

CITY AND COUNTY OF DENVER

Electrical Safety Policy		
Occupational Safety and Health Management System No. 65.5.3 This policy was developed and shall be implemented under the authority of Executive Order No. 65 and the Risk Management Office.	September 1995 January 1, 2008	Prepared / Revised By: Risk Management – Safety Unit

1.0 Introduction

The purpose of this policy is to establish safe work practices that are intended 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 be energized. Because of the diversity in job assignments throughout the City, employees are at varying levels of potential exposure to energized components of electrical systems.

This Policy addresses a variety of potential exposure levels and describes precautionary measures that are to be implemented to minimize risks.

2.0 Scope

This policy applies to all electrical installations, as well as to work performed on or near electrical equipment and/or distribution systems. Since electrical equipment is present within most city work areas, this policy encompasses a large number of work locations. This policy applies to everyone performing work for the City including, but not limited to; permanent and temporary City and County employees, summer students, subcontractors, vendors, etc.

3.0 Definitions

3.1. **Qualified Person:** A person permitted to work on or near exposed energized parts who has been trained in and familiar with:

- The skills and techniques necessary to distinguish exposed live parts from other parts of electric equipment;
- The skills and techniques necessary to determine the nominal voltage of exposed live parts;
- The knowledge, skills and techniques to work safely on energized circuits;
- The proper use of special precautionary techniques, personal protective equipment, Insulating and shielding materials, and insulated tools; and
- The clearance distances for work performed near overhead lines that are specified in the OSHA standard that appears in 29 CFR 1910.333(c) and the corresponding voltages to which the person will be exposed.

- 3.2. **Unqualified Person:** A person with little or no training in avoiding the electrical hazards of working on or near exposed energized parts.
- 3.3. **On or Near:** Close enough to exposed line parts (by either personal contact or contact by tools or materials) for an employee to be exposed to any hazard they present.
- 3.4. **Electrical Distribution System:** Electrical components and associated hardware, such as wall mounted switches, receptacles, conduit, circuit breaker panels, etc. that are permanently attached to buildings for the purpose of delivering electrical power.
- 3.5. **Electrical Exposure Levels:** Risk levels of exposure to energized electrical systems and components that employees face while performing their daily job assignments. Three levels have been identified as follows:
- *Low:* Employees with a low risk of potential exposure to energized electrical components are managers, financial and administrative support personnel and other staff members who primarily work in an office environment. Electrical equipment in these areas is generally limited to 120 volt devices such as; computers, printers, typewriters, space heaters, coffee pots, extension cords and other consumer electronics devices.
 - *Moderate:* Employees with moderate risk of potential exposure to energized electrical systems are general maintenance workers, technicians, street maintenance workers machinists, copy center employees and other employees who routinely work with or around electrical or electromechanical equipment. Equipment used by these employees may operate with voltages up to 480 volts. These employees must be trained to recognize electrical hazards and must be able to safely shut off power to the equipment in the event of an emergency. Electrical equipment used by these employees may include; power supplies, machining equipment, electric hand tools, test equipment, etc. Police officers, firefighters and paramedics may also be exposed to downed power lines or other energized electrical equipment when responding to emergencies.
 - *High:* Employees with the highest risk of potential exposure to energized electrical components are electricians, traffic engineering technicians and maintenance technicians who are responsible for maintenance, calibration, installation, modifications and set up of traffic signal equipment and electrical distribution systems. Parks and Recreation Forestry Division tree trimmers also have a high exposure potential to energized high voltage lines. These employees may periodically work on or near systems that require 480 volts or higher, and shall be thoroughly trained in hazard recognition, precautionary measures (including Lockout/Tagout/Verify and the use of personal protective equipment (PPE)) and emergency response procedures prior to beginning work on electrical systems and equipment. Equipment may include; electrical distribution systems, large electric motors, heating-ventilation-and-air conditioning (HVAC) equipment, uninterruptible power supplies (UPS), etc.
- 3.6. **Energized Work:** Any work performed close enough to exposed parts of electrical circuits and equipment operating at 50 V or more to ground for a hazard to exist.

- 3.7. **Journeyman Level Electrician:** An individual who has achieved a level of expertise in the electrical field and has completed at least 4-years of apprentice level training and hands-on experience. This level of expertise is generally accompanied by formal trade school training and/or licensing by the state.
- 3.8. **Lockout/Tagout/Verify:** A procedure which ensures that all hazardous energy sources are secured in a safe manner prior to any servicing or maintenances activities. The City and County of Denver 5.3 Lockout/Tagout/Verify Program provides the details of this procedure.
- 3.9. **Two Man Rule:** A City and County of Denver rule which requires that a second worker be present whenever work is performed on or near energized electrical systems. The second worker shall be trained in emergency response procedures and shall be present only as an observer and must not participate in the actual work that is being performed.

