ELECTRICAL SAFETY POLICY

1. Purpose

Safety-related work practices shall be employed at the University of Denver (DU) to prevent electric shock or other injuries resulting from either direct or indirect electrical contacts, when work is performed near or on equipment or circuits which are or may become energized. The specific safety-related work practices shall be consistent with the nature and extent of the associated electrical hazards.

2. Scope

The University of Denver Electrical Safety Policy covers electrical safety work practices for persons working on, near, or with equipment that expose them to a risk of electrical shock. This policy is in accordance with the Occupational Safety and Health Administration (OSHA) standard 29 CFR 1910.331 through 1910.335.

3. Definitions

Deenergized: Free from any electrical connection to a source of potential difference and from electrical charge; not having a potential different from that of the earth

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

Energized: Electrically connected to a source of potential difference.

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

Exposed: Capable of being inadvertently touched or approached nearer than a safe distance by a person. It is applied to parts not suitably guarded, isolated, or insulated.

Ground-fault circuit-interrupter (GFCI): A device intended for the protection of personnel that functions to deenergize a circuit or a portion of a circuit within an established period of time when a current to ground exceeds some predetermined value that is less than that required to operate the overcurrent protective device of the supply circuit.

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 to a point of danger or contact by persons or objects.

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

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

Qualified person: One who has received training in and has demonstrated skills and knowledge in the construction and operation of electric equipment and installations and the hazards involved.

Note 1 to the definition of "qualified person": Whether an employee is considered to be a "qualified person" will depend upon various circumstances in the workplace. For example, it is possible and, in fact, likely for an individual to be considered "qualified" with regard to certain equipment in the workplace, but "unqualified" as to other equipment.

Note 2 to the definition of "qualified person": An employee who is undergoing on-the-job training and who, in the course of such training, has demonstrated an ability to perform duties safely at his or her level of training and who is under the direct supervision of a qualified person is considered to be a qualified person for the performance of those duties.

4. Responsibilities

Supervisors

- Anticipate all work hazards and utilize all safeguards as necessary.
- Ensure that all employees are properly trained, instructed in the safe operation of electrical equipment and are aware of all hazards associated with the use of these electrical devices.
- Initiate any necessary administrative action required to enforce safety practices.
- Request assistance from Facilities Management on equipment and devices, which require unique safety practice instruction.

Employees

- Follow DU’s electrical safety policies/procedures and instructions of the responsible supervisor.
- Bring to the attention of the supervisor and/or the Environmental Health and Safety Department (EHS) potentially hazardous situations such as discrepancies between instruction, procedures, and policies, faulty equipment, misapplication of device, etc.
- Recognize that malfunctioning electrical equipment must be repaired or replaced before use. The repair must be initiated as soon as possible after the malfunction is noted.

Environmental Health and Safety

- Provide technical assistance in defining hazardous operations, designating safe practices and selecting proper devices.
- When necessary, recommend the development of standard operating procedure for electrical equipment and devices in use from the principal supervisor.
- In coordination with Facilities Management and other supervisors, review and approve standard operating procedures upon request.
- Evaluate potential electrical hazards during facility inspections to insure compliance with existing policy and other safety guidelines.
- Support employees training relative to electrical safety.
- Develop and revise DU's electrical safety policy periodically, or when regulatory changes occur.

Qualified Persons

- Comply with DU's electrical safety program and take all required training.
- Be designated as the only people allowed to work on or near exposed electrical parts greater than 50 volts.
- Be designated as the only people who can test exposed electrical currents and equipment.
- Test equipment for damages and defects before use.
- Must be trained on how to work on energized currents, be familiar with proper precautionary work practices, personal protective equipment, insulating and shielding materials, and the use of insulated tools.

5. Procedures

Electrical Installation Requirements

- Electrical equipment must be free from recognized hazards that are likely to cause death or serious physical harm. Equipment must be suitable for the installation and use, and must be installed and used in accordance with the National Electrical Code (NEC) and/or Occupational Safety and Health Administration (OSHA).
- Labeling of Disconnects -Each disconnecting means, must be clearly labeled to indicate the circuit's function unless it is located and arranged so the purpose is evident. Identification should be specific rather than general and all labels and marking must be durable enough to withstand the environment to which they may be exposed and must include nominal voltage being utilized by the device.
- Guarding of Live Parts - Live parts of electric equipment operating at 50 volts or more must be guarded by use of an approved cabinet or in a room or vault that is accessible to qualified persons only.
- Entrances to rooms and other guarded locations that contain exposed live parts operating at 50 volts or more shall be marked with conspicuous warning signs forbidding unqualified persons to enter.
- New electrical wiring, and the modification, extension or replacement of existing wiring must conform to the requirements of NEC, the National Fire Protection Association (NFPA), OSHA and any other applicable codes or regulations.

Working on Electrical Systems

Live parts to which an employee may be exposed will be de-energized, using approved lockout/tagout (LOTO) procedures, before the employee works on or near them!

