

B. Electrical Safety

1. Electric Codes and Safety Standards

The Occupational Safety and Health Administration (OSHA) standards form the basis of our electrical safety rules. These standards apply to general industry and construction. OSHA draws its standards from the National Electric Code (NEC), National Electric Safety Code (NESC) and from consensus bodies such as ASTM and ANSI. All employees should be familiar with these requirements as they apply to their areas of work.

2. Medical Services and First Aid

The Student Health Center and the Baton Rouge EMS unit provides emergency medical services and first aid on campus. To enhance our services for electrical workers who may be exposed to electric shock accidents, all electricians shall be trained in CPR and first aid treatment of severe shock and burn injuries.

3. Employee Training

Employees in occupations listed in the following table are believed to face electrical hazard risk and are required to be trained as shown.

Electrical Safety Training Requirements

Position	Electrical Safety (Awareness)	Electrical Safety (Basic)	Electrical Safety (Advanced)
Outside Electricians			X
Inside Electricians		X	
Craft Supervisors		X	
Craft Mid Managers		X	
Plumbers		X	
Carpenter and Painters		X	
Landscape Workers		X	
Asbestos/Lead Abatement		X	
Electrical Engineers and Technicians		X	
Power Plant Operators		X	

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All employees other than those listed above who may be exposed to electrical hazards	X		
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NOTE: Other employees who also may reasonably be expected to face comparable risk of injury due to electric shock or other electrical hazards must also be trained. The training required shall be of the classroom or on-the-job type.

- a. Employees shall be trained in and familiar with the electrical safety-related work practices covered in this manual that pertain to their respective job assignments. Training must be documented. Qualified persons (i.e. those permitted to work on or near exposed energized parts) shall, at a minimum, be trained in and familiar with the following:
 - i. The skills and techniques necessary to distinguish exposed live parts from other parts of electric equipment.
 - ii. The skills and techniques necessary to determine the nominal voltage of exposed live parts, and
 - iii. The clearance distances specified in the approach distances table and the corresponding voltages to which the qualified person will be exposed.
 - iv. Qualified persons whose work on energized equipment involves either direct or indirect contact shall be familiar with the proper use of special precautionary techniques, personal protective equipment, insulating and shielding materials, and insulated tools.

Note: The supervisor shall determine, through regular supervision and through inspections conducted on at least an annual basis, that each employee is complying with the safety-related work practices required by this manual. Employees must be retrained upon introduction of a new procedure or new equipment on which the employee has not been trained.

- b. Employees who work in areas where they are not normally exposed to electrical hazards shall be trained or made familiar with the requirements for unqualified workers to protect them around electrical installations. For example, landscape personnel who maintain the grounds around an electrical substation should be familiar with the safe approach distances for unqualified employees.
4. General Electrical Safety Precautions
- a. Existing conditions related to the safety of the work to be performed shall be determined before work on or near electric lines or equipment is started. Such conditions include, but are not limited to, the nominal voltages of lines and equipment, the presence of hazardous induced voltages, the presence and condition of protective grounds and equipment grounding conductors, the condition of poles, environmental conditions relative to safety, and the locations of circuits and equipment, including power and communication lines and fire protective signaling circuits. The employee in charge shall conduct a job briefing with the employees involved in an electrical job before they start each job. The briefing shall cover at

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- least the following subjects: hazards associated with the job, work procedures involved, special precautions, energy source controls, and personal protective equipment requirements.
- b. When an unqualified person is working on the ground or above 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 below. (An employee who is not trained to work near electrical circuits is considered to be unqualified):
 - i. For voltages to ground 50kV or below – 10 feet (305 cm);
 - ii. For voltages to ground over 50kV – 10 feet (305 cm) plus 4 inches (10 cm) for every 10kV over 50kV.
 - c. Any vehicle or mechanical equipment capable of having parts of its structure elevated near energized overhead lines shall be operated so that a clearance of 10 ft. (305 cm) is maintained. If the voltage is higher than 50kV, the clearance shall be increased 4 in. (10 cm) for every 10kV over that voltage. However, under any of the following conditions, the clearance may be reduced:
 - i. 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 shall be increased 4 in. (10 cm) for every 10 kV over that voltage.
 - ii. 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.
 - iii. If the equipment is an aerial lift insulated for the voltage involved, and if the work is performed by a qualified (trained) person, the clearance (between the uninsulated portion of the aerial lift and the power line) may be reduced to the distance given in the approach distances table above.
 - d. Employees standing on the ground may not contact the vehicle or mechanical equipment or any of its attachments, unless:
 - i. The employee is using protective equipment rated for the voltage; or
 - ii. The equipment is located so that no uninsulated part of its structure (that portion of the structure that provides a conductive path to employees on the ground) can come closer to the line than the clearance distances permitted above.

Note: 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 may not stand at the grounding location whenever there is a possibility of overhead line contact. Additional precautions, such as the use of barricades or insulation, shall be taken to

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protect employees from hazardous ground potentials, depending on earth resistivity and fault currents, which can develop within the first few feet or more outward from the grounding point.

- e. Work on electrical circuits and equipment should always be performed with the circuit or equipment de-energized and locked/tagged out. Only in special circumstances where the power cannot be reasonably turned off may work be performed on or near an exposed energized circuit. Safe procedures for de-energizing circuits and equipment shall be determined before circuits or equipment are de-energize using the following guidelines:
 - i. The circuits and equipment to be worked on shall 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 and tagging procedures.
 - ii. Stored electric energy which might endanger personnel shall be released. Capacitors shall be discharged and high capacitance elements shall be short-circuited and grounded, if the stored electric energy might endanger personnel.
Note: If the capacitors or associated equipment are handled in meeting this requirement, they shall be treated as energized.
 - iii. Stored non-electrical energy in devices that could reenergize electric circuit parts shall be blocked or relieved to the extent that the circuit parts could not be accidentally energized by the device.
 - iv. Each disconnecting means used to de-energize circuits and equipment on which work is to be performed shall be locked/tagged. When a lock is used, it shall be attached so as to prevent persons from operating the disconnecting means unless they resort to undue force or the use of tools. If a lock cannot be applied, or if the employee believes that tagging procedures will provide a level of safety equivalent to that obtained by the use of a lock, a tag may be used without a lock.
 - v. Each tag shall contain a statement prohibiting unauthorized operation of the disconnecting means and removal of the tag.
 - vi. A tag used without a lock, shall be supplemented by at least one additional safety measure (such as the removal of an isolating circuit element, blocking of a controlling switch, or opening of an extra disconnecting device) that provides a level of safety equivalent to that obtained by use of a lock
 - vii. A lock may be placed without a tag only where only one circuit or piece of equipment is de-energize, and the lockout period does not extend beyond the work shift.
 - viii. In order for equipment to be considered and worked as de-energize, a qualified person must operate the equipment operating controls or otherwise verify that the equipment cannot be restarted; and use test equipment to test the circuit elements and electrical parts of equipment to which employees will be exposed and verify that the circuit elements and equipment parts are de-energize. The test shall also determine if any energized condition exists as a

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result of inadvertently induced voltage or unrelated voltage backfeed even though specific parts of the circuit have been de-energized and presumed to be safe. If the circuit to be tested is over 600 volts, nominal, the test equipment shall be checked for proper operation immediately after this test.

