Chapter 296-45 WAC
((~~SAFETY STANDARDS FOR ELECTRICAL WORKERS~~)) ELECTRIC POWER GENERATION, TRANSMISSION, AND DISTRIBUTION

AMENDATORY SECTION (Amending WSR 01-11-038, filed 5/9/01, effective 9/1/01)

WAC 296-45-015 Scope and application. (1) This chapter covers the operation ((~~and~~)), maintenance, and construction of electric power generation, control, transformation, transmission, and distribution lines and equipment. These provisions apply to:

(a) Power generation, transmission, and distribution installations, including related equipment for the purpose of communication or metering, which are accessible only to qualified electrical employees;

Note: The types of installations covered by this chapter include the generation, transmission, and distribution installations of electric utilities, as well as equivalent installations of industrial establishments. Trolley maintenance, jumpering, and bypass is also covered by this chapter. Supplementary electric generating equipment that is used to supply a workplace for emergency, standby, or similar purposes only is covered under Part L of chapter 296-24 WAC and WAC 296-800-280.

(b) Other installations at an electric power generating station, as follows:

(i) Fuel and ash handling and processing installations, such as coal conveyors;

(ii) Water and steam installations, such as penstocks, pipelines, and tanks, providing a source of energy for electric generators; and

(iii) Chlorine and hydrogen systems.

(c) Test sites where electrical testing involving temporary measurements associated with electric power generation, transmission, and distribution is performed in laboratories, in the field, in substations, and on lines, as opposed to metering, relaying, and routine line work;

(d) Work on or directly associated with the installations covered in subsections (1)(a) through (c) of this section; and

(e) Line-clearance tree-trimming operations, as follows:

(i) This chapter except WAC 296-45-455, applies to line-clearance tree-trimming operations performed by qualified electrical employees (those who are knowledgeable in the construction and operation of electric power generation, transmission, or distribution equipment involved, along with the associated hazards).

(ii) WAC 296-45-065, 296-45-125, 296-45-135, 296-45-255, 296-45-315, 296-45-375, and 296-45-455 through 296-45-45530 apply to line-clearance tree-trimming operations performed by line-clearance tree trimmers who are not qualified electrical employees.

(2) Notwithstanding subsection (1) of this section, this chapter does not apply to electrical installations, electrical safety-related work practices, or electrical maintenance considerations covered by Part L of chapter 296-24 WAC and WAC 296-800-280.

Note 1: Work practices conforming to WAC 296-24-970 through 296-24-985 are considered as complying with the electrical safety-related work practice requirements of this chapter, provided the work is being performed on a generation or distribution installation meeting WAC 296-24-95601 through 296-24-95699. This chapter also applies to work by qualified ((~~persons~~)) electrical employees directly on or associated with installations of electric power generation, transmission, and distribution lines or equipment, regardless of compliance with WAC 296-24-970 through 296-24-985.

Note 2: Work practices performed by qualified ((~~persons~~)) electrical employees and conforming to this chapter are considered as complying with WAC 296-24-95601 through 296-24-95699.

(3) This section applies in addition to all other applicable safety and health standards administered by the department. Specific

references in this section to other standards are provided for emphasis only.

(4) Operation, conditions, work methods and other work related situations or activities not specifically covered by this chapter are subject to the rules and regulations of chapter 296-24 WAC((,)) General safety and health standards; chapter 296-27 WAC Recordkeeping and reporting; chapter 296-62 WAC((,)) General occupational health standards; chapter 296-155 WAC((,)) Safety standards for construction work; chapter 296-800 WAC((,)) Safety and health core rules; and, insofar as applicable to employee safety and health, chapter 19.29 RCW. Additionally, operations, conditions, work methods and other work related situations or activities may be subject to additional rules and regulations depending upon the nature of the work being performed.

(5) These rules shall not apply to the use of existing electrical installations during their lifetime, provided they are maintained in good condition and in accordance with the applicable safety factor requirements and the rules in effect at the time they were installed, and provided that reconstruction shall conform to the rules as herein provided.

(6) Any rule, regulation or standard contained within this chapter, if subject to interpretation, shall be interpreted so as to achieve employee safety, which is the ultimate purpose of this chapter.

(7) Should a rule or standard contained within this chapter conflict, in any manner, with a standard or rule contained within any other chapter of Title 296 WAC the standard or rule contained herein shall apply so long as the work being done is power generation, transmission, and distribution installations, including related equipment for the purpose of communication or metering, which are accessible only to qualified electrical employees. If there are rules within this chapter that conflict, the rule that provides the greatest employee safety will apply.

(8) Neither the promulgation of these rules, nor anything contained in these rules shall be construed as affecting the relative status or civil rights or liabilities between employers and their employees and/or the employees of others and/or the public generally; nor shall the use herein of the words "duty" and "responsibility" or either, import or imply liability other than provided for in the industrial insurance and safety laws of the state of Washington, to any person for injuries due to negligence predicated upon failure to perform or discharge any such "duty" or "responsibility," but failure on the part of the employees, leadworker, or employer to comply with any compulsory rule may be cause for the department of labor and industries to take action in accordance with the industrial insurance and safety laws.

(9) "Shall" and "must" as used in this chapter make the provisions mandatory. "Should," "may," or "it is recommended" are used to indicate the provisions are not mandatory but are recommended.

(10) If any section, subsection, phrase, or provisions of this chapter or part thereof should be held invalid by any court for any reason, such invalidity shall not in any way affect the validity of the remainder of this chapter, unless such decision renders the remainder of the provision unintelligible, or changes the meaning of such other provision or provisions.

(11) When the language used in this chapter indicates that it is the responsibility, duty, or obligation of the leadworker or other employee, it shall also be the employer's responsibility, obligation, and duty.

(12) Whenever this chapter refers to the provisions of another safety and health standard or statute affecting safety and health, such reference refers to the statute or code in effect at the time the work is being performed.

AMENDATORY SECTION (Amending WSR 14-07-086, filed 3/18/14, effective 5/1/14)

WAC 296-45-035 Definitions. These definitions apply to chapter 296-45 WAC.

"Aerial manlift equipment" - Equipment such as extended towers, boom-mounted cages or baskets, and truck-mounted ladders, that is primarily designed to place personnel and equipment aloft to work on elevated structures and equipment.

"Affected employee" - An employee whose job requires him or her to operate or use a machine or equipment on which servicing or maintenance is being performed under lockout or tagout, or whose job requires him or her to work in an area in which such servicing or maintenance is being performed.

"Apprentice" - An employee who is being trained to be journey level.

"Approved" - Meets or exceeds the recognized standards of safety within the industry.

"Approved protectors" - Gloves worn over rubber insulating gloves which are of such material or substance and so constructed as to protect the rubber gloves from abrasions, lacerations, or other physical damage which might otherwise occur to rubber gloves. Approved protectors must conform to the standards which are recognized by the industry.

"Attendant" - An employee assigned to remain immediately outside the entrance to an enclosed or other space to render assistance as needed to employees inside the space.

"Authorized employee" - An employee who locks out or tags out machines or equipment in order to perform servicing or maintenance on that machine or equipment. An affected employee becomes an authorized employee when that employee's duties include performing servicing or maintenance covered under this section.

"Automatic ((~~circuit recloser~~)) <u>reclosing device</u>" - A self-controlled device for interrupting and reclosing an alternating current circuit with a predetermined sequence of opening and reclosing followed by resetting, hold-closed, or lockout operation.

"Barricade" - A physical obstruction such as tapes, cones, or A-frame type wood or metal structures intended to provide a warning about and to limit access to a hazardous area.

"Barrier" - A physical obstruction which is intended to prevent contact with energized lines or equipment or to prevent unauthorized access to a work area.

"Bond" - The electrical interconnection of conductive parts designed to maintain a common electrical potential.

"Bus" - A conductor or a group of conductors that serve as a common connection for two or more circuits.

"Bushing" - An insulating structure, including a through conductor or providing a passageway for such a conductor, with provision for mounting on a barrier, conducting or otherwise, for the purposes of

insulating the conductor from the barrier and conducting current from one side of the barrier to the other.

"Cable" - A conductor with insulation, or a stranded conductor with or without insulation and other coverings (single-conductor cable), or a combination of conductors insulated from one another (multiple-conductor cable).

"Cable sheath" - A conductive protective covering applied to cables.

Note: A cable sheath may consist of multiple layers of which one or more is conductive.

"Circuit" - A conductor or system of conductors through which an electric current is intended to flow.

"Clearance" (between objects) - The clear distance between two objects measured surface to surface.

"Clearance" (for work) - Authorization to perform specified work or permission to enter a restricted area.

"Communication lines." (See "Lines, communication.")

"Conductor" - A material, usually in the form of a wire, cable, or bus bar, used for carrying an electric current.

"Contract employer" - An employer, other than a host employer, that performs work covered by this chapter under contract.

