurrent Protective Modification.

Overcurrent protection of circuits and conductors may not be modified, even on a temporary basis, except what is specified in VOSH 29 CFR 1910.304(e), which are the installation requirements for overcurrent protection.

### Testing Instruments and Equipment

- Only qualified persons will test electrical circuits or equipment.
- All testing instruments, as well as test leads, cables, power cords, and probes shall be visually inspected by a competent employee for external defects and damage before use.
- If defects or damage might expose an employee to injury, the device shall be removed from service. It shall not be used until it is repaired to work properly, and retested prior to use.
- Testing instruments (and accessories) shall be used only on circuits and equipment as rated, and shall be appropriate for the environment.

### Occasional Use of Flammable or Ignitable Materials

- Where flammable materials are present, equipment capable of igniting any flammable or combustible material may not be used unless precautions are taken to prevent fire (e.g., by complying with the County of Henrico Hot Work Permit Program).
- Flammable materials include, but are not limited to: gases, vapors, liquids, combustible dusts, ignitable fibers and/or air-borne debris.

### Safeguards for Personal Protection

- Use of Personal Protective Equipment
  - Employees working where electrical hazards exist shall use the personal protective equipment (PPE) appropriate to protect them from anticipated hazards. The county will provide employees with all personal protective equipment required by this section.
  - PPE shall be maintained in a usable and sanitary condition. Employees will be trained to inspect their PPE and to notify supervisors when PPE is damaged, or needs replacement.
  - When the insulating capability of PPE is damaged during use, the PPE shall be protected by an outer covering of leather or other appropriate material ONLY when no other alternative exists (i.e., changing the PPE at the work site).
  - Nonconductive head protection, such as a hard hat, shall be worn wherever there is danger of head injury from electrical shock or burns due to overhead contact with energized parts.
  - Facial PPE is mandatory whenever eyes and/or face could be injured from arcs, flashes, or from debris resulting from an explosion.
- General Protective Equipment and Tools
  - Employees working near exposed energized conductors or circuit parts must use insulated tools if the tools may contact conductors or energized parts. The insulating material of tools and equipment shall be replaced or protected if damage occurs.
  - Fuse handling equipment that has been insulated for the voltage, shall be used to remove or install fuses whenever fuse terminals are energized.
  - All ropes and handlines used near exposed energized parts shall be nonconductive.
  - Protective shields or barriers, gloves, or insulated materials shall be used to protect employees from shock, burns, or other related injuries while employees work near exposed energized parts that might be hot, or where arcing might occur.



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5. When energized parts (normally covered) must be exposed for maintenance or repair, those parts shall be guarded to protect workers and other persons from contact until coverings are replaced.
- C. Alerts and Warnings  
The following alert and warning methods shall be used to protect employees and other persons from electrical shock hazards, burns, or failure of electronic equipment.
  1. Signs and Tags:
    - a. Where necessary, employees shall warn other employees, visitors, and contractors of electrical hazards with appropriate signs, symbols, or warning tags.
    - b. Signs, symbols or accident prevention tags shall meet the requirements of VOSH standard 29 CFR 1910.145, Specifications for Accident Prevention Signs and Tags. Information regarding proper signage may be obtained by contacting Risk Management.
  2. Barricades:  
If needed, barricades shall be used in conjunction with safety signs to prevent or limit access to work areas that would expose employees and other people to uninsulated energized conductors or circuits. Barricades that might conduct electricity shall not be used.
  3. Attendants  
If necessary, station a qualified attendant to warn and protect employees, visitors and contractors where signs and barricades will not provide sufficient warning and protection.

### **Disciplinary Procedures:**

Non-compliance with any part of this procedure may be subject to disciplinary action as outlined in Henrico County Personnel Rules and Regulations, Section 14 (Employee Relations), Part 14.1, Discipline.

### **Disclaimer:**

Although every effort has been made to ensure this Policy addresses all applicable regulations, it is the operational manager's responsibility to ensure all rules and regulations are identified and followed.