- ix. To reenergize conductors or equipment, even momentarily, the 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
 - x. Employees exposed to the hazards associated with reenergizing the circuit or equipment shall be warned to stay clear of circuits and equipment.
 - xi. Each lock and tag shall be removed by the employee who applied it or under his or her direct supervision, unless the employee is absent from the workplace, in which case the lock or tag may be removed by a qualified person designated to perform this task after a visual determination that all employees are clear of the circuits and equipment.
An employee whose lock or tag has been removed shall be informed before he or she resumes work at the worksite.
- f. A trained (qualified) employee may not approach or take a conductive object without an approved insulating handle closer to energized electrical conductors than the distances in the chart below unless they are protected from harm by one of the following means:
- i. They are insulated from the conductor by wearing properly rated insulating gloves, or
 - ii. The energized part is insulated both from all other conductive objects at a different potential and from the person, or
 - iii. The person is insulated from all conductive objects at a potential different from that of the energized part (live line work).

Approach Distances for Qualified Employee – Alternating Current

Voltage Range (phase to phase)	Minimum Approach Distance
300V and less	Avoid contact.
Over 300V, not over 750V	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. (46 cm)
Over 15KV, not over 37 KV	3 ft. 0 in. (61 cm)
Over 37KV, not over 87.5KV	3 ft. 6 in. (91 cm)
Over 87.5KV, not over 121KV	4 ft. 0 in. (122 cm)

- g. Employees may not enter spaces containing exposed energized parts, unless illumination is provided that enables the employees to perform the work safely. Where

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- lack of illumination or an obstruction precludes observation of the work to be performed, employees shall not perform tasks near exposed energized parts. Employees shall not reach blindly into areas which may contain energized parts. The points of control shall be so located that persons are not likely to come in contact with any live part or moving part of the equipment while turning on the lights.
- h. When an employee works in a confined or enclosed space (such as a manhole or vault) that contains exposed energized the employee shall use protective shields, protective barriers, or insulating materials as necessary to avoid inadvertent contact with these parts. Doors, hinged panels, and the like shall be secured to prevent their swinging into an employee and causing the employee to contact exposed energized parts.
 - i. Conductive materials and equipment that are in contact with any part of an employee's body shall be handled in a manner that will prevent them from contacting exposed energized conductors or circuit parts. If an employee must handle long dimensional conductive objects (such as ducts and pipes) in areas with exposed live parts, work practices (such as the use of insulation, guarding, and material handling techniques) shall be used to minimize the hazard.
 - j. Portable ladders shall have nonconductive siderails if they are used where the employee or the ladder could contact exposed energized parts.
 - k. Conductive articles of jewelry and clothing (such a 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.
 - l. 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 barriers) are provided. 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 procedures are followed which will prevent electrical contact.
 - m. Only a qualified (trained) person may defeat an electrical safety interlock, and then only temporarily while he or she is working on the equipment. The interlock system shall be returned to its operable condition when this work is completed.
 - n. Portable electrical equipment, including power tools and extension cords, shall be handled in a manner which will not cause damage. Flexible electric cords connected to equipment may not be used for raising or lowering the equipment. Flexible cords may not be fastened with staples or otherwise hung in such a fashion as could damage the outer jacket or insulation.
 - o. Portable cord and plug connected equipment and extension cords shall be visually inspected before use for external defects (such as loose parts, deformed and missing pins, or damage to outer jacket or insulation) and for evidence of possible internal damage (such as pinched or crushed outer jacket). Cord and plug connected equipment and 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.

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- p. If there is a defect or evidence of damage that might expose an employee to injury, the defective or damaged item shall be removed from service, and no employee may use it until repairs and tests necessary to render the equipment safe have been made.
- q. An extension cord used with grounding type equipment shall contain an equipment grounding conductor. Attachment plugs and receptacles may not be connected or altered in a manner which would prevent proper continuity of the equipment grounding conductor at the point where plugs are attached to receptacles. Adapters which interrupt the continuity of the equipment grounding connection may not be used.
- r. 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, shall be approved for those locations.
- s. Employees' hands may not be wet when plugging and unplugging flexible cords and cord and plug connected equipment, if energized equipment is involved. Plugs and receptacles shall be dry when being handled without protective gloves.
- t. Locking type connectors shall be properly secured after connection.
- u. Load rated switches, circuit breakers, or other devices shall be used for the opening, reversing, or closing of circuits under load conditions. 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.
- v. After a circuit is de-energized by a circuit protective device, the circuit may not be manually reenergized until it has been determined that the equipment and circuit can be safely energized. The repetitive manual reclosing of circuit breakers or reenergizing circuits through replaced fuses is prohibited. When it can be determined that the automatic operation of a device was caused by an overload rather than a fault condition, no examination of the circuit or connected equipment is needed before the circuit is reenergized.
- w. Overcurrent protection of circuits and conductors may not be modified to increase the permissible current above the rating of the conductors/equipment.
- x. Only qualified persons may perform testing work on electric circuits or equipment.
- y. Test instruments and equipment and all associated leads shall be properly rated and 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 shall be removed from service, and no employee may use it until repairs and tests necessary to render the equipment safe have been made.
- z. Where flammable materials are present only occasionally, electric equipment capable of igniting them shall not be used, unless measures are taken to prevent hazardous conditions from developing. Such materials include, but are not limited to: flammable gases, vapors, or liquids; combustible dust; and ignitable fibers or flyings.
Note: Electrical installation requirements for locations where flammable materials are present on a regular basis are contained in NFPA 70.
- aa. Before employees work on power line voltage capacitors, the capacitors shall be disconnected from energized sources and, after a wait of at least 5 minutes from the time of disconnection, short-circuited.