"Covered conductor" - A conductor covered with a dielectric having no rated insulating strength or having a rated insulating strength less than the voltage of the circuit in which the conductor is used.

"Current-carrying part" - A conducting part intended to be connected in an electric circuit to a source of voltage. Noncurrent-carrying parts are those not intended to be so connected.

"Deenergized" - Free from any electrical connection to a source of potential difference and from electric charge; not having a potential difference from that of the earth.

Note: The term is used only with reference to current-carrying parts, which are sometimes energized (alive).

"Designated employee((~~/person~~))" - ((~~An employee/~~)) A person who is designated by the employer to perform specific duties under the terms of this ((~~section~~)) chapter and who is knowledgeable in the construction and operation of the equipment and the hazards involved.

Note: Considering an employee to be a designated employee will depend on various circumstances in the workplace, on the level of training they have received, and the proficiency demonstrated by the employee with the tasks required of the job.

"Electric line truck" - Any vehicle used to transport employees, tools, and material, which serves as a traveling workshop for electric power line construction and maintenance work. It may be equipped with a boom and auxiliary equipment for setting poles, digging holes, and elevating material and/or workers.

"Electric supply equipment" - Equipment that produces, modifies, regulates, controls, or safeguards a supply of electric energy.

"Electric supply lines." (See "Lines, electric supply.")

((~~**"Electric utility"** - An organization responsible for the installation, operation, or maintenance of an electric supply system.~~))

"Emergency" - An unforeseen occurrence endangering life, limb, or property.

"Enclosed" - Surrounded by a case, cage, fence or otherwise which will protect the contained equipment and prevent accidental contact of a person with live parts.

"Enclosed space" - A working space, such as a manhole, vault, tunnel, or shaft, that has a limited means of egress or entry, that is designed for periodic employee entry under normal operating conditions, and that under normal conditions does not contain a hazardous

atmosphere, but that may contain a hazardous atmosphere under abnormal conditions.

Note: Spaces that are enclosed but not designed for employee entry under normal operating conditions are not considered to be enclosed spaces for the purposes of this section. Similarly, spaces that are enclosed and that are expected to contain a hazardous atmosphere are not considered to be enclosed spaces for the purposes of this section. Such spaces meet the definition of permit spaces in ((~~WAC 296-62-145~~)) chapter 296-809 WAC, Confined spaces, and entry into them must be performed in accordance with that standard.

"Energized" (alive, live) - Electrically connected to a source of potential difference, or electrically charged so as to have a potential significantly different from that of earth in the vicinity.

"Energy isolating device" - A physical device that prevents the transmission or release of energy, including, but not limited to, the following: A manually operated electric circuit breaker, a disconnect switch, a manually operated switch, a slide gate, a slip blind, a line valve, blocks, and any similar device with a visible indication of the position of the device. (Push buttons, selector switches, and other control-circuit-type devices are not energy isolating devices.)

"Energy source" - Any electrical, mechanical, hydraulic, pneumatic, chemical, nuclear, thermal, or other energy source that could cause injury to personnel.

"Entry" (as used in WAC 296-45-205 of this chapter) - The action by which a person passes through an opening into an enclosed space. Entry includes ensuing work activities in that space and is considered to have occurred as soon as any part of the entrant's body breaks the plane of an opening into the space.

"Equipment" (electric) - A general term including material, fittings, devices, appliances, fixtures, apparatus, and the like used as part of or in connection with an electrical installation.

"Exposed" - Not isolated or guarded.

"Fall restraint system" - A fall protection system that prevents the user from falling any distance.

"Fault current" - The current that flows in an electrical system because of a defect in the circuit induced accidentally or otherwise.

"First-aid training" - Training in the initial care, including cardiopulmonary resuscitation (which includes chest compressions, rescue breathing, and, as appropriate, other heart and lung resuscitation techniques), performed by a person who is not a medical practitioner, of a sick or injured person until definitive medical treatment can be administered.

"Fixed ladder" - A ladder that is permanently secured to a structure.

"Ground" - A conducting connection, whether intentional or accidental, between an electric circuit or equipment and the earth, or to some conducting body that serves in place of the earth.

"Grounded" - Connected to earth or to some conducting body that serves in place of the earth.

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

"Groundperson" - A member of crew working on ground under direction of a leadworker.

"Guarded" - Covered, fenced, enclosed, or otherwise protected, by means of suitable covers or casings, barrier rails or screens, mats, or platforms, designed to prevent the possibility, under normal conditions, of dangerous approach or accidental contact by persons or objects.

Note: Wires which are insulated, but not otherwise protected, are not considered as guarded.

"Hazardous atmosphere" - 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:

• Flammable gas, vapor, or mist in excess of 10 percent of its lower flammable limit (LFL);

• 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;

• Atmospheric oxygen concentration below 19.5 percent or above 23.5 percent;

• Atmospheric concentration of any substance for which a dose or a permissible exposure limit is published in chapter 296-62 WAC, Part L, or in chapter 296-62 WAC, toxic and hazardous substances, 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.

• Any other atmospheric condition that is "immediately dangerous to life or health" (IDLH).

((~~**"IDLH"** - Any condition that poses an immediate or delayed threat to life or that would cause irreversible adverse health effects or that would interfere with an individual's ability to escape unaided from a permit space.~~

~~Note: Some materials (hydrogen fluoride gas and cadmium vapor, for example) may produce immediate transient effects that, even if severe, may pass without medical attention, but are followed by sudden, possibly fatal collapse 12-72 hours after exposure. The victim "feels normal" from recovery from transient effects until collapse. Such materials in hazardous quantities are considered to be "immediately" dangerous to life or health.~~

~~Note: For air contaminants for which WISHA has not determined a dose or permissible exposure limit, other sources of information, such as Safety Data Sheets that comply with the hazard communication program, WAC 296-901-140, published information, and internal documents can provide guidance in establishing acceptable atmospheric conditions.~~))

"High-power tests" - Tests in which fault currents, load currents, magnetizing currents, and line-dropping currents are used to test equipment, either at the equipment's rated voltage or at lower voltages.

"High-voltage tests" - Tests in which voltages of approximately 1000 volts are used as a practical minimum and in which the voltage source has sufficient energy to cause injury.

"High wind" - A wind of such velocity that the following hazards would be present:

• An employee would be exposed to being blown from elevated locations; or

• An employee or material handling equipment could lose control of material being handled; or

• An employee would be exposed to other hazards not controlled by the standard involved.

Note: Winds exceeding 40 miles per hour (64.4 kilometers per hour), or 30 miles per hour (48.3 kilometers per hour) if material handling is involved, are normally considered as meeting this criteria unless precautions are taken to protect employees from the hazardous effects of the wind.

"Host employer" - An employer that operates, or that controls the operating procedures for, an electric power generation, transmission, or distribution installation on which a contract employer is performing work covered by this chapter.

Note: The division of occupational safety and health (DOSH) will treat the electric utility or the owner of the installation as the host employer if it operates or controls operating procedures for the installation. If the electric utility or installation owner neither operates nor controls operating procedures for the installation, DOSH will treat the employer that the utility or owner has contracted with to operate or control the operating procedures for the installation as the host employer. In no case will there be more than one host employer.

"IDLH" - Any condition that poses an immediate or delayed threat to life or that would cause irreversible adverse health effects or

that would interfere with an individual's ability to escape unaided from a permit space.

Note: Some materials (hydrogen fluoride gas and cadmium vapor, for example) may produce immediate transient effects that, even if severe, may pass without medical attention, but are followed by sudden, possibly fatal collapse twelve to seventy-two hours after exposure. The victim "feels normal" from recovery from transient effects until collapse. Such materials in hazardous quantities are considered to be "immediately" dangerous to life or health.

Note: For air contaminants for which WISHA has not determined a dose or permissible exposure limit, other sources of information, such as safety data sheets that comply with the hazard communication program, WAC 296-901-140, published information, and internal documents can provide guidance in establishing acceptable atmospheric conditions.

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

Note: When any object is said to be insulated, it is understood to be insulated for the conditions to which it is normally subjected. Otherwise, it is, within the purpose of this section, uninsulated.

"Insulation" (cable) - That which is relied upon to insulate the conductor from other conductors or conducting parts or from ground.

"Insulation shielding" - An envelope which encloses the insulation of a cable and provides an equipotential surface in contact with cable insulation.

"Isolated" - An object that is not readily accessible to persons unless special means of access are used.

"Leadworker" - The person directly in charge of workers doing the work, regardless of title.

"Line-clearance tree trimmer" - An employee who, through related training or on-the-job experience or both, is familiar with the special techniques and hazards involved in line-clearance tree trimming.

Note 1: An employee who is regularly assigned to a line-clearance tree-trimming crew and who is undergoing on-the-job training and who, in the course of such training, has demonstrated an ability to perform duties safely at his or her level of training and who is under the direct supervision of a line-clearance tree trimmer is considered to be a line-clearance tree trimmer.

