

ELECTRICAL and MOTOR MACHINE SHOP SAFETY PROCEDURES

This section has been formulated to set guidelines for all electrical work performed by this department. The purpose of this manual is to provide direction and to the greatest extent possible, to assure a safe work environment for all electrical employees.

The majority of this section's material has been derived from the following existing safety manuals:

Power Systems Safety Manual from the United State Department of Energy
Western Area Power Administration
Safety Manual, City of Fort Collins
Safety Manual for an Electric Utility, American Public Power Association and
Safety Handbooks from the Panama Canal Company and Panama Canal Commission

DEFINITIONS

APPROVED: The term "approved," when used in connection with methods, tools, or equipment, refers to the methods, tools, or equipment approved by the department through committee, departmental action, or in a Safety Rule.

ATTENDED STATION: Any station manned at all times.

AUTHORIZED PERSON: One who has the authority to perform specific duties under certain conditions or who is carrying out orders from responsible authority.

BARRIER: A physical obstruction, which is intended to prevent contact with energized lines or equipment.

BARRICADE: A physical obstruction such as tapes, screens, and cones intended to warn and limit access to a hazardous area, and to prevent contact with energized lines or equipment.

BOND: An electrical connection from one conductive element to another for the purpose of minimizing potential differences, providing suitable conductivity for fault current, or for reducing leakage current and electrolytic action.

CIRCUIT: A conductor or system of conductors through which an electric current is intended to flow.

COMPANY: The employer; the entity having jurisdiction and control over the operation of the utility.

CONDUCTOR: A material, usually in the form of a wire, cable, or bus bar, suitable for carrying an electric current.

DEAD: When "dead" is used in connection with wires or equipment that are a part of the electrical system, it shall be taken to mean disconnected from any electrical source of supply and properly tagged, shorted, and grounded.

DE-ENERGIZED: Disconnected from any electrical source of supply. The term "de-energized" shall differ from the term "dead" in that it shall not imply grounding and tagging.

DEPARTMENT: CSU Facilities Management - Electrical Department.

DISCIPLINARY ACTION: Administrative action taken by the employer against the employee. May vary from verbal reprimand to dismissal.

DISCONNECTED: Means disconnected from any electrical source of supply.

EFFECTIVELY GROUNDED: Intentionally connected to earth through a ground connection or connections of sufficiently low impedance and having sufficient current-carrying capacity to prevent the buildup of voltages which may result in undue hazard to connected equipment or to persons.

EMERGENCY: An emergency occurs when an unusual condition exists that endangers life and/or property.

EMPLOYEE: In the broad sense, any person employed by or representing Facilities Management Electrical Department.

ENCLOSED: When equipment is surrounded by a case, cage, or fence to prevent accidental contact with people.

ENERGIZED: (also alive or live): Electrically connected to a source of potential difference or electrically charged so as to have a potential difference from that of the earth or different from that of adjacent conductors or equipment.

ENTRY: Unless otherwise modified, entry shall mean the act of placing oneself entirely within the confines of enclosures or designated areas.

EQUIPMENT: Any machine, device, or apparatus, either electrical or mechanical.

EXCAVATIONS: The word "excavations" shall be used to indicate any opening made in the ground, street, or sidewalk in connection with Utility work; such as, holes, trenches, ditches, or tunnels.

EXPOSED: (a) Exposed circuits or lines means in such a position that in case of failure of supports or insulation, contact with another circuit or line may result. (b) Exposed equipment means an object or device that can be inadvertently touched or approached nearer than a safe distance by any person. It is applied to objects not suitably guarded or situated.

FLARES: The word "flares" shall be used to indicate flares, torches, red lanterns, reflectors or any other equipment that is adaptable for the purpose intended.

FOREMAN OR SUPERVISOR: Is used in a general sense to indicate any person who is qualified, regardless of classification, who is directly in charge of a specific job(s). When the Electrical Department Foreman is not at the job site, a person is designated as "foreman" or "lead person" at the site and takes on those responsibilities.

GENERAL SWITCHING: Switching performed for line sectionalizing or system rearrangement for testing and/or changes in operating conditions.

GOVERNMENTAL: Any type of political agency having control over a certain activity. Included are federal, state, county, township, city, etc.

GROUND: (noun) The term means a conductive connection whether intentional or accidental, by which an electric circuit or equipment is connected to reference ground.

GROUND: (reference) The term means a conductive body, usually earth, to which an electric potential is referenced.

GROUND: (verb) The term means the connecting or establishment of a connection, whether by intention or accident of an electric circuit or equipment to reference ground.

GROUNDING ELECTRODE (ground electrode): A conductor embedded in the earth, used for maintaining ground potential on conductors connected to it, and for dissipating into the earth current conducted to it.

GROUNDING SYSTEM: A system of conductors in which at least one conductor or point (usually the middle wire, or neutral point or transformer or generator windings) is intentionally grounded, either solidly or through a current-limiting device, (not a current-interrupting device).

GUARDED: Protected by personnel, covered, fenced, or enclosed by means of suitable casings, barrier rails, screens, mats, platforms, or other suitable devices in accordance with standard barricading techniques designed to prevent dangerous approach or contact by persons or objects. (Note: Wires, which are insulated but not otherwise protected, are not considered as guarded.)