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- bb. Before the capacitor units are handled, each unit in series-parallel capacitor banks shall be short-circuited between all terminals and the capacitor case or its rack. If the cases of capacitors are on ungrounded substation racks, the racks shall be bonded to ground.
- cc. Any line to which capacitors are connected shall be short-circuited before it is considered de-energize.
- dd. The secondary of a current transformer may not be opened while the transformer is energized. If the primary of the current transformer cannot be de-energize before work is performed on an instrument, a relay, or other section of a current transformer secondary circuit, the circuit shall be bridged so that the current transformer secondary will not be opened.
- ee. Before work is begun in the vicinity of vehicular or pedestrian traffic that may endanger employees, warning signs or flags and other traffic control devices shall be placed in conspicuous locations to alert and channel approaching traffic. Where additional employee protection is necessary, barricades shall be used.
- ff. If there is a possibility of voltage backfeed from sources of cogeneration or from the secondary system (for example, backfeed from more than one energized phase feeding a common load), de-energizing and grounding shall apply if the lines or equipment are to be worked as de-energize, and the energized work procedures apply if the lines or equipment are to be worked as energized.
- gg. Hydraulic fluids used for the insulated sections of equipment shall provide insulation for the voltage involved.

5. Electrical Installations

- a. Each disconnecting means for motors and appliances and each service, feeder, and branch circuit, at its disconnecting means or overcurrent device, shall be durably and legibly marked to indicate its purpose, unless located and arranged so the purpose is evident.
- b. Sufficient access and working space shall be provided and maintained about all electric equipment to permit ready and safe operation and maintenance of such equipment. At least one entrance of sufficient area shall be provided to give access to the working space about electric equipment.
- c. Working space around access to live parts operating at 600 volts or less and likely to require operation, examination, adjustment, servicing, or maintenance while energized may not be less than indicated in the following table:

WORKING CLEARANCES AROUND ELECTRICAL EQUIPMENT

Nominal voltage to ground (volts)	Minimum clear distance for condition
0-150	3 ft. 3 ft. (exposed to contact one side only)
151-600	3.5 ft. (exposed to contact one side, grounded surface on other side) 4 ft. (exposed to contact both sides)
600 – 2500	3 ft. (exposed to contact one side only)

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4 ft. (exposed to contact one side, grounded surface other side)

5 ft. (exposed to contact both sides)

NOTE: 1. Working space may not be used for storage. When normally enclosed live parts are exposed for inspection or servicing, the working space, if in a passageway or general open space, shall be suitably guarded. The minimum headroom of working spaces about service equipment, switchboards, panel-boards, or motor control centers shall be 6 feet 3 inches for 600 volts or less, 6 feet 6 inches for over 600 volts.

NOTE: 2. Where energized parts are exposed, the minimum clear workspace may not be less than 3 feet wide (measured parallel to the equipment). Where rear access is required to work on de-energize parts on the back of enclosed equipment, a minimum working space of 30 inches horizontally shall be provided.

- d. A disconnecting means shall be located in sight from a motor controller location for equipment at 600 volts or less. If the motor controller is marked with a warning label giving the location and identification of the disconnecting means which can be locked in the open position, the disconnecting means does not have to be in sight on circuits over 600 volts.
 - i. If a motor and the driven machinery are not in sight from the controller location, the installation shall comply with one of the following conditions:
 1. The controller disconnecting means shall be capable of being locked in the open position.
 2. A manually operable switch that will disconnect the motor from its source of supply shall be placed in sight from the motor location.
 - ii. A disconnecting means shall plainly indicate whether it is in the open (off) or closed (on) position, shall be accessible, and shall disconnect the motor and controller from all ungrounded supply conductors.
 - iii. An individual disconnecting means shall be provided for each motor, but a single disconnecting means may be used for a group of motors under any one of the following conditions:
 1. If a number of motors drive special parts of a single machine or piece of apparatus, such as a metal or woodworking machine, crane, or hoist
 2. If a group of motors is under the protection of one set of branch-circuit protective devices; or
 3. if a group of motors is in a single room in sight from the location of the disconnecting means.
 - iv. Motors, motor-control apparatus, and motor branch-circuit conductors shall be protected against overheating due to motor overloads or failure to start, and against short-circuits or ground faults. These provisions shall not require overload protection that will stop a motor where a shutdown is likely to introduce additional or increased hazards, as in the case of fire pumps, or where continued operation of a motor is necessary for a safe shutdown of

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- equipment or process and motor overload sensing devices are connected to a supervised alarm.
- v. A disconnecting means shall be provided in the supply circuit for each motor-generator arc welder, and for each AC transformer and DC rectifier arc welder which is not equipped with a disconnect mounted as an integral part of the welder.
 - vi. A switch or circuit breaker shall be provided by which each resistance welder and its control equipment can be isolated from the supply circuit. The ampere rating of this disconnecting means may not be less than the supply conductor ampacity.
- e. Except as required or permitted elsewhere in this manual, live parts of electric equipment operating at 50 to volts or more shall be guarded against accidental contact by approved cabinets or other forms of approved enclosures, or by any of the following means:
- i. By location in a room, vault, or similar enclosure that is accessible only to qualified persons.
 - ii. By suitable permanent, substantial partitions or screens so arranged that only qualified persons will have access to the space within reach of the live parts. Any openings in such partitions or screens shall be so sized and located that persons are not likely to come into accidental contact with the live parts or to bring conducting objects into contact with them.
 - iii. By location on a suitable balcony, gallery, or platform so elevated and arranged as to exclude unqualified persons.
 - iv. By elevation of 8 feet or more above the floor or other working surface for 600 volts or less.
- f. In locations where electric equipment would be exposed to physical damage, enclosures or guards shall be so arranged and of such strength as to prevent such damage.
- g. Entrances to rooms and other guarded locations containing exposed live parts shall be marked with conspicuous warning signs forbidding unqualified persons to enter. In addition, the entrances to all buildings, rooms, or enclosures containing exposed live parts or exposed conductors operating at over 600 volts, nominal, shall be kept locked or shall be under the observation of a qualified person at all times. At voltages over 600 volts a wall, screen, or fence less than 8 feet in height is not considered to prevent access unless it has other features that provide a degree of isolation equivalent to an 8 foot fence. Ventilating or similar openings in metal-enclosed equipment shall be designed so that foreign objects inserted through these openings will be deflected from energized parts.
- h. Electrical installations that are open to unqualified persons shall be marked with appropriate caution signs and be constructed as metal-enclosed equipment or enclosed in a vault or an area, access to which is controlled by a lock. If equipment is exposed to physical damage from vehicular traffic, suitable guards shall be provided to prevent such damage.