Note 2: A line-clearance tree trimmer is not considered to be a "qualified electrical employee" under this section unless ((~~he or she has~~)) they have the training required for a qualified electrical employee under WAC 296-45-065. However, under the electrical safety-related work practices standard, a line-clearance tree trimmer is considered to be a "qualified employee." Tree trimming performed by such "qualified employees" is not subject to the electrical safety-related work practice requirements contained in WAC 296-24-970. (See also the note following WAC 296-24-970 for information regarding the training an employee must have to be considered a qualified employee.)

"Line-clearance tree trimming" - The pruning, trimming, repairing, maintaining, removing, or clearing of trees or the cutting of brush that is within ((~~10 feet (305 cm)~~)) the following distance of electric supply lines and equipment:

- For voltages to ground of 50 kilovolts or less - 3.05 meters (10 feet);
- For voltages to ground of more than 50 kilovolts - 3.05 meters (10 feet) plus 0.10 meters (4 inches) for every 10 kilovolts over 50 kilovolts.

"Lines" -

- **"Communication lines"** - The conductors and their supporting or containing structures which are used for public or private signal or communication service, and which operate at potentials not exceeding 400 volts to ground or 750 volts between any two points of the circuit, and the transmitted power of which does not exceed 150 watts. If the lines are operating at less than 150 volts, no limit is placed on the transmitted power of the system. Under certain conditions, communication cables may include communication circuits exceeding these limitations where such circuits are also used to supply power solely to communication equipment.

Note: Telephone, telegraph, railroad signal, data, clock, fire, police alarm, cable television, and other systems conforming with this definition are included. Lines used for signaling purposes, but not included under this definition, are considered as electric supply lines of the same voltage.

- **"Electric supply lines"** - Conductors used to transmit electric energy and their necessary supporting or containing structures. Signal lines of more than 400 volts are always supply lines within this sec-

tion, and those of less than 400 volts are considered as supply lines, if so run and operated throughout.

"Live-line tools and ropes" - Tools and ropes specifically designed for work on energized high voltage lines and equipment.

"Load-break elbow" - A connector designed to close and interrupt current on energized circuits within the design current and voltage rating.

"Manhole" - A subsurface enclosure which personnel may enter and which is used for the purpose of installing, operating, and maintaining submersible equipment or cable.

"Manhole steps" - A series of steps individually attached to or set into the walls of a manhole structure.

"May" and **"should"** or **"it is recommended"** are used to indicate the provisions are not mandatory but are recommended.

"Minimum approach distance" - The closest distance an employee is permitted to approach an energized or a grounded object.

"Must" and **"shall"** as used in this chapter make the provisions mandatory.

"Network system" - An electrical installation fed from multiple primary sources directly associated with area-wide secondary network connected into a common grid.

"Neutral" - A system in which one conductor is used as the neutral for one or more circuits; one conductor may be used as the neutral for both primary and secondary circuits of a distribution system.

"Personal fall arrest system" - A system used to arrest an employee in a fall from a working level.

"Pole" - Any device used to support a power distribution or transmission line. The pole may be made of any substance including wood, concrete, metal, is usually cylindrical in shape and comparatively slender. It is the upright standard to which is affixed part of the power distribution and transmission line system as defined in this chapter.

"Power dispatcher" (load dispatcher or system operator) - A person who has been designated by the employer as having authority over switching and clearances of high voltage lines and station equipment.

"Protective devices" - Devices such as rubber gloves, rubber blankets, line hose, rubber boots, or other insulating devices, which are specifically designed for the protection of employees.

((~~**"Public highway"** - Every way, land, road, street, boulevard, and every other way or place in the state open as a matter of right to public vehicular travel, both inside and outside the limits of cities and towns, regardless of ownership.~~))

"Qualified ((~~person or qualified~~)) electrical employee" - A person who is familiar ((~~with~~)) and knowledgeable in the construction ((~~of, or~~)) and operation of the electric power generation, transmission, and distribution equipment involved, and such lines and/or equipment that concerns his/her position and who is fully aware of the hazards connected therewith, or, one who has passed a journey status examination for the particular branch of the electrical trades with which he/she may be connected.

((~~Note 1:~~)) • An employee must have the training required by WAC 296-45-065((~~(1)~~)) in order to be considered a qualified electrical employee.

Notes:

((~~Note 2:~~)) (((~~Apprentice) Except under WAC 296-45-25510(12),~~)) • An employee who is undergoing on-the-job training ((~~and~~)) (an apprentice) who, in the course of such training, has demonstrated an ability to perform duties safely at his or her level of training and who is under the direct supervision of a qualified ((~~person~~)) electrical employee is considered to be a qualified ((~~person~~)) electrical employee for the performance of those duties.

• An employee having experience and training comparable to journey level would be considered a qualified electrical employee.

"Roadway or public highway" - Every way, land, road, street, boulevard, and every other way or place in the state open as a matter of right to public vehicular travel, both inside and outside the limits of cities and towns, regardless of ownership.

"Rubber" - Any goods, equipment, or tool made out of either natural or synthetic rubber.

"Secured ladder" - A ladder which is not capable of being dislodged from the top by lateral, or jerking motion(s).

"Shall" and **"must"** as used in this chapter make the provisions mandatory.

"Sheath" - As applied to tools carried in a lineman's tool belt, a sheath that effectively covers the tool and prevents such tool from falling from the belt.

"Should" and **"may"** or **"it is recommended"** are used to indicate the provisions are not mandatory but are recommended.

"Statistical sparkover voltage" - A transient overvoltage level that produces a 97.72 percent probability of sparkover (that is, two standard deviations above the voltage at which there is a 50 percent probability of sparkover).

"Statistical withstand voltage" - A transient overvoltage level that produces a 0.14 percent probability of sparkover (that is, three standard deviations below the voltage at which there is a 50 percent probability of sparkover).

"Step bolt" - A bolt or rung attached at intervals along a structural member and used for foot placement during climbing or standing.

"Supporting structure" - The main supporting unit (usually a pole or tower).

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

"System operator or power dispatcher" - A qualified ((~~person~~)) electrical employee who has been designated by the employer and having authority over switching, clearances, and operation of the system and its parts.

"Tag" - A system or method of identifying circuits, systems, or equipment for the purpose of alerting employees and others that the circuit, system, or equipment is being worked on.

((~~**"Underground network"** - An underground electrical installation fed from multiple primary sources directly associated with area-wide secondary network connected into a common grid.~~))

"Underground residential distribution system" (URD) - An electrical installation normally fed from a single primary source which may feed one or more transformers with secondaries not connected to a common grid.

"Utility" - An organization responsible for the installation, operation, or maintenance of electric supply or communications systems.

"Vault" - An enclosure, above or below ground, which personnel may enter and which is used for the purpose of installing, operating, or maintaining equipment or cable.

"Vented vault" - A vault that has provision for air changes using exhaust flue stacks and low level air intakes operating on differentials of pressure and temperature providing for airflow which precludes a hazardous atmosphere from developing.

"Voltage" - The effective (rms) potential difference between any two conductors or between a conductor and ground. Voltages are expressed in nominal values unless otherwise indicated. The nominal voltage of a system or circuit is the value assigned to a system or

circuit of a given voltage class for the purpose of convenient designation. The operating voltage of the system may vary above or below this value.

Note: Low voltage includes voltages from 50 to 600 volts. High voltage shall mean those voltages of 601 volts to 230,000. Extra high voltage means any voltage over 230,000 volts. Where the words "high voltage" are used in this chapter it shall include extra high voltage, unless otherwise specified.

"Work-positioning equipment" - A body belt or body harness system rigged to allow an employee to be supported on an elevated vertical surface, such as a utility pole or tower leg, and work with both hands free while leaning.

AMENDATORY SECTION (Amending WSR 03-17-071, filed 8/19/03, effective 11/1/03)

WAC 296-45-045 NESC applicable. (1) All electric utilities and entities operating transmission and distribution facilities within the state of Washington must design, construct, operate, and maintain their lines and equipment according to the requirements of the ((~~2002~~)) 2012 National Electrical Safety Code (NESC) (ANSI-C2), parts (1), (2), and (3).

Note: The department has copies of the NESC available for review at each service location across the state. To purchase a copy, write to:
The Institute of Electrical and Electronics Engineers, Inc. (IEEE, Inc.)
445 Hoes Lane
Piscataway, NJ 08855-1331

(2) The employer must ensure that climbing space is provided on all poles and structures. The climbing space must meet the requirements of the ((~~2002~~)) 2012 National Electrical Safety Code (NESC) (ANSI-C2), except that Rule 236H does not apply.

AMENDATORY SECTION (Amending WSR 14-07-086, filed 3/18/14, effective 5/1/14)

WAC 296-45-055 Employer's responsibility. (1) The employer shall provide and maintain the necessary protective devices specified in these rules and require the employees to use them properly.