HOLD CARDS: Also called "Hold Tags." A card or tag-type device, usually having a predominant color of white or red that warns against, or which cautions against, the operation of a particular switch, device, circuit, tool, machine, etc. The use of such tags must be respected; equipment or items so tagged must not be activated or used without full and proper authority from a responsible person.

HOTLINE TOOLS AND ROPES: Those tools and ropes that are especially designed for work on energized high voltage lines and equipment. Insulated aerial equipment especially designed for work on energized high voltage lines and equipment shall be considered "hotline."

INSULATED: Separated from other conducting surfaces by a dielectric substance or air space, permanently offering a high resistance to the passage of current and to disruptive discharge through the substance or space.

ISOLATED: An object that is not readily accessible to persons unless special means of access are used.

MANHOLE: A subsurface enclosure that personnel may enter and which is used for the purpose of installing, operating, and maintaining equipment and/or cable.

PAD MOUNT: Transformer or equipment in a surface-mounted enclosure and normally worked from ground level.

PRIMARY COMPARTMENT: A compartment containing voltages above 600 volts.

PRIMARY HIGH VOLTAGE: Any electric circuit that normally operates at more than 600 volts.

PUBLIC: Any individual who is not an employee or representative of the Company.

QUALIFIED PERSON: A person who is familiar with the construction or operation of the lines and/or equipment that concern his position and who is fully aware of the hazards involved; or one who has passed a journeyman's examination for the particular branch of the electrical trade with which he may be connected. A person who has successfully demonstrated his ability and is recognized by management as qualified to perform the duties to which he has been assigned.

SAFETY RULE: A positive rule requiring compliance by all employees concerned. Deviation from safety rules is not permitted and is subject to disciplinary action.

SECONDARY COMPARTMENT: A compartment containing voltages below 600 volts.

SECONDARY VOLTAGE: Any electrical circuit that normally operates at less than 600 volts.

SHALL: When the word "shall" appears in the wording of a rule, the rule is to be obeyed as written.

SHOULD: When the word "should" appears in the wording of a rule, the rule is to be obeyed as written when it is reasonable or practical to do so.

SPECIAL CONDITION: An unusual, temporary condition pertaining to equipment, and not associated with other protective procedures. This term indicates the requirement for special operating instructions and information on the current condition of equipment.

STREAM: Upstream--towards substation; Downstream--away from substation.

SUBSTATION: A substation is an assemblage of equipment for the purpose of switching and/or changing or regulating the voltage of electricity. Service equipment, line transformer installations, or minor distribution or transmission equipment are not classified as substations. See also Switching Station.

SUPERVISOR: See definition of *Foreman*.

SWITCH: A device for opening and closing or changing the connection of a circuit. In these rules, a switch is understood to be manually operable, unless otherwise stated.

SWITCHPERSON: Any person authorized to perform switching and tagging operations.

SWITCHING STATION: An assemblage of equipment for the sole purpose of tying together two or more electric circuits through switches, selectively arranged to permit a circuit to be disconnected, as in case of trouble, or to change the electric connections between the circuits. A type of substation.

TAILBOARD SAFETY TALK: A short informal discussion of the work to be accomplished and the safety measures to be incorporated. Normally conducted by the foreman, these are sometimes referred to as "Tailgate Talks," or "Five-Minute Safety Talks." Prior to high voltage maintenance or repair, the person in charge will conduct a Tailboard Safety Talk. Specific jobs will be assigned as required by the person in charge.

UNATTENDED STATION: Any station not normally manned, and includes stations which are physically checked periodically by qualified personnel.

UNDERGROUND RESIDENTIAL DISTRIBUTION (URD): General term that covers the necessary facilities to furnish underground service to residential and "commercial-type" customers.

UNSAFE CONDITIONS: This is used to indicate dangerous conditions, hazardous conditions, defective conditions, or unusual conditions which could be conducive to accidents.

VAULTS: An enclosure above or below ground that personnel may enter and is used for the purpose of installing, operating, and/or maintaining equipment and/or cable.

VOLTAGE: The effective Root Mean Square (RMS) potential difference between any two conductors or between a conductor and a ground. The voltage specified in this Manual shall mean the maximum effective voltage to which the personnel or protective equipment may be subjected. Low voltage includes voltages up to 600 volts. High voltage shall mean voltages in excess of 600 volts.

VOLTAGE OF AN EFFECTIVELY GROUNDED CIRCUIT: The term means the voltage between any conductor and ground, unless otherwise indicated.

WARNING SIGNS: For the purpose of these rules, a warning sign is any sign or similar means of employee or public notification alerting individuals to an actual or possible hazard. Included are "Danger" signs, traffic protection signs, instructional signs, and informational signs.

WORKER: Any person authorized to inspect, service, repair, or otherwise be in contact with equipment. Those authorized may include electricians, test persons, linepersons, mechanics, and inspectors.

PERSONAL SAFETY ALWAYS COMES FIRST!

All Facilities Management Electrical employees shall not begin work on a high voltage circuit until they personally have made sure that all circuit breakers, sectionalizing switches, and disconnecting switches are opened and properly tagged and locked; and, if necessary, blocked or properly grounded.