4.0 General Requirement

Appropriate safe work practices shall be employed 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 that are or may be energized. Those specific work practices shall be consistent with the nature and extent of the associated electrical hazards.

5.0 Work on or Near Exposed De-energized Parts

1. Live parts to which an employee may be exposed must be de-energized before any employee works on or near them, unless de-energizing will introduce additional or increased hazards or is not feasible due to equipment design or operational limitations (See below for examples).

Note: Live parts that operate at less than 50 volts to ground need not be de-energized if there will be no increased exposure to electrical burns or to explosion due to electric arcs.

- a. Examples of increased or additional hazards include interruption of life support equipment, deactivation of emergency alarm systems, shutdown of hazardous location ventilation equipment, or removal of illumination for an area.
 - b. Examples of work that may be performed on or near energized circuit parts because of infeasibility due to equipment design or operational limitations include testing of electric circuits that can only be performed with the circuit energized and work on circuits that form an integral part of a continuous process that would otherwise need to be completely shut down in order to permit work on one circuit or piece of equipment.
2. Whenever any employee is exposed to contact with parts of fixed electric equipment or circuits that have been de-energized, the circuits energizing the parts will be properly locked out.
 3. Safe procedures for de-energizing circuits and equipment will be determined before circuits or equipment is de-energized.
 4. The circuits and equipment to be worked on must be disconnected from all electric energy sources. Control circuit devices, such as push buttons, selector switches, and interlocks, may

not be used as the sole means for de-energizing circuits or equipment. Interlocks for electric equipment may not be used as a substitute for lockout procedures.

5. Stored electric energy that might endanger personnel will be released before starting work. Capacitors shall be discharged and high capacitance elements shall be short-circuited and grounded, if the stored electric energy might endanger personnel.
6. Stored non-electrical energy in devices that could reenergize electric circuit parts will be blocked or relieved to the extent that the circuit parts could not be accidentally energized by the device.
7. No work shall be performed on or near de-energized live parts, circuits or equipment until their de-energized condition has been verified. Verification of the de-energized condition shall be made as follows:
 - a) A qualified person will operate the equipment operating controls or otherwise verify that the equipment cannot be restarted.
 - b) A qualified person will use test equipment to test the circuit elements and electrical parts of equipment to which employees will be exposed and will verify that the circuit elements and equipment parts are de-energized.
 - c) The test shall also determine if any energized condition exists as a result of inadvertently induced voltage or unrelated voltage back feed even though specific parts of the circuit have been de-energized and presumed to be safe.
8. Before any circuit or equipment is reenergized (even temporarily) the following requirements will be met in the order listed:
 - a) A qualified person shall conduct tests and visual inspections, as necessary, to verify that all tools, electrical jumpers, shorts, grounds, and other such devices have been removed, so that the circuits and equipment can be safely energized.
 - b) Employees exposed to the hazards associated with reenergizing the circuit or equipment shall be warned to stay clear of circuits and equipment.
 - c) Each lock will be removed by the employee who applied it or under his or her direct supervision.
 - d) If that employee is absent from the workplace, then the lock may be removed provided that it is certain that the employee who applied the lock is not available at the workplace, and that employee is made aware that the lock has been removed before he or she resumes work.
 - e) There will be a visual determination that all employees are clear of the circuits and equipment.

6.0 Work on or Near Exposed Energized Parts

1. In those cases where the exposed live parts are not de-energized, either because of increased or additional hazards or because of infeasibility due to equipment design or operational limitations, other safety-related work practices must be used to protect employees who may be exposed to the electrical hazards involved.

The work practices used must protect employees against contact with energized circuit parts directly with any part of their body or indirectly through some other conductive object or where employees are near enough to be exposed to any hazard they present.