(2) The employer shall develop and maintain a hazard communication program as required by ((~~WAC 296-901-140~~)) chapter 296-901 WAC, which will provide information to all employees relative to hazardous chemicals or substances to which they are exposed, or may become exposed, in the course of their employment.

(3) There shall be installed and maintained in every fixed establishment employing eight or more persons a safety bulletin board of a size to display and post safety bulletins, newsletters, posters, accident statistics and other safety educational material. It is recommended that safety bulletin boards be painted green and white.

(4) The employer shall require the leadworker to observe and enforce all safety rules and shall furnish a copy of the electrical workers' safety rules to each employee who is covered by these rules.

(5) The employer shall appoint only competent workers to supervise other employees and those appointed shall be responsible for the safety of the employees under their supervision.

AMENDATORY SECTION (Amending WSR 98-07-009, filed 3/6/98, effective 5/6/98)

WAC 296-45-065 Training. (1) Each employee((~~s~~)) shall be trained and proficient in the safety-related work practices, safety procedures, and other safety requirements in this section that pertain to their respective job assignments. Employees shall also be trained in and proficient with any other safety practices, including applicable emergency procedures (such as pole top, aerial, manhole, and tree rescue), that are not specifically addressed by this section but that are related to their work and are necessary for their safety.

((~~(1)~~)) (2) The degree of training shall be determined by the risk of the employee for the hazard involved.

(3) Qualified electrical employees shall also be trained and competent in:

(a) The skills and techniques necessary to distinguish exposed live parts from other parts of electric equipment;

(b) The skills and techniques necessary to determine the nominal voltage of exposed live parts;

(c) The minimum approach distances specified in this ((~~section~~)) chapter corresponding to the voltages to which the qualified electrical employee will be exposed((~~;~~)) and the skills and techniques necessary to maintain those distances;

(d) The proper use of the special precautionary techniques, personal protective equipment, insulating and shielding materials, and insulated tools for working on or near exposed energized parts of electric equipment; and

(e) The recognition of electrical hazards to which the employee may be exposed and the skills and techniques necessary to control or avoid these hazards.

Note: For the purposes of this section, a person must have this training in order to be considered a qualified ((~~person~~)) electrical employee.

((~~(2)~~)) (4) The employer 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 ((~~section.~~

~~(3)~~)) chapter.

(5) An employee shall receive additional training (or retraining) under any of the following conditions:

(a) If the supervision and annual inspections required by subsection ((~~(2)~~)) (4) of this section indicate that the employee is not complying with the safety-related work practices required by this ((~~section~~)) chapter; or

(b) If new technology, new types of equipment, or changes in procedures necessitate the use of safety-related work practices that are different from those which the employee would normally use; or

(c) If ((~~he or she~~)) the employee must employ safety related work practices that are not normally used during ((~~his or her~~)) their regular job duties.

Note: ((~~WISHA~~)) DOSH would consider tasks that are performed less often than once per year to necessitate retraining before the performance of the work practices involved.

((~~(4)~~)) (6) The training required by ((~~WAC 296-45-065~~)) this section shall be of the classroom or on-the-job type.

((~~(5)~~)) (7) The training shall establish employee proficiency in the work practices required by this section and shall introduce the procedures necessary for compliance with this section.

((~~(6)~~)) (8) The employer shall certify that each employee has received the training required by ((~~WAC 296-45-065~~)) this section. This certification shall be made when the employee demonstrates proficiency in the work practices involved and shall be maintained for the duration of the employee's employment.

Notes:
- Employment records that indicate that an employee has received the required training are an acceptable means of meeting this requirement.
- For an employee with previous training, an employer may determine that the employee has demonstrated the proficiency required by this subsection using the following process:
  - Confirm that the employee has the training required by this section;
  - Use an examination or interview to make an initial determination that the employee understands the relevant safety related work practices before he or she performs any work covered by this chapter; and
- Supervise the employee closely until that employee has demonstrated proficiency as required by this section.

(9) Each line-clearance tree trimmer who is not a qualified electrical employee shall also be trained and competent in:

(a) The skills and techniques necessary to distinguish exposed live parts from other parts of electric equipment;

(b) The skills and techniques necessary to determine the nominal voltage of exposed live parts; and

(c) The minimum approach distances specified in this chapter corresponding to the voltages to which the employee will be exposed and the skills and techniques necessary to maintain those distances.

NEW SECTION

WAC 296-45-067 Information transfer. (1) Host employer responsibilities. Before work begins, the host employer shall inform contract employers of:

(a) The characteristics of the host employer's installation that are related to the safety of the work to be performed and are listed in subsection (4)(a) through (e) of this section;

Note: This subsection requires the host employer to obtain information listed in subsection (4)(a) through (e) of this section if it does not have this information in existing records.

(b) Conditions that are related to the safety of the work to be performed, that are listed in subsection (4)(f) through (h) of this section, and that are known to the host employer;

Note: For the purposes of this subsection, the host employer need only provide information to contract employers that the host employer can obtain from its existing records through the exercise of reasonable diligence. This subsection does not require the host employer to make inspections of worksite conditions to obtain this information.

(c) Information about the design and operation of the host employer's installation that the contract employer needs to make the assessments required by this chapter; and

Note: This subsection requires the host employer to obtain information about the design and operation of its installation that contract employers need to make required assessments if it does not have this information in existing records.

(d) Any other information about the design and operation of the host employer's installation that is known by the host employer, that the contract employer requests, and that is related to the protection of the contract employer's employees.

Note: For the purposes of this subsection, the host employer need only provide information to contract employers that the host employer can obtain from its existing records through the exercise of reasonable diligence. This subsection does not require the host employer to make inspections of worksite conditions to obtain this information.

(2) Contract employer responsibilities.

(a) The contract employer shall ensure that each of its employees is instructed in the hazardous conditions relevant to the employee's work that the contract employer is aware of as a result of information communicated to the contract employer by the host employer under subsection (1) of this section.

(b) Before work begins, the contract employer shall advise the host employer of any unique hazardous conditions presented by the contract employer's work.

(c) The contract employer shall advise the host employer of any unanticipated hazardous conditions found during the contract employer's work that the host employer did not mention under subsection (1) of this section. The contract employer shall provide this information to the host employer within two working days after discovering the hazardous condition.

(3) Joint host- and contract-employer responsibilities. The contract employer and the host employer shall coordinate their work rules and procedures so that each employee of the contract employer and the host employer is protected as required by this section.

(4) Existing characteristics and conditions. Existing characteristics and conditions of electric lines and equipment that are related to the safety of the work to be performed shall be determined before work on or near the lines or equipment is started. Such characteristics and conditions include, but are not limited to:

(a) The nominal voltages of lines and equipment;

(b) The maximum switching-transient voltages;

(c) The presence of hazardous induced voltages;

(d) The presence of protective grounds and equipment grounding conductors;

(e) The locations of circuits and equipment, including electric supply lines, communication lines, and fire protective signaling circuits;

(f) The condition of protective grounds and equipment grounding conductors;

(g) The condition of poles; and

(h) Environmental conditions relating to safety.

AMENDATORY SECTION (Amending WSR 01-11-038, filed 5/9/01, effective 9/1/01)

WAC 296-45-075 Employer's safety program. (1) The employer shall hold safety meetings at least once a month, which meetings shall be held at a reasonable time and place as selected by the employer. The employer shall require all employees subject to provisions of this chapter to attend said meetings: Provided, That employees whose presence is otherwise required by reason of an emergency or whose function is such that they cannot leave their station or cease their work without serious detriment to the service provided, such as dispatcher, may be excused from such meeting under those circumstances. Minutes shall be kept of each safety meeting and retained for a period of one year.

(2) The employer or a representative(s) designated shall investigate all accidents or injuries of a serious nature and, where possible, take the proper remedial steps to prevent the occurrence of similar accidents.

(3) The employer shall furnish instructions stating the proper procedure in event of an emergency, which shall include the names of those individuals to be notified and methods of contacting them.

(4) The employer shall provide and make available to all employees accident report and safety suggestion forms or other approved methods. Safety suggestion forms should, where possible, be used for

suggesting the elimination of hazardous conditions and such reported suggestions shall be retained (for one year) by the employer or an authorized representative.

(5) ((~~The employer must notify the department of employee fatalities or catastrophes according to the requirements of WAC 296-800-320.~~)) For work-related injuries and illnesses involving any employee that resulted in death, inpatient hospitalization, amputation or loss of an eye, the employer must comply with the recordkeeping and reporting regulations located in chapter 296-27 WAC.

(6) Nothing contained within this chapter shall prohibit an employer or an authorized representative from disciplining employees for failure to comply with the provisions of this or any other safety code.

(7) 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 maximum switching transient voltages, 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.