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- i. Unguarded live parts above working space at voltages 600 volts through 6000 volts shall be maintained at elevations not less than 8 feet 6 inches (8 feet if constructed before April 16, 1991).
- j. At least one entrance not less than 24 inches wide and 6 feet 6 inches high shall be provided to give access to the working space about electric equipment. On switchboard and control panels exceeding 48 inches in width, there shall be one entrance at each end of such board where practicable. Where bare energized parts at any voltage or insulated energized parts above 600 volts are located adjacent to such entrance, they shall be suitably guarded.
- k. Permanent ladders or stairways shall be provided to give safe access to the working space around electric equipment installed on platforms, balconies, mezzanine floors, or in attic or roof rooms or spaces.
- l. Temporary electrical power and lighting wiring methods may be of a class less than would be required for a permanent installation. Temporary electrical power and lighting installations 600 volts, nominal, or less may be used only:
 - i. During and for remodeling, maintenance, repair, or demolition of buildings, structures, or equipment, and similar activities;
 - ii. For experimental or development work, and
 - iii. For a period not to exceed 90 days for Christmas decorative lighting, carnivals, and similar purposes.
- m. Temporary wiring over 600 volts, nominal, may be used only during periods of tests, experiments, or emergencies.
- n. Temporary wiring feeders shall originate in an approved distribution center. The conductors shall be run as multi conductor cord or cable assemblies, or, where not subject to physical damage, they may be run as open conductors on insulators not more than 10 feet apart.
- o. Temporary branch circuits shall originate in an approved power outlet or panelboard. Conductors shall be multi conductor cord or cable assemblies. Branch-circuit conductors used outdoors must be protected against traffic damage and routed safely away from damage producing traffic or activities.
- p. Temporary wiring receptacles shall be of the grounding type. Unless installed in a complete metallic raceway, each branch circuit shall contain a separate equipment grounding conductor and all receptacles shall be electrically connected to the grounding conductor.
- q. No bare conductors nor earth returns may be used for the wiring of any temporary circuit.
- r. Suitable disconnecting switches or plug connectors shall be installed to permit the disconnection of all ungrounded conductors of each temporary circuit.
- s. Temporary lamps for general illumination shall be protected from accidental contact or breakage. Protection shall be provided by elevation of at least 7 feet from normal working surface or by a suitable fixture or lampholder with a guard.
- t. Flexible cords and cables used in temporary wiring shall be protected from accidental damage. Sharp corners and projections shall be avoided. Where passing through doorways or other pinch points, flexible cords and cables shall be provided with protection to avoid damage.

6. Special Rules for Power Distribution Circuits

LSU primarily utilizes an underground distribution system of 4,160 volts. Some overhead circuits exist in surrounding areas and may operate at voltages greater than 4,160 volts. The rules in this section pertain to work on the underground and overhead distribution circuits, including the service wires and conductors from the transformers to the various buildings and facilities. The rules are derived from OSHA standard 29CFR1910.269, Electrical Power Generation, Transmission and Distribution.

- a. Insulating blankets, matting, covers, line hose, gloves, and sleeves made of rubber shall meet the following ASTM Standards for Electrical Protective Equipment for Workers:

American Society for Testing and Materials (ASTM) D 120-87, Specification for Rubber Insulating Gloves.

ASTM D 178-88, Specification for Rubber Insulating Matting.

ASTM D 1048-88a, Specification for Rubber Insulating Blankets.

ASTM D 1049-88, Specification for Rubber Insulating Covers.

ASTM D 1050-90, Specification for Rubber Insulating Line Hose.

ASTM D 1051-87, Specification for Rubber Insulating Sleeves.

- b. Electrical protective equipment shall be maintained in a safe, reliable condition.
- c. Maximum use voltages shall conform to those listed in the table below:

RUBBER INSULATING EQUIPMENT VOLTAGE REQUIREMENTS

Class of equipment	Maximum use voltage*	Retest voltage	Retest voltage
	a – c Phase to phase volts	(a – c – rms)	(d – c – avg.)
0	1,000	5,000	20,000
1	7,500	10,000	40,000
2	17,000	20,000	50,000
3	26,500	30,000	60,000
4	36,000	40,000	70,000

NOTE: Maximum use voltage can be the phase to ground voltage in some circumstances. Check with Occupational and Environmental Safety before using the phase to ground voltage to rate gloves and other electrical equipment.

- d. Insulating equipment shall be inspected for holes, tears, punctures, cuts, ozone damage, embedded objects, swelling, softening, hardening, stickiness, filthiness, and other damage before each day's use and immediately following any incident that can reasonably be

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suspected of having caused damage. Insulating gloves shall be given an air test, along with the inspection.

- e. Insulating equipment shall be stored in such a location and in such a manner as to protect it from light, temperature extremes, excessive humidity, ozone, and other injurious substances and conditions.
- f. Protector gloves shall be worn over insulating gloves.
- g. Electrical protective equipment shall be subjected to periodic electrical tests. Test voltages and the maximum intervals between tests shall be in accordance with the table above on test voltages and the table below on test intervals:

RUBBER INSULATING EQUIPMENT TEST INTERVALS

Type of equipment	Type of equipment
Rubber insulating line hose	Upon indication that insulating value is suspect.
Rubber insulating covers	Upon indication that insulating value is suspect.
Rubber insulating blankets	Before first issue and every 12 months thereafter.
Rubber insulating gloves	Before first issue and every 6 months thereafter
Rubber insulating sleeves	Before first issue and every 12 months thereafter

- h. Insulating equipment failing to pass inspections or electrical tests may not be used by employees, except as follows:
 - i. Rubber insulating line hose may be used in shorter lengths with the defective portion cut off.
 - j. Rubber insulating blankets may be repaired using a compatible patch that results in physical and electrical properties equal to those of the blanket.
 - k. Rubber insulating blankets may be salvaged by severing the defective area from the undamaged portion of the blanket. The resulting undamaged area may not be smaller than 22 inches by 22 inches (560 mm by 560 mm) for Class 1, 2, 3, and 4 blankets.
 - l. Rubber insulating gloves and sleeves with minor physical defects, such as small cuts, tears, or punctures, may be repaired by the application of a compatible patch. Also, rubber insulating gloves and sleeves with minor surface blemishes may be repaired with a compatible liquid compound. The patched area shall have electrical and physical properties equal to those of the surrounding material. Repairs to gloves are permitted only in the area between the wrist and the reinforced edge of the opening.

Note: Repaired insulating equipment shall be retested before it may be used by employees.

- i. The department shall certify that equipment has been tested and shall identify the equipment that passed the test and the date it was tested. Marking of equipment and

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entering the results of the tests and the dates of testing onto logs are two acceptable means of meeting this requirement.