OVERHEAD DISTRIBUTION

- ◆ Only qualified employees shall work on or near energized lines or equipment.
- ◆ Workers must be insulated from other conducting surfaces or use adequate protective devices to touch any exposed ungrounded line wire or apparatus.
- ◆ Report any defective line, apparatus, tool or other condition, that is judged to be dangerous either to persons or property or likely to interrupt or delay service, to the nearest supervisor or foreman.
- ◆ Electrical equipment and lines are to be considered as "live" unless they are positively known to be dead. Before starting to work, preliminary inspection or a test will be made to determine what conditions exist. Handle neutral wires with the same caution as is used with energized wires.
- ◆ Secondary windings or current or series transformers must be short-circuited before any instrument, or other device connected in the circuit, is removed or disconnected.

PROTECTIVE EQUIPMENT (RUBBER, SYNTHETICS, ETC.)

- ◆ Do not touch or work on any exposed energized lines or apparatus except when wearing protective equipment approved for the voltage to be contacted.
- ◆ When work is to be done on or near energized lines, all energized and grounded conductors or guy wires within reach of any part of the body, while working, shall be covered with rubber protective equipment (with the exception of the part of the conductor on which work is being performed).
- ◆ When working on energized lines or apparatus, work should be done from below, if possible.
- ◆ In applying flexible protective equipment, always protect the nearest and lowest wires first. Thus, protecting the body as you progress. In removing rubber protective equipment, the reverse order shall be maintained.
- ◆ Protect flexible blankets from physical damage and moisture by means of a tarp, canvas, or protective mat when using them on the ground.
- ◆ Put on protective equipment before entering the working area within which energized lines or apparatus may be reached. Keep equipment on until you are completely out of this area.
- ◆ When not in use, safeguard rubber protective equipment from mechanical and chemical damage by storing it in the containers provided. Do not store anything else in the containers.
- ◆ To avoid corona and ozone damage, rubber protective equipment must not be kept in place on energized lines or apparatus overnight or for more than one eight-hour period, unless approved by the supervisor in charge.
- ◆ Visually inspect line hose, hoods, blankets, line guards, etc., before each job.

- ♦ Store flexible protective devices in special compartments on trucks and elsewhere where they will not be subjected to damage from tools or other equipment.
- ♦ Treat bare communications conductors as energized lines, and protect them accordingly.

USE AND CARE OF RUBBER GLOVES

NOTE: Supervision or company rules may require the use of rubber sleeves in addition to rubber gloves.

- ♦ Only authorized employees or those under the continuous supervision of an experienced worker shall work on lines or equipment energized in excess of 600 volts.
- ♦ Rubber gloves shall be worn with leather protectors when working on lines or equipment energized at voltages above 600 volts.
- ♦ When the use of rubber gloves is required, put them on before coming within falling or reaching distance (in any event, not less than 5 feet) of unprotected energized circuits, apparatus, or those, which may become energized. Do not remove them until you are entirely out of falling or reaching distance of such circuits or apparatus.
- ♦ Rubber gloves with leather protectors shall be worn when:
 - Working on or within falling distance or reaching distance of any electrical equipment or metal surface (cross arms, cross arm braces, or transformer cases) that are not effectively grounded and which may be or may become energized above 600 volts to ground.
 - During wet or stormy weather, working on or within falling or reaching distance of any conductor or equipment, which may be or may become energized at any voltage.
 - Required by supervision
 - Removing lead sheath and sleeves from cables and joints, and opening or cutting cables (until they have been proven to be de-energized at the work location by positive tests).
 - Making static tests on cables.
 - Operating manually controlled air break switches (unless protected by a grounding mat or grid).
 - Opening and closing manually operated oil circuit breakers.
 - Opening, closing, removing, or replacing hot clamps, fuses, or fuse doors on cutouts even when using an approved switch stick or hotline tool.
 - Making tests to determine if lines are de-energized, and applying and removing grounding devices.
 - Pulling in wires or handling other conducting materials near circuits, apparatus, or equipment, which is or may become energized.
 - When rubber-glove work is authorized to be performed on circuits from 5kv to 15kv, gloves rated at 20,000 volts shall be used. For circuits above 15kv, gloves rated at 40,000 volts shall be used.
NOTE: Supervision may require the use of rubber sleeves in addition to rubber gloves.

- When working with rubber protective equipment on energized circuits or apparatus where the voltage between any two conductors is over 7,500 volts, the following minimum conditions shall be met in addition to all other rules governing the use of protective equipment:
 - 1) Rubber gloves shall be used.
 - 2) Do not make physical contact with protective devices installed on energized primary conductors with anything other than rubber gloves or rubber sleeves.
 - 3) Isolate oneself from all grounds (wooden poles shall be considered as grounds in this case) by using approved supplementary insulation such as aerial baskets, a lineman's platform, or other approved insulated devices.
 - 4) When two or more employees are working on the same structure, they shall work on or contact only the same conductor at one time.
- Wear rubber gloves as they are meant to be. Do not wear them inside out or without leather protectors. Exchange them whenever they become damaged or when the possibility of damage exists. Wear leather protectors or leather gloves only when in use over rubber gloves.
- Inspect rubber gloves for corona cracks or other damage. Give them air tests at least once each day while in use, preferably at the beginning of the work period and at any other time when their condition is in doubt. They shall be checked before each use.
- When not in use gloves shall be kept in canvas bags or other approved containers and stored where they will not become damaged from sharp objects or exposed to direct sunlight. Do not fold them to store or place other objects upon them.
- Rubber gloves shall be stored in the glove bag with the cuffs down to permit drainage, and better ventilation and to reduce the possibility of damage.