Unless it can be demonstrated that:

- De-energizing is not possible due to equipment design or operational limitations
- De-energizing creates a greater hazard (e.g. deactivation of emergency alarm)
- Parts operate at less than 50 volts
- Equipment can be unplugged and the plug is continuously under the exclusive control of the employee performing the work

Lockout/Tagout

Specific energy control procedures shall be written for each hazardous energy source. Below are the general requirements of LOTO. Please review the DU lockout/tagout detailed policy and procedures before locking out any energy source.

- **Preparation –** Notify all affected employees that servicing or maintenance is required on a machine or equipment and that the machine or equipment must be shut down and locked out to perform the servicing or maintenance.
- **Machine or Equipment Shutdown** If the machine or equipment is operating, shut it down by the normal stopping procedure.
- **Machine or Equipment Isolation -** Operate the switch, valve, or other energy isolating device(s) so that the equipment is disconnected or isolated from it energy source(s).
- **Release of Energy -** Ensure that all energy is dissipated or restrained (such as that in capacitors, springs, elevated machine members, rotating flywheels, hydraulic systems, air, gas, steam, water pressure, etc.) by methods such as grounding, repositioning, blocking, bleeding down, etc.
- **Application of Lockout/Tagout -** Lockout the energy isolating device(s) with the assigned individual lock.
- **Verification of Isolation –** After ensuring that no personnel can be exposed, operate the push button or other normal operating control(s) or by testing to make certain the equipment will not operate.
- **Removal of Lockout Devices –** Before lockout or tagout devices are removed and energy is restored to the machine or equipment, the authorized person must take the following actions:
    - **Inspect** the work area to ensure that nonessential items have been removed and that machine or equipment components are intact and capable of operating properly.
    - **Check** the area around the machine or equipment to ensure that all employees have been safely positioned or removed.
    - **Notify** affected employees immediately after removing locks or tags and before starting equipment or machines.
    - **Ensure** that locks or tags are removed ONLY by those employees who attached them. (In the very few instances when this is not possible, the device may be removed under the direction of the employer, provided that he or she strictly adheres to the specific procedures outlined in the standard).

Jobs involving more than one employee - If more than one individual is needed for a job that requires lockout/tagout, each shall place his/her own personal lockout/tagout device on the energy isolating device(s). When an energy isolating device cannot accept multiple locks or tags; a multiple lockout or tagout device (hasp) should be used.

Working with Energized Parts

- If the exposed live parts are not de-energized (i.e., for reasons of increased or additional hazards or infeasibility), other safety-related work practices shall be used to protect employees who may be exposed to the electrical hazards involved.
- Such work practices shall protect employees against contact with energized circuit parts directly with any part of their body or indirectly through some other conductive object. The work practices that are used shall be suitable for the conditions under which the work is to be performed and for the voltage level of the exposed electric conductors or circuit parts.
- This section applies to work performed on exposed live parts (involving either direct contact or by means of tools or materials) or near enough to them for employees to be exposed to any hazard they present.
- Only qualified persons may work on electric circuit parts or equipment that has not been de-energized under the procedures of this section. Such persons shall be capable of working safely on energized circuits and shall be familiar with the proper use of special precautionary techniques, personal protective equipment, insulating and shielding materials, and insulated tools.

Overhead Power Lines

- When work is to be performed near overhead lines, the lines must be de- energized and grounded whenever possible.
- If it is not possible to de-energize and ground overhead lines, then other protective measures, such as guarding, isolating or insulating, must be taken before the work is started. These protective measures must prevent direct contact by the qualified person or indirect contact through conductive materials, tools, or equipment.
- Only qualified persons are allowed to install insulating devices on overhead power transmission and distribution lines.
- All other persons, and any conductive object used by these employees, may not approach closer than the minimum approach distance of 10 feet when the voltage to ground is 50 kV or less, and 10 ft. + 4 inches for every 10 kV over 50 kV when the voltage to ground is >50 kV.
- Qualified persons working in the vicinity of energized overhead lines, whether in an elevated position or on the ground, are not allowed to approach any exposed energized parts closer than allowed in the table below unless:
    - The person is insulated from the energized part by using voltage rated gloves, (with sleeves and or hot stick if necessary); or
    - The energized part is insulated from all other conductive objects at a different potential and from the person; or
    - The person is insulated from all conductive objects that are at a potential different from the energized part.

APPROACH DISTANCES FOR QUALIFIED PERSONS EXPOSED TO ALTERNATING CURRENT	
Voltage Range (phase-to-phase)	**Minimum Approach Distance**
300 V and less	Avoid contact
Over 300 V, not over 750 V	1 ft. 0 in.
Over 750 V, not over 2 kV	1 ft. 6 in.

Over 2 kV, not over 15 kV	2 ft. 0 in.
Over 15 kV, not over 37 kV	3 ft. 0 in.
Over 37 kV, no over 87.5 kV	3 ft. 6 in.
Over 87.5 kV, not over 121 kV	4 ft. 0 in.
Over 121 kV, not over 140 kV	4 ft. 6 in.