2. Only qualified persons may work on electric circuit parts or equipment that has not been de-energized. These employees must be familiar with the proper use of special precautionary techniques, personal protective equipment, insulating and shielding materials, and insulated tools.
3. Whenever work is to be performed near overhead lines, the lines will be de-energized and grounded, or other protective measures will be provided before work is started.
4. When overhead lines are to be de-energized, arrangements to de-energize and ground them will be made with the organization that operates or controls the electrical circuits involved.
5. When protective measures are provided such as guarding, isolating, or insulating, those precautions shall prevent employees from contacting such lines directly with any part of their body or indirectly through conductive materials, tools, or equipment.
6. Only qualified employees will be permitted to install insulating devices on overhead power transmission or distribution lines.
7. Whenever an unqualified employee is working in an elevated positions near overhead lines, the location will be such that the person and the longest conductive object he or she may contact cannot come closer to any unguarded, energized overhead line than the following distances:
 - a) For voltages to ground 50kV or below - 10ft.(305cm);
 - b) For voltages to ground over 50kV - 10 ft. (305cm) plus 4 inches (10 cm) for every 10kV over 50kV
8. Whenever an unqualified employee is working on the ground in the vicinity of overhead lines, the person may not bring any conductive object closer to unguarded, energized overhead lines than the distances given above.
9. For voltages normally encountered with overhead power lines, objects which do not have an insulating rating for the voltage involved are considered to be conductive.
10. Whenever a qualified person is working in the vicinity of overhead lines, whether in an elevated position or on the ground, the person may not approach or take any conductive object without an approved insulating handle closer to exposed energized parts than that shown in **Table S-5** of 29 CFR 1910.333(c)(3) (see #11 below), unless:
 - a) The person is insulated from the energized part. Gloves, with sleeves if necessary, rated for the voltage involved, are considered to be insulation of the person from the energized part on which work is performed, or
 - b) The energized part is insulated both from all other conductive objects at a different potential and from the person, or

- c) The person is insulated from all conductive objects at a potential different from that of the energized part.

11. The minimum safe approach distances are as follows:

Voltage Range (Phase to Phase)	Minimum Approach Distance
300V and less	Avoid Contact
Over 300V, not over 750 V	1 ft. 0 in. (30.5 cm)
Over 750V, not over 2kV	1 ft. 6 in. (46 cm)
Over 2kV, not over 15kV	2 ft. 0 in. (61 cm)
Over 15kV, not over 37kV	3 ft. 0 in. (91 cm)
Over 37kV, not over 87.5kV	3 ft. 6 in. (107 cm)
Over 87.5V, not over 121kV	4 ft. 0 in. (122 cm)
Over 121kV, not over 140kV	4 ft. 6 in. (137 cm)

12. Any vehicle or mechanical equipment capable of having parts of its structure elevated near energized overhead lines will be operated so that a clearance of 10 ft. (305 cm) is maintained. If the voltage is higher than 50kV, the clearance will be increased 4 in. (10 cm) for every 10kV over that voltage. However, under any of the following conditions, the clearance may be reduced:

- a) If the vehicle is in transit with its structure lowered, the clearance may be reduced to 4 ft. (122 cm). If the voltage is higher than 50kV, the clearance will be increased 4 in. (10 cm) for every 10kV over that voltage.
- b) If insulating barriers are installed to prevent contact with the lines, and if the barriers are rated for the voltage of the line being guarded and are not a part of or an attachment to the vehicle or its raised structure, the clearance may be reduced to a distance within the designed working dimensions of the insulating barrier.
- c) If the equipment is an aerial lift insulated for the voltage involved, and if the work is performed by a qualified person, the clearance (between the un-insulated portion of the aerial lift and the power line) may be reduced to the distance given in said Table S-5 (see #11, above).

13. Employees standing on the ground may not contact the vehicle or mechanical equipment or any of its attachments, unless:

- a) The employee is using protective equipment rated for the voltage; or
- b) The equipment is located so that no un-insulated part its structure (that portion of the structure that provides a conductive path to employees on the ground) can come closer to the line than permitted in number 12 (see above).

14. If any vehicle or mechanical equipment capable of having parts of its structure elevated near energized overhead lines is intentionally grounded, employees working on the ground near the point of grounding will not stand at the grounding location whenever there is a possibility of overhead line contact.