WORKING ON DE-ENERGIZED LINES AND EQUIPMENT

- ◆ Treat all conductors and equipment as energized until tested or otherwise determined to be de-energized or until grounded.
- ◆ New construction, new lines, or equipment may be considered de-energized and worked as such where:
 - The lines or equipment are grounded, or,
 - The hazard of induced voltage is not present, and adequate clearance or other means are implemented to prevent contact with energized lines or equipment and the new lines or equipment.
- ◆ Communication conductors. Treat bare wire communication conductors on power poles or structures as energized lines unless protected by insulating materials.

WORKING ON TRANSFORMERS

- ◆ Always consider the primary leads of a distribution transformer energized at full voltage until both the primary and the secondary leads have been disconnected, or it has been definitely determined that the secondary circuit to which it is attached is not energized from another source.
- ◆ Consider the cases of all transformers connected to a source of supply as energized at the full primary voltage unless they are adequately grounded.
- ◆ While working on or near energized circuits, do not stand on, or otherwise contact transformer cases.

GROUNDING

- ♦ Consider all previously energized conductors energized until tested and properly grounded.
- ♦ New construction. New lines or equipment may be considered de-energized and worked as such where:
 - The lines or equipment are grounded, or
 - The hazard of induced voltage is not present, and adequate clearances or other means are implemented to prevent contact with energized lines or equipment and the new lines or equipment.
- ♦ Communication conductors. Treat bare wire communication conductors on power poles or structures as energized lines unless protected by insulating materials.
- ♦ Voltage testing. De-energized conductors and equipment which are to be grounded shall first be tested for the presence of voltage.
- ♦ Attaching grounds.
 - When attaching grounds, the ground end shall be attached first, and the other end shall be attached and removed by means of insulated tools.
 - When removing grounds, the grounding device shall first be removed from the line or equipment, using insulated tools.
- ♦ Grounds shall be placed between work location and all sources of energy and as close as practicable to the work location, or grounds shall be placed at the work location. If work is to be performed at more than one location in a line section, the line section must be grounded and short-circuited at one location in the line section and the conductor to be worked on shall be grounded at each work location. Where the making of a ground is impracticable, or the conditions resulting there from would be more hazardous than working on the lines or equipment without grounding, the grounds may be omitted and the line or equipment worked as energized.
- ♦ Testing without grounds. Grounds may be temporarily removed only when necessary for test purposes and extreme caution shall be exercised during the test procedures.
- ♦ Grounding electrodes. When grounding electrodes are utilized, such electrodes shall have a resistance to ground low enough to remove the danger of harm to personnel or permit prompt operation of protective devices.
- ♦ Ground lead. A ground lead, to be attached to either a tower ground or driven ground, shall be capable of conducting the anticipated fault current and shall have a minimum conductance of No. 2 AWG copper.
- ♦ Lifting equipment shall be bonded to an effective ground, or it shall be considered energized and barricaded when utilized near energized equipment or lines.

FUSES (HIGH VOLTAGE)

Rubber gloves shall be worn while opening, closing, removing, or replacing hot clamps, fuses or fuse doors on cutouts even when using an approved switch stick or hotline tool. Approved eye protection shall also be used during these procedures.

UNDERGROUND RESIDENTIAL DISTRIBUTION

Underground Residential Distribution systems have a number of apparent advantages over overhead systems; however, they also have some disadvantages such as confined working spaces, closer clearances between energized parts, and greater exposure to all types of grounds. In most cases, if protective devices are not used, the employee will be in direct contact with the ground, or grounded equipment. This contact completes half of an electrical circuit; therefore, if these contacts are not avoided, or protection against contact is not used, serious injury could result. There is a safe way of doing every job; be sure you know it before proceeding.

PULLING CABLES

- ◆ Do not handle pull-wires or pulling lines, while pulling under strain, within reaching distance of block, sheaves, winch drums, and take-up reels.
- ◆ When metallic or current carrying lines are used in blowing or pulling cable near energized equipment, the cable blowing or pulling apparatus shall be grounded.
- ◆ Pull-wires, steel pulling lines, or metal roding shall not be pushed through ducts in areas where energized equipment is present, unless another worker is stationed at the other end of the run.

It is recommended that no employee remain in a manhole or vault during pulling operations involving heavy pulling strains.

OPENING AND GUARDING HOLES

Whenever cover is to be removed from a manhole or a vault, or when any other obstruction to traffic exists, the following precautions shall be taken:

- ◆ All obstructions to traffic shall be guarded by adequate signs, barricades, lights, flares, flags, etc. Traffic shall be warned in sufficient time, that an obstruction exists, through the use of signs, high level standards, flashing lights, traffic cones, flagmen, etc., as may be needed.
- ◆ Where permissible and practicable, a truck should also be placed to guard the work area against oncoming traffic.
- ◆ A blowtorch or other open flame shall never be used to melt ice around a manhole or vault cover.
- ◆ Manhole, vault, and service-box covers shall always be removed and replaced by means of approved tools.
- ◆ To avoid back injuries, use the manhole cover lift rather than a shovel.