- j. Safe work practices for entry into and work in enclosed spaces (manholes and unvented vaults) and for rescue of employees from such spaces shall be employed:
 - i. Employees who enter enclosed spaces or who serve as attendants shall be trained in the hazards of enclosed space entry, in enclosed space entry procedures, and in enclosed space rescue procedures.
 - ii. Equipment to ensure the prompt and safe rescue of employees from the enclosed space shall be available.
 - iii. Before any entrance cover to an enclosed space is removed, the employee in charge shall determine whether it is safe to do so by checking for the presence of any atmospheric pressure or temperature differences. He/she shall also evaluate whether there might be a hazardous atmosphere in the space by having the space checked for oxygen deficiency, flammable gases, and any toxic agent reasonably foreseeable. Any conditions making it unsafe to remove the cover or enter shall be eliminated before the cover is removed and entry is made.
 - iv. “Hazardous atmosphere” means an atmosphere that may expose employees to the risk of death, incapacitation, impairment of ability to self-rescue (that is, escape unaided from an enclosed space), injury, or acute illness from one or more of the following causes:
 1. Flammable gas, vapor, or mist in excess of 10 percent of its lower flammable limit (LFL);
 2. Airborne combustible dust at a concentration that meets or exceeds its LFL;
Note: This concentration may be approximated as a condition in which the dust obscures vision at a distance of 5 feet (1.52 m) or less.
 3. Atmospheric oxygen concentration below 19.5 percent or above 23.5 percent;
 4. Atmospheric concentration of any substance for which a dose or a permissible exposure limit published in OSHA’s Subpart G, Occupational Health and Environmental Control, or in OSHA’s Subpart Z, Toxic and Hazardous Substances, of this Part and which could result in employee exposure in excess of its dose or permissible exposure limit;
Note: An atmospheric concentration of any substance that is not capable of causing death, incapacitation, impairment of ability to self-rescue, injury, or acute illness due to its health effects is not covered by this provision.
 5. Any other atmospheric condition that is immediately dangerous to life or health.
Note: For air contaminants for which OSHA has not determined a dose or permissible exposure limit, other sources of information, such as Material Safety Data Sheets that comply with the Hazard Communication Standard, 1910.1200, published information, and internal documents can provide guidance in establishing acceptable atmospheric conditions.
 - v. When covers are removed from enclosed spaces, the opening shall be promptly guarded by a railing, temporary cover, or other barrier intended to prevent an accidental fall through the opening and to protect employees working in the space from objects entering the space.

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- e. While work is being performed in the enclosed space, a person with first aid training shall be immediately available outside the enclosed space to render emergency assistance.
- f. If open flames are used in enclosed spaces, a test for flammable gases and vapors shall be made immediately before the open flame device is used and at least once per hour while the device is used in the space. Testing shall be conducted more frequently if conditions present in the enclosed space indicate that once per hour is insufficient to detect hazardous accumulations of flammable gases or vapors.
- g. Live line tools, body belts, safety straps, lanyards, lifelines, and body harnesses shall be inspected before use each day to determine that the equipment is in safe working condition. Defective equipment may not be used. Lifelines shall be protected against being cut or abraded. Fall arrest equipment, work positioning equipment, or travel restricting equipment shall be used by employees working at elevated locations more than 4 feet (1.2 m) above the ground on poles, towers, or similar structures if other fall protection has not been provided. Qualified employees may climb or position on overhead line/substation structures without use of fall protection.
 - i. When stopping or arresting a fall, personal fall arrest systems shall limit the maximum arresting force on an employee to 900 pounds (4 kN) if used with a body belt or 1800 pounds (8 kN) if used with a body harness.
 - ii. Personal fall arrest systems shall be rigged such that an employee can neither free fall more than 6 feet (1.8 m) nor contact any lower level.
 - iii. If vertical lifelines or droplines are used, not more than one employee may be attached to any one lifeline.
 - iv. Snaphooks may not be connected to loops made in webbing-type lanyards, nor connected to each other.
- h. Cord-and plug-connected equipment supplied by a source other than premises wiring shall:
 - i. Be equipped with a cord containing an equipment grounding conductor connected to the tool frame and to a means for grounding the other end; or
 - ii. Be of the double-insulated type; or
 - iii. Be connected to the power supply through an isolating transformer with an ungrounded secondary.
- i. Portable and vehicle-mounted generators used to supply cord- and plug-connected equipment shall only supply equipment located on the generator or the vehicle and cord- and plug-connected equipment through receptacles mounted on the generator or the vehicle.
- j. The non-current-carrying metal parts of equipment and the equipment grounding conductor terminals of the receptacles shall be bonded to the generator frame; and, in the case of vehicle-mounted generators, the frame of the generator shall be bonded to the vehicle frame. Any neutral conductor shall be bonded to the generator frame.
- k. Safe operating pressures for hydraulic and pneumatic tools, hoses, valves, pipes, filters, and fittings may not be exceeded, and these items must be free from defects to be used. Hoses may not be kinked and pressure shall be released before

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connections are broken, unless quick acting, self-closing connectors are used. Employees may not use any part of their bodies to locate or attempt to stop a hydraulic leak.

- l. A hydraulic or pneumatic tool used where it may contact exposed live parts shall be designed and maintained for such use.

Note: The hydraulic system supplying a hydraulic tool used more than 35 feet (10.7 m) above the ground where it may contact exposed live parts shall provide protection against loss of insulating value for the voltage involved due to the formation of a partial vacuum in the hydraulic line.

- m. A pneumatic tool used on energized electrical lines or equipment or used where it may contact exposed live parts shall provide protection against the accumulation of moisture in the air supply.
- n. Live-line tools shall:
 - i. be constructed using materials meeting ASTM F711-89, Standard Specification for Fiberglass-Reinforced Plastic (FRP) Rod and Tube Used in Live-Line Tools.
 - ii. be wiped clean and visually inspected for defects before use each day.
 - iii. be removed from service and examined and tested if defects are found
 - iv. be removed from service and inspected, waxed and cleaned every two years if it is used for “primary” protection. After inspection, it shall be electrically tested if the tool:
 1. is made from hollow FRP (fiberglass reinforced product) tube products or wood, or
 2. is found to have defects during the inspection
 - v. The voltage applied during the tests shall be as follows:
 1. 75,000 volts per foot (2461 volts per centimeter) of length for 1 minute if the tool is made of fiberglass, or
 2. 50,000 volts per foot (1640 volts per centimeter) of length for 1 minute if the tool is made of wood.
- o. In areas not restricted to qualified persons only, materials or equipment may not be stored closer to energized lines or exposed energized parts of equipment than the following distances plus an amount providing for the maximum sag and side swing of all conductors and providing for the height and movement of material handling equipment:
 - i. For lines and equipment energized at 50 kV or less, the distance is 10 feet (305 cm).
 - ii. For lines and equipment energized at more than 50 kV, the distance is 10 feet (305 cm) plus 4 inches (10 cm) for every 10 kV over 50 kV.
- p. In areas restricted to qualified employees, material may not be stored within the working space about energized lines or equipment.
- q. Only qualified employees may work on or with exposed energized lines or parts of equipment. Only qualified employees may work in areas containing unguarded, uninsulated energized lines or parts of equipment operating at 50 volts or more. Electric lines and equipment shall be considered and treated as energized unless de-energized and locked or tagged out, and grounded where appropriate.