AMENDATORY SECTION (Amending WSR 98-07-009, filed 3/6/98, effective 5/6/98)

WAC 296-45-105 Work required of leadworkers. (1) A leadworker cannot properly supervise the work and look out for the safety of employees under their direction if required to work as a leadworker and a ((~~lineworker~~)) qualified electrical employee at the same time.

(2) Leadworkers should be constantly alert and shall not be required to serve in such dual capacity, except in crews of not more than two ((~~lineworkers~~)) qualified electrical employees, in which case they may work as one of the ((~~lineworkers~~)) qualified electrical employees.

(3) In crews of two ((~~lineworkers~~)) qualified electrical employees or less, each ((~~lineworker~~)) qualified electrical employee may have a groundworker but, if additional ((~~lineworkers~~)) qualified electrical employees or groundworkers are added to the crew, the leadworker shall confine his/her activities to supervising the work, as exhibited below:

Type of Crew	Minimum Requirements
2 ((~~lineworkers~~)) qualified electrical employees	One ((~~lineworker~~)) qualified electrical employee as person-in-charge.
2 ((~~lineworkers~~)) qualified electrical employees plus 1 groundworker	One ((~~lineworker~~)) qualified electrical employee as person-in-charge or climbing leadworker.
2 ((~~lineworkers~~)) qualified electrical employees plus 2 groundworkers	One ((~~lineworker~~)) qualified electrical employee as person-in-charge or climbing leadworker.

Type of Crew	Minimum Requirements
2 ((~~lineworkers~~)) qualified electrical employees plus any combination of 3 ((~~lineworkers~~)) qualified electrical employees or groundworkers	One nonclimbing leadworker.

AMENDATORY SECTION (Amending WSR 04-07-160, filed 3/23/04, effective 5/1/04)

WAC 296-45-125 Medical services and first aid. The employer shall provide medical services and first aid as required in WAC 296-800-150. The following requirements also apply:

(1) Cardiopulmonary resuscitation and first-aid training. When employees are performing work on or associated with exposed lines or equipment energized at 50 volts or more, persons trained in first aid including cardiopulmonary resuscitation (CPR) shall be available as follows:

(a) For field work involving two or more employees at a work location, at least two trained persons shall be available. However, for line-clearance tree trimming operations performed by line-clearance tree trimmers who are not qualified electrical employees, only one trained person need be available if all new employees are trained in first aid, including CPR, within 3 months of their hiring dates.

(b) For fixed work locations such as generating stations, the number of trained persons available shall be sufficient to ensure that each employee exposed to electric shock can be reached within 4 minutes by a trained person. However, where the existing number of employees is insufficient to meet this requirement (at a remote substation, for example), all employees at the work location shall be trained.

(2) First-aid supplies. First-aid supplies required by WAC 296-800-150 shall be placed in weatherproof containers if the supplies could be exposed to the weather.

(3) First-aid kits. ((~~Each first-aid kit~~)) The employer shall ((~~be maintained~~)) maintain each first-aid kit, shall ((~~be~~)) ensure that it is readily available for use, and shall ((~~be inspected~~)) inspect it frequently enough to ensure that expended items are replaced ((~~but~~)). The employer also shall inspect each first-aid kit at least once per year.

AMENDATORY SECTION (Amending WSR 98-07-009, filed 3/6/98, effective 5/6/98)

WAC 296-45-135 Job briefing. (1) The employer shall ensure that the leadworker conducts a job briefing with the employees involved before they start each job. ((~~The briefing shall cover at least the following subjects: Hazards associated with the job, work procedures in-~~

~~volved, special precautions, energy source controls, and personal protective equipment requirements.~~

~~(1)~~)) (2) The employer shall provide the employee in charge of the job with all available information that relates to the determination of existing characteristics and conditions required by WAC 296-45-067(4) of this chapter.

(3)The briefing shall also cover at the least the following subjects:

(a) Hazards associated with the job;

(b) Work procedures involved;

(c)Special precautions;

(d)Energy source controls; and

(e)Personal protective equipment requirements.

(4) Number of briefings. If the work or operations to be performed during the work day or shift are repetitive and similar, at least one job briefing shall be conducted before the start of the first job of each day or shift. Additional job briefings shall be held if significant changes, which might affect the safety of the employees, occur during the course of the work.

((~~(2)~~)) (5) Extent of briefing. A brief discussion is satisfactory if the work involved is routine and if the employee, by virtue of training and experience, can reasonably be expected to recognize and avoid the hazards involved in the job. A more extensive discussion shall be conducted:

(a) If the work is complicated or particularly hazardous; or

(b) If the employee cannot be expected to recognize and avoid the hazards involved in the job.

Note: The briefing is always required to touch on all the subjects listed in the introductory text to this section.

((~~(3)~~)) (6) Working alone. An employee working alone need not conduct a job briefing. However, the employer shall ensure that the tasks to be performed are planned as if a briefing were required.

AMENDATORY SECTION (Amending WSR 98-07-009, filed 3/6/98, effective 5/6/98)

WAC 296-45-17505 Lockout/tagout (hazardous control) program. (1) The employer shall establish a program consisting of energy control procedures, employee training, and periodic inspections to ensure that, before any employee performs any servicing or maintenance on a machine or equipment where the unexpected energizing, start up, or release of stored energy could occur and cause injury, the machine or equipment is isolated from the energy source and rendered inoperative.

(2) The employer's energy control program under this section shall meet the following requirements:

(a) If an energy isolating device is not capable of being locked out, the employer's program shall use a tagout system.

(b) If an energy isolating device is capable of being locked out, the employer's program shall use lockout, unless the employer can demonstrate that the use of a tagout system will provide full employee protection as follows:

(i) When a tagout device is used on an energy isolating device which is capable of being locked out, the tagout device shall be attached at the same location that the lockout device would have been

attached, and the employer shall demonstrate that the tagout program will provide a level of safety equivalent to that obtained by the use of a lockout program.

(ii) In demonstrating that a level of safety is achieved in the tagout program equivalent to the level of safety obtained by the use of a lockout program, the employer shall demonstrate full compliance with all tagout-related provisions of this standard together with such additional elements as are necessary to provide the equivalent safety available from the use of a lockout device. Additional means to be considered as part of the demonstration of full employee protection shall include the implementation of additional safety measures such as the removal of an isolating circuit element, blocking of a controlling switch, opening of an extra disconnecting device, or the removal of a valve handle to reduce the likelihood of inadvertent energizing.

(3) Whenever replacement or major repair, renovation, or modification of a machine or equipment is performed, and whenever new machines or equipment are installed, energy isolating devices for such machines or equipment shall be designed to accept a lockout device.

(4) Procedures shall be developed, documented, and used for the control of potentially hazardous energy covered by this section.

(5) The procedure shall clearly and specifically outline the scope, purpose, responsibility, authorization, rules, and techniques to be applied to the control of hazardous energy, and the measures to enforce compliance including, but not limited to, the following:

(a) A specific statement of the intended use of this procedure;

(b) Specific procedural steps for shutting down, isolating, blocking and securing machines or equipment to control hazardous energy;

(c) Specific procedural steps for the placement, removal, and transfer of lockout devices or tagout devices and the responsibility for them; and

(d) Specific requirements for testing a machine or equipment to determine and verify the effectiveness of lockout devices, tagout devices, and other energy control measures.

(6) The employer shall conduct a periodic inspection of the energy control procedure at least annually to ensure that the procedure and the provisions of this section are being followed.

(a) The periodic inspection shall be performed by an authorized/designated employee who is not using the energy control procedure being inspected.

(b) The periodic inspection shall be designed to identify and correct any deviations or inadequacies.

(c) If lockout is used for energy control, the periodic inspection shall include a review, between the inspector and each authorized/designated employee, of that employee's responsibilities under the energy control procedure being inspected.

(d) Where tagout is used for energy control, the periodic inspection shall include a review, between the inspector and each authorized/designated and affected employee, of that employee's responsibilities under the energy control procedure being inspected, and the elements set forth in this section.

(e) The employer shall certify that the inspections required by this section have been accomplished. The certification shall identify the machine or equipment on which the energy control procedure was being used, the date of the inspection, the employees included in the inspection, and the person performing the inspection.

Note: If normal work schedule and operation records demonstrate adequate inspection activity and contain the required information, no additional certification is required.

(7) The employer shall provide training to ensure that the purpose and function of the energy control program are understood by employees and that the knowledge and skills required for the safe application, usage, and removal of energy controls are acquired by employees. The training shall include the following:

(a) Each authorized/designated employee shall receive training in the recognition of applicable hazardous energy sources, the type and magnitude of energy available in the workplace, and in the methods and means necessary for energy isolation and control.

(b) Each affected employee shall be instructed in the purpose and use of the energy control procedure.

(c) All other employees whose work operations are or may be in an area where energy control procedures may be used shall be instructed about the procedures and about the prohibition relating to attempts to restart or reenergize machines or equipment that are locked out or tagged out.