ENTERING VAULTS AND ENCLOSURES

Whenever entry is required into submerged concrete vault, walk-in building vault, fiberglass vault, or transclosure, entry shall be in accordance with the following procedures and requirements:

Submerged Primary Concrete Vault Entry Procedure:

- ◆ Review **CONFINED SPACE ENTRY PROGRAM (Chapter 18)**. Coordinate with the Heating Plant before entering steam tunnels.
- ◆ Rubber gloves, safety glasses or face shield, and hardhat must be worn. (Energized vault)
- ◆ Two workers must be present at vault location before entry. Never enter alone. (All vaults)
- ◆ Contact supervisor, to inform of vault to be entered. If necessary, place barricades and cones around entrance as required. (All vaults)
- ◆ Pump water from vault as required. (All vaults)
- ◆ Before entering, force ventilate vault and check for presence of gas as follows (all vaults):
 - Locate ventilator away from any source of bad air, exhausts, etc.
 - Purge blower hose before placing blower hose in manhole.
 - Insert hose in manhole to at least within three feet of the bottom of the vault. Continue forced ventilation until work in vault is completed.
 - In an emergency, to save time, personnel may use gas detector to check for presence of gas and lack of oxygen. If vault tests O.K., personnel may enter vault immediately. If vault fails test, force ventilate until it does pass test. Vault must pass test.
- ◆ After entry, use blower hose to purge corners of vault. (All vaults)
- ◆ After purging vault corners:
 - Visually inspect all devices, cables and connections for any obvious problems. (All vaults)

- Use heat gun to inspect all devices and connections for excessive heating. (Energized vaults)
- Reset tripped fault indicators.
- ◆ Perform work as required.
- ◆ If blower stops, get out of vault, restart forced ventilation, test for gas, and do not reenter vault until vault tests OK. (All vaults)
- ◆ If duct plugs are removed while working in vault, test for gas. (All vaults)
- ◆ Repeat gas test every two hours while working in vault that has failed gas test initially or is otherwise suspect. (All vaults)
- ◆ If, in an emergency situation WHICH ENDANGERS LIFE, it becomes necessary to enter a manhole where gas is suspected, proceed as follows (All vaults):
 - Review CONFINED SPACE ENTRY PROGRAM (Chapter 18).
 - Immediately call for help by contacting Environmental Health Services (EHS) to have them check tunnel; they should ascertain when it is safe to enter the tunnel before entering.
 - When determined safe, enter vault, and as entering, direct the ventilator hose output toward person to assure being surrounded by an adequate supply of good air.
- ◆ Where physically possible, a ladder shall be used for entering and exiting the vault. The ladder shall extend above the manhole and shall be securely attached. Climbing into or out of manholes by stepping on cables or hangers is forbidden. Manhole guards should not be used as a substitute for ladder extension.

WALK-IN BUILDING VAULT ENTRY PROCEDURE

- ◆ The building vault entry procedure shall be the same as the procedure for entering the submerged concrete vault.

OTHER VAULTS ENTRY PROCEDURE

- ◆ Complete entry shall be prohibited if the vault contains circuits or apparatus energized with voltages in excess of 600 volts. (Energized only)
- ◆ Rubber gloves, safety glasses or face shield, and hardhat must be worn when vault contains energized circuits. (Energized only)
- ◆ Contact supervisor to inform of vault to be entered. (Energized only)
- ◆ If vault contains cables or apparatus energized above 600 volts, only partial entry (e.g., using hands to work on equipment inside of vault while body is located on outside) shall be allowed for vaults containing circuits energized above 600 volts. (Energized only)
- ◆ Before entry, vaults with partial, removable roof shall be ventilated by either of the following methods (All vaults):
 - Removing the lid and leaving the vault open to natural ventilation for a minimum of 15 minutes, or forced ventilation for a minimum of 3 minutes.

TRANCLOSURE ENTRY PROCEDURE

- ◆ The transclosure entry procedure shall be the same as the procedure for entering "Other Vaults," except for ladder requirements.

HARD HATS, RUBBER GLOVES, AND OTHER PROTECTIVE EQUIPMENT

- ◆ Wear hardhat on the job site where there is a hazard of falling objects, electric shock, or burns.
- ◆ Wear hardhat, rubber gloves, and safety glasses or face shield before entering any compartment or enclosure containing energized cables or apparatus.

- ♦ When work is to be performed within four feet of cables or apparatus energized above 600 volts, rubber gloves, safety glasses or face shield, and hardhat shall be worn.

Exceptions

- When personnel are separated from energized cables or apparatus by rigid barriers providing complete isolation.
- When, in the judgment of the work supervisor, adequate levels of protection can be provided.
- ♦ Rubber gloves shall be worn when removing animals, vines, weeds, grass, or vegetation of any kind that has grown into an energized installation, whether the equipment is opened or closed.
- ♦ Rubber gloves shall be worn when energized primary cables are moved, handled, or protected.
- ♦ Rubber gloves shall be worn when working on or contacting a neutral.