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- r. At least two employees shall be present while the following types of work are being performed:
 - i. Installation, removal, or repair of lines that are energized at more than 600 volts,
 - ii. Installation, removal, or repair of de-energize lines and equipment, such as transformers, capacitors, and regulators, if an employee is exposed to contact with other parts energized at more than 600 volts,
 - iii. Work involving the use of mechanical equipment, other than insulated aerial lifts, near parts energized at more than 600 volts, and

Exceptions to two person rule:

- iv. Routine switching of circuits, if the employer can demonstrate that conditions at the site allow this work to be performed safely,
 - v. Work performed with live-line tools if the employee is positioned so that he or she is neither within reach of nor otherwise exposed to contact with energized parts, and
 - vi. Emergency repairs to the extent necessary to safeguard the general public.
- s. Each employee, to the extent that other safety-related conditions at the worksite permit, shall work in a position from which a slip or shock will not bring the employee's body into contact with exposed, uninsulated parts energized at a potential different from the employee.
- t. Connections shall generally be made so that minimum handling is performed on energized conductors.
- u. Employees must removed or render nonconductive any exposed articles, such as key or watch chains, rings, wristwatches, and necklaces.
- v. Electric arcs produce tremendous heat and results in serious injury in many cases. Injury can also be the result of melting and burning clothing resulting from an arc. For this reason, employees who are exposed to the hazards of flames or electric arcs shall not wear clothing that, when exposed to flames or electric arcs, could increase the extent of injury that would be sustained by the employee. The following fabrics, either alone or in blends are prohibited from being worn by such workers: acetate, nylon, polyester, and rayon.
Exception: where the fabric has been treated to withstand the arc without melting, dripping or burning or where the clothing is worn in such a manner as to eliminate the hazard.
- w. Fuse handling. When fuses must be installed or removed with one or both terminals energized at more than 300 volts or with exposed parts energized at more than 50 volts, the employee shall use tools or gloves rated for the voltage. When expulsion-type fuses are installed with one or both terminals energized at more than 300 volts, the employee shall wear eye protection, use a tool rated for the voltage, and stay clear of the exhaust path of the fuse barrel.
- x. Metal parts of equipment or devices, such as transformer cases and circuit breaker housings, shall be treated as energized at the highest voltage to which they are exposed, unless the employee inspects the installation and determines that these parts are grounded before work is performed.

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- y. Devices used to open circuits under load conditions shall be designed to interrupt the current involved.
- z. When de-energizing lines and equipment for work on power distribution lines and other power equipment, the following practices must be used in addition to those provided elsewhere in this manual:
 - i. A qualified and authorized person shall be designated to issue the clearance to work on lines or equipment
 - ii. Protective grounds shall be installed except where greater hazards will be created in certain underground installations.
 - iii. If two or more independent crews will be working on the same lines or equipment, each crew shall independently establish a clearance for their work.
 - iv. To transfer the clearance, the employee in charge (or, if the employee in charge is forced to leave the worksite due to illness or other emergency, the employee's supervisor) shall inform the person who issued the clearance; employees in the crew shall be informed of the transfer; and the new employee in charge shall be responsible for the clearance.
- aa. For employees to work lines or equipment as de-energize, the lines or equipment shall be de-energize using proper procedures grounded as specified below. However, if the supervisor can demonstrate that installation of a ground is impracticable or that the conditions resulting from the installation of a ground would present greater hazards than working without grounds, the lines and equipment may be treated as de-energize provided the lines and equipment have been de-energize using proper procedures, there is no possibility of contact with other energized sources, and the hazard of induced voltage is not present. When work is performed on a cable at a location remote from the cable terminal, the cable may not be grounded at the cable terminal if there is a possibility of hazardous transfer of potential should a fault occur.
- bb. Temporary protective grounds shall be placed at such locations and arranged in such a manner as to prevent each employee from being exposed to hazardous differences in electrical potential:
 - i. Grounding sets must meet ASTM F855-1990, Standard Specifications for Temporary Grounding Systems to be Used on De-Energized Electric Power Lines and Equipment.
 - ii. Protective grounds shall have an impedance low enough to cause immediate operation of protective devices in case of accidental energizing of the lines or equipment
 - iii. Before any ground is installed, lines and equipment shall be tested and found absent of nominal voltage, unless a previously installed ground is present.
 - iv. When a ground is to be attached to a line or to equipment, the ground-end connection shall be attached first, and then the other end shall be attached by means of a live-line tool.

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- v. When a ground is to be removed, the grounding device shall be removed from the line or equipment using a live-line tool before the ground-end connection is removed.
- vi. Grounds may be removed temporarily during tests. During the test procedure, the employee shall use insulating equipment and remain isolated from any hazards involved, and institute any additional measures as may be necessary to protect each exposed employee in case the previously grounded lines and equipment become energized.

7. High Voltage Testing

- a. Permanent test areas shall be guarded by walls, fences, or barriers designed to keep employees out of the test areas.
- b. In field testing, or at a temporary test site where permanent fences and gates are not provided, one of the following means shall be used to prevent unauthorized employees from entering: (The barriers shall be removed when the protection they provide is no longer needed)
 - i. The test area shall be guarded by the use of distinctively colored safety tape that is supported approximately waist high and to which safety signs are attached, or
 - ii. The test area shall be guarded by a barrier or barricade that limits access to the test area, or
 - iii. The test area shall be guarded by one or more test observers stationed so that the entire area can be monitored.
- c. The test operator in charge shall conduct these routine safety checks before each series of tests and shall verify at least the following conditions:
 - i. That barriers and guards are in workable condition and are properly placed to isolate hazardous areas;
 - ii. That system test status signals, if used, are in operable condition;
 - iii. That test power disconnects are clearly marked and readily available in an emergency;
 - iv. That ground connections are clearly identifiable, and that all conductive parts accessible to the test operator during the time the equipment is operating at high voltage will be maintained at ground potential except for portions of the equipment that are isolated from the test operator by guarding. (Visible grounds shall be applied before work is performed on the circuit or item or apparatus under test)
 - v. That personal protective equipment is provided and used as required by this manual; and
 - vi. That signal, ground, and power cables are properly separated and that a separate isolated ground-return path is provided for the current impressed

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during the test (unless the separate path is impractical and the employee is protected from step and touch potentials).

- vii. That if a test trailer or vehicle is used, it is grounded.