(8) When tagout systems are used, employees shall also be trained in the following limitations of tags:

(a) Tags are essentially warning devices affixed to energy isolating devices and do not provide the physical restraint on those devices that is provided by a lock.

(b) When a tag is attached to an energy isolating means, it is not to be removed without authorization of the authorized/designated person responsible for it, and it is never to be bypassed, ignored, or otherwise defeated.

(c) Tags must be legible and understandable by all authorized/designated employees, affected employees, and all other employees whose work operations are or may be in the area, in order to be effective.

(d) Tags and their means of attachment must be made of materials which will withstand the environmental conditions encountered in the workplace.

(e) Tags may evoke a false sense of security, and their meaning needs to be understood as part of the overall energy control program.

(f) Tags must be securely attached to energy isolating devices so that they cannot be inadvertently or accidentally detached during use.

AMENDATORY SECTION (Amending WSR 98-07-009, filed 3/6/98, effective 5/6/98)

WAC 296-45-17510 Retraining. (1) Retraining shall be provided for all authorized/designated and affected employees whenever there is a change in their job assignments, a change in machines, equipment, or processes that present a new hazard or whenever there is a change in the energy control procedures.

(2) Retraining shall also be conducted whenever a periodic inspection reveals, or whenever the employer has reason to believe, that there are deviations from or inadequacies in an employee's knowledge or use of the energy control procedures.

(3) The retraining shall reestablish employee proficiency and shall introduce new or revised control methods and procedures, as necessary.

(4) The employer shall certify that employee training has been accomplished and is being kept up to date. The certification shall contain each employee's name and dates of training.

AMENDATORY SECTION (Amending WSR 98-07-009, filed 3/6/98, effective 5/6/98)

WAC 296-45-17515 Protective materials and hardware. (1) Locks, tags, chains, wedges, key blocks, adapter pins, self-locking fasteners, or other hardware shall be provided by the employer for isolating, securing, or blocking of machines or equipment from energy sources.

(2) Lockout devices and tagout devices shall be singularly identified; shall be the only devices used for controlling energy; may not be used for other purposes; and shall meet the following requirements:

(a) Lockout devices and tagout devices shall be capable of withstanding the environment to which they are exposed for the maximum period of time that exposure is expected.

(b) Tagout devices shall be constructed and printed so that exposure to weather conditions or wet and damp locations will not cause the tag to deteriorate or the message on the tag to become illegible.

(c) Tagout devices shall be so constructed as not to deteriorate when used in corrosive environments.

(3) Lockout devices and tagout devices shall be standardized within the facility in at least one of the following criteria: Color, shape, size. Additionally, in the case of tagout devices, print and format shall be standardized.

(4) Lockout devices shall be substantial enough to prevent removal without the use of excessive force or unusual techniques, such as with the use of bolt cutters or metal cutting tools.

(5) Tagout devices, including their means of attachment, shall be substantial enough to prevent inadvertent or accidental removal. Tagout device attachment means shall be of a nonreusable type, attachable by hand, self-locking, and nonreleasable with a minimum unlocking strength of no less than fifty pounds and shall have the general design and basic characteristics of being at least equivalent to a one-piece, all-environment-tolerant nylon cable tie.

(6) Each lockout device or tagout device shall include provisions for the identification of the employee applying the device.

(7) Tagout devices shall warn against hazardous conditions if the machine or equipment is energized and shall include a legend such as the following: Do Not Start, Do Not Open, Do Not Close, Do Not Energize, Do Not Operate.

Note: ((~~For specific provisions covering accident prevention tags, see chapter 296-24 W~~AC.)) See ANSI Z535.5, 2011 for the format and design criteria of danger/warning tags.

AMENDATORY SECTION (Amending WSR 98-07-009, filed 3/6/98, effective 5/6/98)

WAC 296-45-17520 Energy isolation. Lockout and tagout device application and removal may only be performed by the authorized/designated employees who are performing the servicing or maintenance.

AMENDATORY SECTION (Amending WSR 98-07-009, filed 3/6/98, effective 5/6/98)

WAC 296-45-17525 Notification. Affected employees shall be notified by the employer or authorized/designated employee of the application and removal of lockout or tagout devices. Notification shall be given before the controls are applied and after they are removed from the machine or equipment.

Note: This section requires that the second notification take place before the machine or equipment is reenergized.

AMENDATORY SECTION (Amending WSR 98-07-009, filed 3/6/98, effective 5/6/98)

WAC 296-45-17530 Lockout/tagout application. The established procedures for the application of energy control (the lockout or tagout procedures) shall include the following elements and actions, and these procedures shall be performed in the following sequence:

(1) Before an authorized/designated or affected employee turns off a machine or equipment, the authorized/designated employee shall have knowledge of the type and magnitude of the energy, the hazards of the energy to be controlled, and the method or means to control the energy.

(2) The machine or equipment shall be turned off or shut down using the procedures established for the machine or equipment. An orderly shutdown shall be used to avoid any additional or increased hazards to employees as a result of the equipment stoppage.

(3) All energy isolating devices that are needed to control the energy to the machine or equipment shall be physically located and operated in such a manner as to isolate the machine or equipment from energy sources.

(4) Lockout or tagout devices shall be affixed to each energy isolating device by authorized/designated employees.

(a) Lockout devices shall be attached in a manner that will hold the energy isolating devices in a "safe" or "off" position.

(b) Tagout devices shall be affixed in such a manner as will clearly indicate that the operation or movement of energy isolating devices from the "safe" or "off" position is prohibited.

(5) Where tagout devices are used with energy isolating devices designed with the capability of being locked out, the tag attachment shall be fastened at the same point at which the lock would have been attached.

(6) Where a tag cannot be affixed directly to the energy isolating device, the tag shall be located as close as safely possible to

the device, in a position that will be immediately obvious to anyone attempting to operate the device.

AMENDATORY SECTION (Amending WSR 98-07-009, filed 3/6/98, effective 5/6/98)

WAC 296-45-17535 Releasing stored energy. Following the application of lockout or tagout devices to energy isolating devices, all potentially hazardous stored or residual energy shall be relieved, disconnected, restrained, or otherwise rendered safe.

(1) If there is a possibility of reaccumulation of stored energy to a hazardous level, verification of isolation shall be continued until the servicing or maintenance is completed or until the possibility of such accumulation no longer exists.

(2) Before starting work on machines or equipment that have been locked out or tagged out, the authorized/designated employee shall verify that isolation and deenergizing of the machine or equipment have been accomplished. If normally energized parts will be exposed to contact by an employee while the machine or equipment is deenergized, a test shall be performed to ensure that these parts are deenergized.

AMENDATORY SECTION (Amending WSR 98-07-009, filed 3/6/98, effective 5/6/98)

WAC 296-45-17540 Release from lockout/tagout. Before lockout or tagout devices are removed and energy is restored to the machine or equipment, procedures shall be followed and actions taken by the authorized/designated employees to ensure the following:

(1) The work area shall be inspected to ensure that nonessential items have been removed and that machine or equipment components are operationally intact.

(2) The work area shall be checked to ensure that all employees have been safely positioned or removed.

(3) After lockout or tagout devices have been removed and before a machine or equipment is started, affected employees shall be notified that the lockout or tagout devices have been removed.

(4) Each lockout or tagout device shall be removed from each energy isolating device by the authorized/designated employee who applied the lockout or tagout device. However, if that employee is not available to remove it, the device may be removed under the direction of the employer, provided that specific procedures and training for such removal have been developed, documented, and incorporated into the employer's energy control program. The employer shall demonstrate that the specific procedure provides a degree of safety equivalent to that provided by the removal of the device by the authorized/designated employee who applied it. The specific procedure shall include at least the following elements:

(a) Verification by the employer that the authorized/designated employee who applied the device is not at the facility;

(b) Making all reasonable efforts to contact the authorized/designated employee to inform him or her that his or her lockout or tagout device has been removed; and

(c) Ensuring that the authorized/designated employee has this knowledge before he or she resumes work at that facility.

AMENDATORY SECTION (Amending WSR 99-09-080, filed 4/20/99, effective 8/1/99)

WAC 296-45-17550 Group lockout/tagout. When servicing or maintenance is performed by a crew, craft, department, or other group, they shall use a procedure which affords the employees a level of protection equivalent to that provided by the implementation of a personal lockout or tagout device. Group lockout or tagout devices shall be used in accordance with the procedures required by the following specific requirements:

(1) Primary responsibility shall be vested in an authorized/designated employee for a set number of employees working under the protection of a group lockout or tagout device (such as an operations lock);

(2) Provision shall be made for the authorized/designated employee to ascertain the exposure status of all individual group members with regard to the lockout or tagout of the machine or equipment;

(3) When more than one crew, craft, department, or other group is involved, assignment of overall job-associated lockout or tagout control responsibility shall be given to an authorized/designated employee designated to coordinate affected work forces and ensure continuity of protection; and

(4) Each authorized/designated employee shall affix a personal lockout or tagout device to the group lockout device, group lockbox, or comparable mechanism when he or she begins work and shall remove those devices when he or she stops working on the machine or equipment being serviced or maintained.