OPENING AND CLOSING CIRCUITS

Only qualified personnel shall perform switching. All safety requirements relative to dress, work methods, and procedures shall be followed while performing any switching operation.

- ♦ An approved switching tool, hardhat, and rubber gloves shall be used when operating switching devices, including transformer secondary breakers, in an energized circuit.
- ♦ Eye or face protection shall be worn when primary switching operations are performed.
- ♦ Whenever possible, switching operations should be performed at locations not requiring operation with personnel in a vault.
- ♦ During initial installation or following modification of feeds, voltage checks must be made to assure against cross-phasing, prior to connecting energized circuits.
- ♦ All circuits and devices shall be properly identified before performing any switching operations. If there is any doubt as to the identification, switching shall not be started until it is checked through the foreman.
- ♦ When an underground circuit without fused taps has opened through the operation of a circuit breaker or other protection device, the route of the circuit should be patrolled for obvious hazards before the circuit is re-closed.
- ♦ All personnel involved in switching operations shall be in radio contact with each other during switching operations.
- ♦ When planning switching sequences, every attempt shall be made to avoid energized switching operations with load break connectors inside of submerged concrete vaults. Switching operations that allow to operate switching, are preferred.
- ♦ When on location to begin switching, check locations on switching maps and verify physical location by observing street names, switch number, etc.
- ♦ Identify circuits and determine their directions (make use of labels).
- ♦ Install feed-through(s) and insulating cap(s), connect drain, and ground wires to grounding bus.

SWITCHING OPERATIONS

All safety requirements relative to dress, work methods, and procedures apply.

- Remove test cap(s) from circuit(s) to be worked on. (Place on clean surface.)
- ♦ Freeload break elbow(s) by rotating same with hot stick.
- ♦ Disconnect load break elbow(s) and place on feed through(s). (Keep elbow(s) clear of ground.)
- ♦ Place insulating cap(s) on exposed bushing(s).
- ♦ Repeat procedure at other switching points as required to clear the circuit(s) for work.
- ♦ If other switching personnel are involved in the switching operation, inform the supervisor of status. Wait for progress status report of all switching personnel involved to assure that all circuits are isolated before permission is issued to proceed.
- ♦ Test for voltage at elbow test point using appropriate test equipment. Circuit shall test dead before it can be

grounded.

- ♦ Connect grounding elbow(s) to grounding bus.
- ♦ Insert grounding elbow(s) in feed-through(s) on both ends of cleared circuit if available.
- ♦ Replace test caps.
- ♦ Place Safety Tag(s) on elbow(s) on BOTH ends of cleared circuit(s). (Safety Tag(s) may be removed only after receiving permission for their removal from the Supervisor.) If other switching personnel are involved, the Supervisor will monitor the status of all switching personnel involved to assure that the circuit(s) involved are grounded and tagged before issuing a Clearance.
- ♦ Complete work to be performed on the cleared line. CAUTION: Cables to be worked on must be checked for the presence of voltage at the work location using appropriate instruments. Where cable to be worked on does not have a visible ground at work location, the cable(s) to be cut must be spiked with a hot stick operable cable ground BEFORE commencing with the work.
- ♦ Energizing Cable Circuit Following Completion of Work:
 - Check to assure all personnel and equipment are in the clear.
 - Call Supervisor. Advise work is completed and all personnel and equipment are in the clear. Request permission to proceed with energizing of the circuit.
 - Remove Safety Tag(s).
 - Remove grounding elbow(s) on both ends of circuit(s). If other switching personnel are involved in the switching operation, inform the Supervisor of your status and wait for permission to proceed. The Supervisor will monitor the progress of all switching personnel to assure that all grounding elbows are removed before issuing permission to proceed.
 - Remove insulating caps and place on other terminal of feed-through. CAUTION: If work involves multiple phases, voltage checks must be made on test points to ensure against cross-phasing.
 - Place load break elbow on exposed bussing to energize cable circuit.
 - Complete circuit(s) by closing remaining load break elbow(s).
 - Inform Supervisor switching is completed. (Use switch numbers.)
 - Remove tools and secure vault.

GROUNDING

(Note: A capacitance charge can remain in a URD cable after it has been disconnected from the circuit and a static-type arc can occur when grounds are applied to such cables).

- ♦ All URD cables and equipment, including services, which have been energized or could become energized from any source, shall be considered as energized until the equipment is positively proven to be de-energized and has been grounded.
- ♦ Before working on de-energized primary circuits and equipment:
 - Obtain a Clearance on the circuit or equipment to be worked on.
 - Provide visible open breaks when practicable.
 - Test for voltage.
 - Circuits and equipment must be grounded as close to the job site as practicable.
- ♦ When work is to be done on equipment or cables of an underground system, precautions shall be taken to prevent backfeed. This shall include grounding of the secondary conductors where applicable.