15. Additional precautions, such as the use of barricades or insulation, will be taken to protect employees from hazardous ground potentials, depending on earth resistivity and fault currents that can develop within the first few feet or more outward from the grounding point.
16. Employees may not enter spaces containing exposed energized parts, unless illumination is provided that enables the employees to perform the work safely.
17. Where lack of illumination or an obstruction precludes observation of the work to be performed, employees may not perform tasks near exposed energized parts.
18. Employees must not reach blindly into areas which may contain energized parts.
19. Whenever an employee works in a confined or enclosed space (such as a manhole or vault) that contains exposed energized parts, he/she must be provided with, and he will use, protective shields, protective barriers, or insulating materials as necessary to avoid inadvertent contact with those parts.
20. Doors, hinged panels, and the like that are present in any confined or enclosed space will be secured to prevent their swinging into an employee and causing the employee to contact exposed energized parts.
21. Conductive materials and equipment that are in contact with any part of an employees body will be handled in a manner that will prevent them from contacting exposed energized conductors or circuit parts.
22. Whenever an employee must handle long dimensional conductive objects (such as ducts and pipes) in areas with exposed live parts, appropriate work practices (such as the use of insulation, guarding and material handling techniques) shall be instituted which will minimize the hazard.
23. Only wooden ladders or ladders with non-conductive side rails may be used where the employee or the ladder could contact exposed energized parts.
24. Conductive articles of jewelry and clothing (such as watch bands, bracelets, rings, key chains, necklaces, metalized aprons, cloth with conductive thread, or metal headgear) may not be worn if they might contact exposed energized parts. However, such articles may be worn if they are rendered nonconductive by covering, wrapping, or other insulating means.
25. Where live parts present an electrical contact hazard, employees may not perform housekeeping duties at such close distances to the parts that there is a possibility of contact, unless adequate safeguards (such as insulating equipment or arrears) are provided.
26. Electrically conductive cleaning materials (including conductive solids such as steel wool, metalized cloth, and silicon carbide, as well as conductive liquid solutions) may not be used in proximity to energized parts unless appropriate procedures are followed that will prevent electrical contact.

27. Only a qualified person following the requirements of the procedures set forth in this section of the policy may defeat an electrical safety interlock and then only temporarily while he or she is working on the equipment.
28. The interlock system will be returned to its operable condition when such work is completed

7.0 Portable Electric Equipment

1. All cord- and plug- connected electric equipment, flexible cord sets (extension cords), and portable electric equipment will be handled in a manner that will not cause damage.
2. Flexible electric cords connected to equipment may not be used for raising or lowering the equipment.
3. Flexible cords may not be fastened with staples or otherwise hung in such a fashion as could damage the outer jacket or insulation.
4. Portable cord- and plug- connected equipment and flexible cord sets (extension cords) shall be visually inspected before use and missing pins, or damage to outer jacket or insulation) and for evidence of possible internal damage (such as pinched or crushed outer jacket). However, cord- and plug- connected equipment and flexible cord sets (extension cords) which remain connected once they are put in place and are not exposed to damage need not be visually inspected until they are relocated.
5. If there is a defect or evidence of damage that might expose an employee to injury, the defective or damaged item will be removed from service, and no employee may use it until necessary repair and tests have been made to render the equipment safe.
6. Whenever an attachment plug is to be connected to a receptacle (including any on a cord set), the relationship of the plug and receptacle contacts will first be checked to ensure that they are of proper mating configurations.
7. A flexible cord used with grounding-type equipment will contain an equipment grounding conductor.
8. Attachment plugs and receptacles may not be connected or altered in a manner that would prevent proper continuity of the equipment grounding conductor at the point where plugs are attached to receptacles. Additionally, those devices may not be altered to allow the grounding pole of a plug to be inserted into slots intended for connection to the current carrying conductors.
9. Adapters that interrupt the continuity of the equipment grounding connection may not be used.
10. Portable electric equipment and flexible cords used in highly conductive work locations (such as those inundated with water or other conductive liquids), or in job locations where employees are likely to contact water or conductive liquids.

11. Employees' hands may not be wet when plugging and unplugging flexible cords and cord and plug-connected equipment, if energized equipment is involved.
12. Energized plug and receptacle connections may be handled only with insulating protective equipment if the condition of the connection could provide a conducting path to the employees hand (if, for example, a cord connector is wet from being immersed in water).
13. Locking-type connectors will be properly secured after connection.

8.0 Electric Power and Lighting Circuits

1. Load rated switches, circuit breakers, or other devices specifically designed as disconnecting means will be used for the routine opening, reversing, or closing of circuits under load conditions.
2. Cable connectors not of the load-break type, fuses, terminal lugs, and cable splice connections may not be used for such purposes, except in an emergency.
3. After a circuit is de-energized by a circuit protective device, the circuit may not be manually re-energized until it has been determined that the equipment and circuit can be safely energized. However, when it can be determined from the design of the circuit and the over-current devices involved that the automatic operating of a device was caused by an overload connected equipment is needed before the circuit is reenergized.
4. Repetitive manual re-closing of circuit breakers or reenergizing circuits through replaced fuses is prohibited.
5. Over-current protection of circuits and conductors may not be modified, even on a temporary basis, beyond that allowed by the OSHA standard regulating the installation safety requirements for over-current protection (See 29 CFR 1910.304(e)).