AMENDATORY SECTION (Amending WSR 98-07-009, filed 3/6/98, effective 5/6/98)

WAC 296-45-17565 Central system operator. If energy isolating devices are installed in a central location under the exclusive control of a system operator, the following requirements apply:

(1) The employer shall use a procedure that affords employees a level of protection equivalent to that provided by the implementation of a personal lockout or tagout device.

(2) The system operator shall place and remove lockout and tagout devices in place of the authorized/designated employee.

(3) Provisions shall be made to identify the authorized/designated employee who is responsible for (that is, being protected by) the lockout or tagout device, to transfer responsibility for lockout and tagout devices, and to ensure that an authorized/designated employee requesting removal or transfer of a lockout or tagout device is the one responsible for it before the device is removed or transferred.

AMENDATORY SECTION (Amending WSR 98-07-009, filed 3/6/98, effective 5/6/98)

WAC 296-45-205 Enclosed spaces. This section covers enclosed spaces that may be entered by employees. It does not apply to vented vaults if the employer makes a determination ((~~is made~~)) that the ventilation system is operating to protect employees before they enter the space. This ((~~paragraph~~)) section applies to routine entry into enclosed spaces in lieu of the permit-space entry requirements contained in chapter 296-809 WAC ((~~296-62-145~~)). If, after the employer takes the precautions given in WAC 296-45-205, 296-45-215, and 296-45-225 ((~~are taken~~)), the hazards remaining in the enclosed space endanger the life of an entrant or could interfere with an entrant's escape from the space, then entry into the enclosed space shall meet the permit-space entry requirements of chapter 296-809 WAC ((~~296-62-145~~)).

Note: Entries into enclosed spaces conducted in accordance with the permit-space entry requirements of chapter 296-809 WAC ((~~296-62-145~~)) are considered as complying with this section.

(1) "Safe work practices." The employer shall ensure the use of safe work practices for entry into, and work in, enclosed spaces and for rescue of employees from such spaces.

(2) "Training." Each employee((~~s~~)) who enters an enclosed space((~~s~~)) or who serves as an attendant((~~s~~)) shall be trained in the hazards of enclosed space entry, in enclosed space entry procedures, and in enclosed space rescue procedures.

(3) "Rescue equipment." Employers shall provide equipment to ensure the prompt and safe rescue of employees from the enclosed space.

(4) "((~~Evaluation~~)) Evaluating of potential hazards." Before any entrance cover to an enclosed space is removed, the employer shall determine whether it is safe to do so by checking for the presence of any atmospheric pressure or temperature differences and by evaluating whether there might be a hazardous atmosphere in the space. Any conditions making it unsafe to remove the cover shall be eliminated before the cover is removed.

Note: The ((~~evaluation~~)) determination called for in this subsection may ((~~take the form~~)) consist of a check of the conditions ((~~expected to~~)) that might foreseeably be in the enclosed space. For example, the cover could be checked to see if it is hot and, if it is fastened in place, could be loosened gradually to release any residual pressure. ((~~A determination must~~)) An evaluation also needs to be made of whether conditions at the site could cause a hazardous atmosphere, such as an oxygen deficient or flammable atmosphere, to develop within the space.

(5) "((~~Removal of~~)) Removing covers." When covers are removed from enclosed spaces, the opening shall be promptly guarded by a railing, temporary cover, or other barrier ((~~intended~~)) designed to prevent an accidental fall through the opening and to protect employees working in the space from objects entering the space.

(6) "Hazardous atmosphere." Employees may not enter any enclosed space while it contains a hazardous atmosphere, unless the entry conforms to the ((~~generic~~)) permit-required confined spaces standard in chapter 296-809 WAC ((~~296-62-145 through 296-62-14543~~)).

Note: The term "entry" is defined in chapter 296-809 WAC ((~~296-62-14501~~)).

(7) "Attendants." While work is being performed in the enclosed space, ((~~a person~~)) an attendant with first-aid training ((~~meeting WAC 296-45-125~~)) shall be immediately available outside the enclosed space to ((~~render emergency~~)) provide assistance if ((~~there is reason to believe that~~)) a hazard ((~~may~~)) exists ((~~in the space or if a hazard exists~~)) because of traffic patterns in the area of the opening used for entry. ((~~That person~~)) The attendant is not precluded from performing other duties outside the enclosed space if these duties do not dis-

tract the attendant from monitoring employees within the space or ensuring that it is safe for employees to enter and exit the space.

Note: See WAC 296-45-215(12) for additional requirements on attendants for work in manholes.

(8) "Calibration of test instruments." Test instruments used to monitor atmospheres in enclosed spaces shall be kept in calibration((~~, with~~)) and shall have a minimum accuracy of + or - 10 percent.

(9) "Testing for oxygen deficiency." Before an employee enters an enclosed space, the ((~~internal~~)) atmosphere in the enclosed space shall be tested for oxygen deficiency with a direct-reading meter or similar instrument, capable of collection and immediate analysis of data samples without the need for off-site evaluation. If continuous forced air ventilation is provided, testing is not required provided that the procedures used ensure that employees are not exposed to the hazards posed by oxygen deficiency.

(10) "Testing for flammable gases and vapors." Before an employee enters an enclosed space, the internal atmosphere shall be tested for flammable gases and vapors with a direct-reading meter or similar instrument capable of collection and immediate analysis of data samples without the need for off-site evaluation. This test shall be performed after the oxygen testing and ventilation required by subsection (9) of this section demonstrate that there is sufficient oxygen to ensure the accuracy of the test for flammability.

(11) "Ventilation and monitoring for flammable gases or vapors." If flammable gases or vapors are detected or if an oxygen deficiency is found, forced air ventilation shall be used to maintain oxygen at a safe level and to prevent a hazardous concentration of flammable gases and vapors from accumulating. A continuous monitoring program to ensure that no increase in flammable gas or vapor concentration above safe levels occurs may be followed in lieu of ventilation((~~,~~)) if flammable gases or vapors are initially detected at safe levels.

Note: See the definition of hazardous atmosphere for guidance in determining whether ((~~or not a given~~)) a specific concentration of a substance is ((~~considered to be~~)) hazardous.

(12) "Specific ventilation requirements." If continuous forced air ventilation is used, it shall begin before entry is made and shall be maintained long enough for the employer to ((~~ensure~~)) be able to demonstrate that a safe atmosphere exists before employees are allowed to enter the work area. The forced air ventilation shall be so directed as to ventilate the immediate area where employees are present within the enclosed space and shall continue until all employees leave the enclosed space.

(13) "Air supply." The air supply for the continuous forced air ventilation shall be from a clean source and may not increase the hazards in the enclosed space.

(14) "Open flames." 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.

Note: See the definition of hazardous atmosphere for guidance in determining whether ((~~or not a given~~)) a specific concentration of a substance is ((~~considered to be~~)) hazardous.

AMENDATORY SECTION (Amending WSR 99-09-080, filed 4/20/99, effective 8/1/99)

WAC 296-45-215 Underground electrical installations. This section provides additional requirements for work on underground electrical installations.

(1) Protective barriers, or approved guards and warning signs must be erected before removing manhole covers or making excavations in places accessible to vehicular or pedestrian traffic.

(2) Whenever an opening is made in the street, it shall be properly guarded or covered until same is closed and whenever an obstruction is left in the roadway after dark, it shall be marked with approved lights, flares or similar devices.

(3) Access. 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.

(4) When work is to be performed in a manhole or unvented vault:

(a) No entry shall be permitted unless the atmosphere is found to be safe by testing for the presence of explosive or potentially hazardous gases or fumes.

(b) No entry shall be permitted unless the atmosphere has been found safe by testing for oxygen deficiency or forced ventilation is provided.

(c) When unsafe conditions are detected, by testing or other means, the work area shall be ventilated and otherwise made safe before entry.

(d) Provisions shall be made for a continuous supply of air as provided for in Part L, chapter 296-62 WAC.

(e) When forced ventilation is not used a method of monitoring said manhole or vault so as to prevent the occurrence of oxygen deficiency due to work being performed in said manhole or vault, and to detect the presence of any explosive gases or fumes which may occur while the employees are working in said manhole or vault.

(5) When open flames are used or smoking is permitted in manholes, adequate mechanical forced air ventilation shall be used.

(6) Before using open flames in a manhole or excavation in an area where combustible gases or liquids may be present, such as near a gasoline service station, the atmosphere of the manhole or excavation shall be tested and found safe or cleared of the combustible gases or liquids prior to the entry.