8. Overhead Power Line Work

- a. Before elevated structures, such as poles or towers, are subjected to such stresses as climbing or the installation or removal of equipment may impose, the employee shall ascertain that the structures are capable of sustaining the additional or unbalanced stresses. If the pole or other structure cannot withstand the loads which will be imposed, it shall be braced or otherwise supported so as to prevent failure.
- b. When poles are set, moved, or removed near exposed energized overhead conductors, the pole may not contact the conductors. Each employee shall wear electrical protective equipment or use insulated devices when handling the pole and avoid contact the pole with uninsulated parts of his or her body.
- c. To protect employees from falling into holes into which poles are to be placed, the holes shall be attended by employees or physically guarded whenever anyone is working nearby.
- d. When installing conductors, employees shall minimize the possibility that conductors and cables being installed or removed will contact energized power lines or equipment. Conductors, cables, and pulling and tensioning equipment shall be grounded and/or barricaded during the work, and reclosing relays on adjacent circuits will be disabled.
- e. Load ratings of stringing lines, pulling lines, conductor grips, load-bearing hardware and accessories, rigging, and hoists may not be exceeded, and pulling lines and accessories shall be repaired or replaced when defective. Employees will not stand directly under conductors or on the crossarm while the conductors are being pulled in.
- f. Reliable communications, through two-way radios or other equivalent means, shall be maintained between the reel tender and the pulling rig operator, and the pulling rig may only be operated when it is safe to do so.
- g. Employees shall abide by rules in this manual for mechanical equipment while operating such equipment near overhead lines.
- h. Employees shall not perform live line, barehand work.
- i. Tree trimming rules for work near overhead lines are shown elsewhere in this manual and shall be followed by employees while performing tree trimming work.

9. Underground Electrical Work

- a. A ladder or other climbing device shall be used to enter and exit a manhole or subsurface vault exceeding 4 feet (122 cm) in depth. No employee may climb into or out of a manhole or vault by stepping on cables or hangers.
- b. Equipment used to lower materials and tools into manholes or vaults shall be capable of supporting the weight to be lowered and shall be checked for defects before use. Before tools or material are lowered into the opening for a manhole or

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- vault, each employee working in the manhole or vault shall be clear of the area directly under the opening.
- c. While work is being performed in a manhole containing energized electric equipment, an employee with first aid and CPR training meeting paragraph (b)(1) of this section shall be available on the surface in the immediate vicinity to render emergency assistance. Occasionally, the employee on the surface may briefly enter a manhole to provide assistance, other than emergency. For the purpose of inspection, housekeeping, taking readings, or similar work, an employee working alone may enter, for brief periods of time, a manhole where energized cables or equipment are in service, if the employee is protected from all electrical hazards. Reliable communications, through two-way radios or other equivalent means, shall be maintained among all employees involved in the job
 - d. Only qualified (trained) employees may enter manholes containing unguarded, uninsulated energized lines or parts of electric equipment operating at 50 volts or more.
 - e. If duct rods are used, they shall be installed in the direction presenting the least hazard to employees. An employee shall be stationed at the far end of the duct line being rodded to ensure that the required minimum approach distances are maintained.
 - f. When multiple cables are present in a work area, the cable to be worked shall be identified by electrical means, unless its identity is obvious by reason of distinctive appearance or location or by other readily apparent means of identification. Cables other than the one being worked shall be protected from damage.
 - g. Energized cables that are to be moved shall be inspected for defects.
 - h. Where a cable in a manhole has one or more abnormalities that could lead to or be an indication of an impending fault, the defective cable shall be de-energize before any employee may work in the manhole, except when service load conditions and a lack of feasible alternatives require that the cable remain energized. In that case, employees may enter the manhole provided they are protected from the possible effects of a failure by shields or other devices that are capable of containing the adverse effects of a fault in the joint.
Note: Abnormalities such as oil or compound leaking from cable or joints, broken cable sheaths or joint sleeves, hot localized surface temperatures of cables or joints, or joints that are swollen beyond normal tolerance are presumed to lead to or be an indication of an impending fault.
 - i. When work is performed on buried cable or on cable in manholes, metallic sheath continuity shall be maintained or the cable sheath shall be treated as energized.
 - j. Excavated areas shall be protected with barricades.
 - k. At night, warning lights shall be prominently displayed.

10. Power Substation Installations and Worker Rules

- a. Access and working space in substations shall be in accordance with the National Electrical Safety Code (ANSI C2-1987). This access and working space shall be adequate to permit ready and safe operation and maintenance of such equipment,

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- and to facilitate the minimum approach distances required by these rules. Consideration shall be given to operation of switches with live line tools.
- b. Where installations were installed before 1987, the installation can remain in service if:
 - i. The installation conforms to the edition of ANSI C2 that was in effect at the time the installation was made,
 - ii. The configuration of the installation enables employees to maintain the minimum approach distances required by this manual while they are working on exposed, energized parts, and
 - iii. The precautions taken when work is performed on the installation provide protection equivalent to the protection that would be provided by access and working space meeting ANSI C2-1987.
 - c. When draw-out-type circuit breakers are removed or inserted, the breaker shall be in the open position. The control circuit shall also be rendered inoperative, if the design of the equipment permits. Employees racking in or racking out draw-out-type circuit breakers shall:
 - i. shall wear flame resistant outer garments and face protection at 480 volts
 - ii. shall wear a flame resistant switching suit and face protection at 4160 volts or above
 - d. Conductive fences around substations shall be grounded. When a substation fence is expanded or a section is removed, fence grounding continuity shall be maintained, and bonding shall be used to prevent electrical discontinuity.
 - e. Rooms and spaces in which electric supply lines or equipment are installed shall meet the requirements of paragraphs ci through cv below under the following conditions:
 - i. If exposed live parts operating at 50 to 150 volts to ground are located within 8 feet of the ground or other working surface inside the room or space; or
 - ii. If live parts operating at 151 to 600 volts and located within 8 feet of the ground or other working surface inside the room or space are guarded only by location or
 - iii. If live parts operating at more than 600 volts are located within the room or space, unless the live parts are enclosed within approved metal clad equipment or they are installed at a height above ground and any other working surface that provides protection at the voltage to which they are energized corresponding to the protection provided by an 8-foot height at 50 volts.
 1. The rooms and spaces shall be so enclosed within fences, screens, partitions, or walls as to minimize the possibility that unqualified persons will enter.
 2. Signs warning unqualified persons to keep out shall be displayed at entrances to the rooms and spaces.
 3. Entrances to rooms and spaces that are not under the observation of an attendant shall be kept locked.