WORK ON ENERGIZED CABLES AND EQUIPMENT-CIRCUITS ABOVE 600 VOLTS

- ♦ Cables operating at voltages above 15,000 volts shall not be moved under any circumstances.
- ♦ All cable up to 15,000 volts may be moved at the discretion of the supervisor. They shall not, however, be moved where such movement requires extreme changing of bends.
- ♦ When energized pad-mounted transformers, fiberglass vaults, or translosures containing energized circuits or equipment are unlocked and opened, they require immediate attention. They shall be kept closed and

- locked at all other times.
- ♦ All underground cables and apparatus energized at voltages above 600 volts shall be dead before work is done on the conductor, or before the cables are cut into or spliced.
- ♦ A primary or secondary system neutral on any energized circuit shall not be opened under any circumstances.

WORK ON DE-ENERGIZED CABLES AND EQUIPMENT-CIRCUITS ABOVE 600 VOLTS

- ♦ Before working on any cable or apparatus, the line shall be grounded at the first possible grounding point on each side of the work location.
- ♦ Cables to be worked on must be checked for the presence of voltage at the work location using appropriate instruments.
- ♦ When working on a de-energized cable within four feet of other cables or apparatus that are energized with voltages in excess of 600 volts, rubber gloves, safety glasses or face shield, and hardhat should be worn.

Exceptions:

- When personnel are separated from energized cables or apparatus by rigid barriers providing complete isolation.
- When, in the judgment of the work supervisor, adequate levels of protection can be provided to personnel through the use of rubber blankets or other protecting equipment.

WORK ON ENERGIZED CABLES AND EQUIPMENT-CIRCUITS 600 VOLTS AND UNDER

- ♦ Because of the characteristics of a low voltage network system, extra precautions must be taken in the use of necessary rubber protective equipment, in observing adequate clearances, and in using proper tools in order to prevent short circuits.
- ♦ Before any work is done on an energized cable, other cables and all grounded equipment with which contact can be made while working on the energized cable shall be covered with rubber blankets or approved insulating shields. (Cables with nonmetallic sheaths and those with an insulating jacket over the metallic sheath need not be covered.)
- ♦ Wear rubber gloves with leather protectors, safety glasses or face shield, and hardhat, while cutting into and removing sheathing or sleeves and while testing an energized cable.
- ♦ A primary or secondary system neutral on any energized circuit shall not be opened under any circumstance.
- ♦ Tools with insulated handles should be used to the maximum extent possible for making energized secondary connections, or when work is performed within energized service pedestals, pad-mount compartments, or submersible transformer enclosures.
- ♦ Only one energized secondary or service conductor shall be worked on at any one time. Protective devices shall be used to insulate or isolate it from all others.
- ♦ A shirt with full-length sleeves, rolled down, should be worn when work is performed on any energized underground cable or apparatus. Rubber sleeves may be worn in lieu of a long-sleeved shirt.
- ♦ Control circuits usually require working with small wire and connectors and with power sources having small capacities. Work may be performed on control circuits using only protective equipment and devices as can be used without inhibiting performance of work. If work cannot be performed safely under these conditions, control circuits shall be de-energized before performing work.

WORK ON DE-ENERGIZED CABLES AND EQUIPMENT-CIRCUITS 600 VOLTS AND UNDER

- ♦ Cable to be worked on must be checked for the presence of voltage at the work location, using appropriate instruments.
- ♦ When working on a de-energized cable and within four feet of other cable or apparatus that is energized with voltage in excess of 600 volts, rubber gloves, rubber sleeves, safety glasses or face shield, and hardhat should be worn.

Exceptions:

- When personnel are separated from energized cables or apparatus by rigid barriers providing complete isolation.
- When, in the judgment of the work supervisor, adequate levels of protection can be provided to personnel through the use of rubber blankets or other protective equipment.

TAGGING AND LOCKING OUT

Prior to commencing work on any high-low voltage circuit, the foreman of the job shall have the responsibility of placing protective tags and lockouts where required.

The only protective tags and lockout device to be used on high voltage lines and equipment are as follows:

- ◆ Lockout tags identifiers DT 633 and DT 634. These tags shall be used along with a Safety Lockout device, style number SL 21117.
- ◆ There shall be a minimum of two each Facilities Management Electrical Department tags and lockouts on each device when required. Devices are circuit breakers, sectionalizing switches, disconnect switches, and any equipment or device that is deemed necessary for protection.
- ◆ Any employee who is to work on the preceding may tag and lockout if he so wishes.
- ◆ Each Facilities Management Electrical Department employee is responsible for the removal of their tags and lockouts upon completion of their work.

Exceptions:

- ◆ Facilities Management Electrical Department employees have the option of authorizing the removal of their tags/locks verbally to another FM Electrical employee.

MOTOR SHOP

The Motor/Machine Shop maintains and balances a building's airflow to provide the comfort and safety needs of the building occupants. Specifically, the Motor Shop performs maintenance on all the building air filtering systems, which includes supply, return, and exhaust systems. The following information is extremely important and should help in awareness of the potential hazards faced on the job. Observe standard "hot work" procedures; make the workspace safe, and use smoke detectors in the work area.