9.0 Test Instruments and Equipment

1. Only qualified persons may perform testing work on electric circuits or equipment.
2. Test instruments and equipment and all associated test leads, cables, power cords, probes, and connectors will be visually inspected for external defects and damage before the equipment is used. If there is a defect or evidence of damage that might expose an employee to injury, the defective or damaged item will be removed from service, and no employee may use the item until necessary repairs and tests to render the equipment safe have been made.
3. Test instruments and equipment and their accessories will be rated for the circuits and equipment to which they will be connected and will be designed for the environment in which they will be used.

10.0 Flammable or Ignitable Materials

1. In those situations where flammable materials are present only occasionally, electric equipment capable of igniting them will not be used, unless measures are taken to prevent hazardous conditions from developing.
2. Flammable materials include, but are not limited to: flammable gases, vapors, or liquids; combustible dust and ignitable fibers.
3. In those situations where flammable vapors, liquids or gases, or combustible dusts or fibers are (or may be) present on a regular basis, the electrical installation requirements contained in the OSHA standard regulating hazardous locations must be observed (See 29 CFR 1910.307).

11.0 Personal Protection Safeguards

1. Employees working in areas where there are potential electrical hazards will be provided with, and will use, electrical protective equipment that is appropriate for the specific parts of the body to be protected and for the work to be performed. This equipment may include rubber protective equipment such as insulating gloves, blankets, hoods, line hose, sleeves, and matting for use around electric apparatus.
2. Protective equipment will be maintained in a safe, reliable condition and will be periodically inspected and/or tested.
3. If the insulating capability of protective equipment may be subject to damage during use, the insulating material shall be protected. For example, an outer covering of leather can be used for the protection of rubber insulating material.
4. Employees will wear nonconductive head protection wherever there is a danger of head injury from electric shock or burns due to contact with exposed energized parts.
5. Employees will wear protective equipment for the eyes or face wherever there is danger of injury to the eyes or face from electric arcs or flashes or from flying objects resulting from electrical explosion.
6. When working near exposed energized conductors or circuit parts, each employee will use insulated tools or handling equipment if the tools or handling equipment might make contact with such conductors or parts. If the insulating capability of insulated tools or handling equipment is subject to damage, the insulating material will be protected.
7. Fuse handling equipment, insulated for the circuit voltage, will be used to remove or install fuses when the fuse terminals are energized.
8. Ropes and hand lines used near exposed energized parts shall be nonconductive.
9. Protective shields, protective barriers, or insulating materials will be used to protect each employee from shock, burns, or other electrically related injuries while that employee is

working near exposed energized parts which might be accidentally contacted or where dangerous electric heating or arcing might occur.

10. When normally enclosed live parts are exposed for maintenance or repair, they will be guarded to protect unqualified persons from contact with their live parts.
11. Alerting techniques will be used to warn and protect employees from hazards which could cause injury due to electric shock, burns, or failure of electric equipment parts as follows:
 - a) Safety Signs and Tags: Safety signs, safety symbols, or accident prevention tags will be used where necessary to warn employees about electrical hazards which may endanger them.
 - b) Barricades: Barricades will be used in conjunction with safety signs where it is necessary to prevent or limit employee access to work areas exposing employees to un-insulated energized conductors or circuit parts. Conductive barricades may not be used where they might cause an electrical contact hazard.
 - c) Attendants: If signs and barricades do not provide sufficient seaming and protection from electrical hazards, an attendant will be stationed to warn and protect employees.

12.0 Training

1. Appropriate training will be provided for those employees who face a risk of electric shock in the form of classroom and/or on the job instruction.
2. Each employee required to be trained will become familiar with the safe work practices required by this policy and those sections of the OSHA Electrical Standard that pertain to his/her respective job assignment(s).
3. Qualified persons (i.e. those persons permitted to work on or near exposed energized parts) will, at a minimum, be trained in the following:
 - a) The skills and techniques necessary to distinguish exposed live parts from other parts of electric equipment,
 - b) The skills and techniques necessary to determine the nominal voltage of exposed parts, and
 - c) The clearance distances specified in Table S-5 of 29 CFR 1910.333(c) (see #11 Section 6.0 of this Policy) and the corresponding voltages to which the qualified person will be exposed.

Note: The degree of training will be determined by the risk likely to be encountered by the employee.

13.0 References

City and County of Denver 65.5.2 Lockout/Tagout/Verify Program

NFPA 70, the “National Electrical Code” (NEC)

NFPA 70E, “Electrical Safety Requirements for Employee Workplaces”

29 CFR 1910.147 – The Control of Hazardous Energy (Lockout/Tagout)

29 CFR 1910.331-335 – “Electrical Safety-Related Work Practices”