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4. Unqualified persons may not enter the rooms or spaces while the electric supply lines or equipment are energized.
- f. Guards shall be provided around all live parts operating at more than 150 volts to ground without an insulating covering, unless the location of the live parts gives sufficient horizontal or vertical or a combination of these clearances to minimize the possibility of accidental employee contact. Except for fuse replacement and other necessary access by qualified persons, the guarding of energized parts within a compartment shall be maintained during operation and maintenance functions.
- g. When guards are removed from energized equipment, barriers shall be installed around the work area to prevent employees who are not working on the equipment, but who are in the area, from contacting the exposed live parts.
- h. The job briefing (prejob planning conference) required by this manual shall cover such additional subjects as the location of energized equipment in or adjacent to the work area and the limits of any de-energize work area.

11. Additional Rules for Power House Workers

- a. A designated employee shall inspect conditions before work is permitted and after its completion. Eye protection, or full face protection if necessary, shall be worn at all times when condenser, heater, or boiler tubes are being cleaned.
- b. Where it is necessary for employees to work near tube ends during cleaning, shielding shall be installed at the tube ends.
- c. Areas where chemical cleaning is in progress shall be cordoned off to restrict access during cleaning. If flammable liquids, gases, or vapors or combustible materials will be used or might be produced during the cleaning process, the area shall be posted with signs restricting entry and warning of the hazards of fire and explosion, and smoking, welding, and other possible ignition sources shall be prohibited in these restricted areas.
- d. Where a restricted area is established for chemical cleaning, the number of personnel in the restricted area shall be limited to those necessary to accomplish the task safely.
- e. There shall be ready access to water or showers for emergency use when chemical cleaning is being performed.
- f. Employees in restricted areas shall wear protective equipment meeting the requirements of OSHA's Subpart I of this Part and including, but not limited to, protective clothing, boots, goggles, and gloves.
- g. Before internal furnace or ash hopper repair work is started, overhead areas shall be inspected for possible falling objects. If the hazard of falling objects exists, overhead protection such as planking or nets shall be provided.
- h. When opening an operating boiler door, employees shall stand clear of the opening

12. Wiring in Wet Locations

The following rules apply to electric wiring for and equipment in or adjacent to all swimming, wading, therapeutic, and decorative pools and fountains, whether permanently installed or storable,

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and to metallic auxiliary equipment, such as pumps, filters, and similar equipment. Therapeutic pools in health care facilities are exempt from these provisions.

- a. A single receptacle of the locking and grounding type that provides power for a permanently installed swimming pool recirculating pump motor may be located not less than 5 feet from the inside walls of a pool. All other receptacles on the property shall be located at least 10 feet from the inside walls of a pool. Receptacles which are located within 15 feet of the inside walls of the pool shall be protected by ground-fault circuit interrupters.
Note: In determining these dimensions, the distance to be measured is the shortest path the supply cord of an appliance connected to the receptacle would follow without piercing a floor, wall, or ceiling of a building or other effective permanent barrier.
- b. Unless they are 12 feet above the maximum water level, lighting fixtures and lighting outlets may not be installed over a pool or over the area extending 5 feet horizontally from the inside walls of a pool. However, a lighting fixture or lighting outlet which has been installed before April 16, 1981, may be located less than 5 feet measured horizontally from the inside walls of a pool if it is at least 5 feet above the surface of the maximum water level and shall be rigidly attached to the existing structure. It shall also be protected by a ground-fault circuit interrupter installed in the branch circuit supplying the fixture.
- c. Unless installed 5 feet above the maximum water level and rigidly attached to the structure adjacent to or enclosing the pool, lighting fixtures and lighting outlets installed in the area extending between 5 feet and 10 feet horizontally from the inside walls of a pool shall be protected by a ground-fault circuit interrupter.
- d. Flexible cords used with the following equipment may not exceed 3 feet in length and shall have a copper equipment grounding conductor with a grounding-type attachment plug:
 - i. Cord- and plug-connected lighting fixtures installed within 16 feet of the water surface of permanently installed pools.
 - ii. Other cord- and plug-connected, fixed or stationary equipment used with permanently installed pools.
- e. A ground-fault circuit interrupter shall be installed in the branch circuit supplying underwater fixtures operating at more than 15 volts. Equipment installed underwater shall be approved for the purpose.
- f. No underwater lighting fixtures may be installed for operation at over 150 volts between conductors.
- g. All electric equipment operating at more than 15 volts, including power supply cords, used with fountains shall be protected by ground-fault circuit interrupters.

13. Use of Electrically Powered Equipment and Tools

- a. All electrically powered equipment or hand tools, except double insulated hand tools, shall be grounded.

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- b. Portable hand tools and electrically powered equipment shall be used with a ground fault circuit interrupter (GFCI) or an assured equipment grounding program (AEGP) (see “Ground Fault Circuit Protection” this section) shall be in effect.
- c. Electrical equipment shall be disconnected or the current otherwise interrupted while it is being adjusted or repaired.
- d. Permanent wiring shall be put in conduits.
- e. All breakers, motors, and appliance disconnects shall be labeled.
- f. Framing of electrical motors shall grounded.
- g. Outlets, switching, junction boxes, etc., shall be covered.
- h. Exposed noncurrent-carrying metal parts of fixed equipment that may become energized under abnormal conditions shall be grounded when in wet or damp locations; if electrical contact with metal, if operated in excess of 150 volts to ground, or in a hazardous location.

NOTE: Consider all exposed wires “hot” until verified otherwise.

14. Ground Fault Circuit Protection

- a. When using extension cords, portable electrically powered hand tools, appliances, or other electrically powered equipment outdoors or in an area under construction, they shall be of the 3-wire type (except double insulated tools) and shall be connected to a GFCI or an Assured Equipment Grounding Program (AEGP) shall be in effect.
- b. The AEGP requires regular inspections of all tools, cords, and electric devices. Appropriate documentation shall be maintained. Components of an AEGP are:
 - i. A written description of the program including specific procedures.
 - ii. Qualified employees appointed to run the program. More than one person shall be appointed.
 - iii. All equipment, cords, etc., to be used shall be inspected for external defects each day. All defective equipment shall be tagged out until repairs are made. All defects, repairs, inspections, etc., shall be documented.

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15. Extension Cords

See the appendix for guidelines on extension cord use.

- a. Cords shall not be hung over nails, bolts, or sharp edges.
- b. Cords shall not be laid in aisles unless protected from damage; they shall be so placed so as to not create a tripping hazard.
- c. Cords shall not be used as a substitute for fixed wiring.
- d. Cords shall not be run through holes in walls, ceiling, floors, doors, windows, or hung from light fixtures or attached to building surfaces.

16. Hazardous Locations

- a. Standard electrical apparatus cannot be used in locations where flammable gases, vapors, dusts, and other easily ignitable materials are present.

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- b. Before electrical equipment and its associated wiring is selected for a hazardous location, the exact nature of the flammable materials present should be determined.
- c. The National Electric Code, NFPA-70, Articles 500-503, shall be consulted before any use or installation of electrical equipment and associated wiring is selected.