Vehicles and Mechanical Equipment

- A minimum clearance of 10 feet must be maintained between energized overhead lines and all vehicles or mechanical equipment capable of having parts or its structure elevated (e.g., cranes, mobile scaffolds, elevating platforms, dump trucks, lift trucks, and flatbed trailer cranes). If the voltage of the overhead line is greater than 50 kV, the clearance must be increased by 4 inches for every 10 kV over 50 kV. 7.6.1 The clearance requirement may be reduced if the vehicle is in transit with its structure lowered. The clearance may be reduced to 4 feet when near energized lines operating at less than 50 kV, or 4 ft. plus 4 inches for every 10 kV over 50 kV.
- The clearance requirement may be reduced if insulating barriers, rated for the voltage of the line being guarded, are installed to prevent contact with the lines. The barrier may not be attached to the vehicle or its raised structure. The clearance may be reduced to the distance allowed by the design of the insulating barrier.
- The clearance requirement may be reduced if the equipment is an aerial lift insulated for the voltage involved and the work is performed by a qualified person. The clearance between the uninsulated portion of the lift and the power line may be reduced to the distance given in Table 2 above.
- Persons working on the ground are not allowed to contact the vehicle or mechanical equipment or any of its attachments, unless:
- The person uses protective equipment rated for the voltage; or
- The equipment is located so that no uninsulated part of its structure can provide a conductive path to persons on the ground. Equipment shall not approach closer to the line than 10 feet for voltages less than 50 kV, or 10 feet plus 4 inches for every 10 kV over 50 kV.
- When any vehicle or mechanical equipment is intentionally grounded, persons may not stand near the point of grounding when there is any possibility of contact with overhead energized lines. Additional precautions (e.g., such as the use of barricades or insulation) must be taken as necessary to protect persons from hazardous ground potentials that can develop within a few feet or more outward from the grounding point.
- Unqualified persons shall stay beyond the next utility pole in either direction as a minimum.
- Qualified persons on the ground shall establish boundaries (i.e., plastic red barrier tape stating “DANGER – Do Not Enter”).

Personal Protective Equipment

Normally DU employees do not work with equipment operating at greater than 600 volts. Thusly, PPE requirements in this section are for those activities with exposures less than 600 volts. If exposure to 600 volts or more is anticipated contact EHS.

- Equipment should be inspected before each use. An air test should be performed on lineman’s gloves, along with the inspection.

- Gloves should conform to ASTM standards based upon the voltage protection required. Protector gloves can be worn over the lineman's gloves when needed for flash protection.
- Protective equipment for the eyes must be worn where there is danger of eye and/or face injury from electric arcs and flashes or flying objects resulting from electrical explosions.
- Wear well insulated shoes.
- Nonconductive ANSI 289.1, approved head protection must be worn wherever there is danger of head injury from electrical shock or burns due to contact with exposed energized parts.
- If you have long hair, restrain it.
- Treat all exposed wiring and electrical parts as potentially live until it has been checked with a meter.
- Make sure area you are working is properly illuminated before working on exposed wires. Do not reach into blind areas.
- All ladders used near exposed energized sources must have non-conductive side rails and must be clean (free of oil, grease or contamination that would cause it to be conductive).
- Never work around a source of electricity when you are wet, it is raining, or your surroundings, tools or clothes are wet.
- Where flammable or ignitable materials are present, do not use electric equipment capable of igniting them unless measures are taken to prevent hazardous conditions from developing.

<u>Hand tools and Plug in Equipment</u>

- Never yank cords from their receptacles
- Never carry tools by the cord or hose
- Inspect cords before each shift
- Non-cord carrying metal parts of cord and plug connected equipment must be grounded unless the equipment is double insulated
- The 3rd wire serves as a conductor that is connected in conjunction with the system ground.
- Keep cords away from heat, oil and sharp edges
- Disconnect tool when changing bits, blades and accessories
- Make sure tools are UL listed and must meet NEC Standards for double insulation or 3rd wire power cord grounding.
- Use grounded electrical outlets and don't overload them.
- Never remove the grounding prong to make the plug fit into a two-prong socket.
- Always choose the right tool for the job and never modify tools.
- Don't use tools with gaps, cracks or tears in the insulation

6. Training

- Any employees whose job duties do not bring them close enough to exposed parts of electrical circuits (50 volts or more to the ground) do not need electrical safety training.
- Unqualified persons, including those employees who use power tools, perform services of equipment and machines and/or perform maintenance or repair functions on electrical equipment, and who are close enough to exposed parts of electrical circuits (50 volts or more to the ground), require electrical safety training.
- Training must be performed before the employee is assigned duties involving work around or on electrical systems.

- Retraining will be performed whenever inspections performed by the employee's supervisor or EHS indicate that an employee does not have the necessary knowledge or skills to safely work on or around electrical systems. Retraining will also be performed when policies or procedures change and/or new equipment or systems are introduced into the work area.
- Qualified Persons must be trained in the following
    - Can distinguish exposed energized parts from other parts of electrical equipment
    - Determine the nominal voltage of exposed energized parts
    - Approach distances (see table below)
    - Lockout/Tagout
    - Understand the specific hazards associated with electrical energy
    - Be familiar with DU's electrical safety policy.