- ◆ When checking any belt, sheave, or pulley, make sure that the fan or motor is turned off and has come to a complete stop before proceeding with the check.
- ◆ Checks of any coupling or shaft can be made only when all pumps and motors are turned off.
- ◆ Turn off the fan before going into a fan chamber to check the coils.
- ◆ Filters may be checked in their chamber or fan unit while fan is running. However, if filters are to be changed, the fan must be turned off. This is not only for safety, but also to keep dirt from being blown out of the filters into the building.
- ◆ Replace any fan-belt cover guards. They cannot protect you or your fellow workers if they are not there.

General Safety Procedures

- ◆ Wear goggles when grinding any part.
- ◆ Wear gloves when working with flammables and batteries.
- ◆ Wear goggles when cleaning vacuums.
- ◆ Unplug machines before working on them.
- ◆ Open the shop door for adequate ventilation when spray painting.
- ◆ When using the lift, double-check the hold that the chains have on the machine being lifted.

SAFE USE OF OXYACETYLENE CUTTING TOOL

The main dangers of oxyacetylene cutting are fire, burns, and toxic fumes. If a person feels dizzy or nauseated, or has blurred vision, they should discontinue the job and get some fresh air.

PRECAUTIONS

- ♦ When using oxyacetylene torches, make sure that a multipurpose dry-chemical fire extinguisher is readily available and in working condition. It is recommended that a 10 lb. (4A.40BC) portable extinguisher be on hand.
- ♦ When using torch indoors, use only in a well-ventilated place.
- ♦ Wear welding goggles and protective clothing including gloves and welding shield. Keep gloves, hands, and clothing free of oil and grease. Wear gloves to handle hot metal.
- ♦ Avoid breathing toxic fumes like galvanized metal fumes, and some paint fumes.
- ♦ Use welding shield for jobs on campus that can be seen from passersby.
- ♦ Do not leave a burning torch unattended.
- ♦ Cut or weld at least 5 feet away from cylinders.
- ♦ Always use regulators; do not use oxygen or acetylene directly from cylinders. Be sure that the regulators used are of the proper design for the cylinder.
- ♦ Use flint lights, **NOT MATCHES**, for lighting torch.
- ♦ Use hoses designated for oxygen and acetylene only.
- ♦ Do not use oil on regulators, torches, fittings, or any equipment surface that may come in contact with oxygen. Be especially careful not to oil or grease oxygen fittings. These substances will ignite with a violent explosion.
- ♦ Do not use compressed oxygen to clean off clothing, as compressed oxygen is not compressed air. Oxygen speeds up combustion, and if clothes become oxygen-soaked, they will need only a spark to burst into flames.
- ♦ Do not breathe compressed oxygen directly from cylinder or hose.
- ♦ Use soap and paintbrush to test connections for leaks.
- ♦ Do not use acetylene at pressures higher than 15 pounds per square inch (psi). Acetylene becomes unstable and highly explosive when pressure is over 15 psi.
- ♦ Do not cut or weld directly on gravel or concrete.
- ♦ Keep heat, flames, and sparks away from combustibles.
- ♦ Do not cut or weld on containers that have been used to store combustible materials unless containers have been properly cleaned and purged. Containers that fall into this category are ones that once contained nitrogen, carbon dioxide, or argon.

Safety Rules for Operating Hi-Ranger (Aerial Lift)

See HI-RANGER (AERIAL LIFT) SAFETY PROCEDURES, Chapter 21 of this manual.

SHEET METAL

- ♦ Always be aware of your environment. Keep the work areas as clean as possible; clean up metal scraps immediately after using any of the cutters.
- ♦ When carrying an object that weighs more than 50 pounds, use one of the two-wheelers (dolly).
- ♦ If you use the solvent tank, put on the rubber gloves found on the tank.
- ♦ When soldering or welding in the shop, remember to turn on the exhaust fan.
- ♦ When welding, lens' light-resistance should be rated #9- #11.

Safe Use of the Machines in the Shop

BAND SAW: Use the light provided on the saw at all times. Use a push stick to guide wood through the saw rather than guiding it with your hands.

BRAKE MACHINE: The brake machine bends metal. As the arms move, there is a chance of being hit below the belt. When using the machine make sure that the area is clear of personnel. If someone else is using the machine, stay clear of its operation.

SHEARS: The shears cut metal. They are relatively safe to operate, but always be aware of your hand position. Keep hands away from the blades as you depress the footplate. Immediately after using the machine, clean up the scraps.

GRINDER: Wear gloves and full-face shield provided at the grinder. Use only the front of the grinding wheel, not the side. This will avoid wearing down the wheel and causing it to break.

DRAFT

Electrical Standard Operating Procedures				
	Disconnect Switch and Lock Out/ Tag Out	Connect/ Disconnect Wiring Related to Specific Pieces of Equipment	Measure Amperage	All Other Electrical
Carpenter Shop				
<input type="checkbox"/> Carpenter	X			
<input type="checkbox"/> Paint	X			
Environment				
<input type="checkbox"/> Alarms	X			
<input type="checkbox"/> Controls	X			
<input type="checkbox"/> HVAC	X	X	X	
Plumbing				
<input type="checkbox"/> Plumber	X			
<input type="checkbox"/> Heat/Cool	X			
Electric	X	X	X	X
Lock	X			
Zone	X			
District Energy	X	X	X	
Utility Locator	X			
Electrical Engineer			X	

Notes:

1. Specify voltages for the restrictions.