(7) When work is to be performed in manholes containing any wires or appliances carrying electrical current, they shall be in a sanitary condition.

(8) Care shall be taken to prevent the possibility of vehicles or pedestrians coming in contact with the wires and equipment.

(9) Lowering equipment into manholes. 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 materials are lowered into the opening for a manhole or vault, each employee working in the manhole or vault shall be clear of the area directly under the opening.

(10) Materials shall not be thrown into or out of manholes but shall be placed in the proper receptacle and hoisted in and out by means of a rope.

(11) Tools and materials shall not be left on the ground around or near the manhole opening where they might be pushed or otherwise fall into the hole.

(12) Attendants for manholes.

(a) An attendant shall be kept at the surface when there is any hazard to the employees in the manhole and the attendant should not leave the manhole unwatched until such time as all employees are out and the cover has been replaced.

(b) While work is being performed in a manhole containing energized electric equipment, an employee with first aid and CPR training meeting WAC 296-45-125(1) shall be available on the surface in the immediate vicinity to render emergency assistance.

((~~Note 1:~~)) Notes:

- An attendant may also be required under WAC 296-45-205(7). One person may serve to fulfill both requirements. However, attendants required under WAC 296-45-205(7) are not permitted to enter the manhole.

((~~Note 2:~~))

- Employees entering manholes containing unguarded, uninsulated energized lines or parts of electric equipment operating at 50 volts or more are required to be qualified electrical employees under WAC ((~~296-45-325 (1) through (4)~~)) 296-45-065.

(c) No work shall be permitted to be done in any manhole or subway on any energized wire, cable or appliance carrying more than 300 volts of electricity by less than two qualified ((~~persons~~)) electrical employees who shall at all times, while performing such work, be in the same manhole or subway in which work is being done. This rule shall not apply to work on telephone, telegraph or signal wires or cables.

(d) 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 employer can demonstrate that the employee will be protected from all electrical hazards.

(e) Reliable communications, through two-way radios or other equivalent means, shall be maintained among all employees involved in the job.

(13) Cable in manholes or underground vaults shall be accessible to employees and a clear working space shall be maintained at all times; and/or approved protective guards, barriers, etc., when installed shall be considered as providing adequate working clearance for cables over 5 k.v. If a manhole and/or underground vault is determined to have an electrical or structural hazard, no work shall be done in the manhole and/or vault until the unsafe condition is corrected or deenergized.

(14) No work shall be performed on cables or equipment unless they have been properly identified by an approved method.

(15) Duct rods. 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.

(16) Multiple cables. 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.

(17) Before cutting into a high voltage cable or opening a high voltage splice, the cable shall be deenergized then clearance obtained, tested and then grounded in an approved manner. The cable to be worked on shall be identified by tags or equivalent means.

(18) Moving cables. Energized cables that are to be moved shall be inspected for defects.

(19) Insulated platforms or other protective devices shall be provided when work is to be done on energized wires or equipment in manholes.

(20) Furnaces shall always be placed in a secure, level position on the downhill side of the manhole to avoid spillage of hot metals or compounds into the manhole.

(21) Pulling underground cable. When pulling cable(s) all employees shall be made aware of the hazard of being caught in the sheaves, lashings or winch gears. All employees shall stand clear of the pulling line when the pull is begun or when the line is under tension. This rule applies to all work performed by means of a winch.

(22) Fishing conduit or ducts. When fishing conduit or ducts, it shall first be determined that the fish tape or wires will not contact any energized line or equipment.

(23) WAC 296-45-335 on clearances shall be complied with. Also WAC 296-45-345 and/or WAC 296-45-355 on grounding shall be complied with.

(24) Defective cables. 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 deenergized 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 cables 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.

(25) Sheath continuity. When work is performed on buried cable or on cable in manholes, metallic sheath continuity shall be maintained by bonding across the opening (or by equivalent means), or the cable sheath shall be treated as energized.

AMENDATORY SECTION (Amending WSR 98-07-009, filed 3/6/98, effective 5/6/98)

WAC 296-45-225 Underground residential distribution (URD). (1) General.

(a) Each employee shall be knowledgeable of the equipment provided for their use and shall at all times use this equipment only for the purpose intended.

(b) U.R.D. cables which are properly insulated for the voltages to which they are energized shall be considered as an effective barrier to protect the employees and table ((~~one~~)) two need not apply.

(i) Workers will take adequate precautions to avoid physical contact with energized U.R.D. cable by using approved procedures and/or protective devices.

(ii) When handling energized U.R.D. primary cables, the work shall be done with approved tools and/or procedures by two qualified electrical employees. Switching is exempt from this rule.

(iii) When energized terminators or load-break elbows are handled by a hot stick, there shall be two qualified electrical employees at the scene.

(c) When energized pad-mounted transformers or similar equipment are to be left unlocked and open, they shall be attended by a ((~~qualified~~)) designated employee.

(d) Approved tools and procedures shall be used to remove any debris, vines, weeds, etc., from an underground system.

(e) A primary and secondary system neutral on any energized circuit shall not be opened under any circumstances except for testing.

(f) Primary and secondary neutrals shall be firmly connected and grounded before the circuit or equipment is energized.

(g) Where different phases are in the same vault, enclosures, or parked in some manner that they could be looped, these phases shall be marked or identified.

(h) Bayonet fuses:

(i) Bayonet fuses shall not be closed into suspected faults or overloads.

(ii) Submersible U.G. transformer installations will require other methods of energizing or deenergizing and bayonet fuses shall not be used for this purpose.

(iii) Bayonet fuses shall only be operated after pad-mount transformers have been properly vented.

(iv) Bayonet fuses shall only be operated in accordance with manufacturing design and rating capabilities.

(2) Working on cables.

(a) Before any work is to be performed on underground cables and apparatus carrying high voltage, they shall be deenergized with the following exceptions:

(i) Replacing fuses, operating switches, closing or opening load-break elbows, when approved protective devices are used.

(ii) Work in the high-voltage compartment of pad-mounted transformers and similar equipment installed above ground, provided the work is done by approved methods.

(b) Only one energized conductor shall be worked on at any one time, and protective means shall be used to insulate or isolate it from all others.

(c) When work is to be performed in manholes containing any wires or appliances carrying electrical current, they shall be in a sanitary condition.

AMENDATORY SECTION (Amending WSR 03-17-071, filed 8/19/03, effective 11/1/03)

WAC 296-45-255 Protective equipment. (1) Rubber protective equipment must be in accordance with and tested as follows:

Item	Standard
Rubber Insulating Gloves	(ASTM) D 120-2002
Rubber Matting for Use Around Electrical Apparatus	(ASTM) D 178-2001
Rubber Insulating Blankets	(ASTM) D 1048-1999
Rubber Insulating Hoods	(ASTM) D 1049-2002
Rubber Insulating Line Hose	(ASTM) D 1050-1999
Rubber Insulating Sleeves	(ASTM) D 1051-2002

(2) No protective equipment or material other than rubber shall be used: Provided, That such other nonconductive equipment may be used if it provides equal or better (dielectric) electrical and mechanical protection than rubber protective equipment: Provided, That the employer obtain before placing in service, manufacturer's data or other data to demonstrate that such nonrubber protective equipment provided equal or better electrical and mechanical protection than approved rubber equipment.

(3) Protective equipment shall not be used at voltages in excess of that for which the manufacturer has supplied data to the employer demonstrating that it is fit for such voltages.

(4) No protective equipment shall be modified, altered, or used for purposes other than those for which it is designed unless and until the manufacturer has, in writing, agreed or suggested that there be such modification, alteration, or use.

(5) Each rubber glove before it is used shall be inspected for defects and an approved air test performed. If, upon inspection, rubber gloves are either defective or appear to be defective, they shall not be used.

(6) Before being placed in service, all rubber protective equipment shall be numbered and records kept for test purposes and assignment.

(7) Rubber protective equipment shall not be used unless it has been dielectrically tested within six months and bears marking or identification of the date of the test or the expiration date.

(8) Protector gloves must be worn over insulating gloves.

Exception: Protector gloves need not be used with Class 0 gloves, under limited-use conditions, where small equipment and parts manipulation necessitate unusually high finger dexterity.

Note: Extra care is needed in the visual examination of the glove and in the avoidance of handling sharp objects.

(9) Rubber gloves when not in use shall be carried in an approved bag provided and designed for that purpose. It shall be provided by the employer and made available to the employees.

(10) Approved rubber gloves and carrying bag shall be assigned to each employee who works with, or is exposed to energized parts.

(11) Rubber protective equipment shall not be vulcanized or patched.

(12) A compartment or box shall be provided on each electric line truck, which box or compartment shall be used for storing rubber protective equipment. No equipment shall be stored in said compartment or box which can or could cause damage to the rubber equipment or goods placed in the compartment or box. Additionally, a separate container or compartment shall be provided for rubber blankets.

(13) Line hose shall not be doubled on themselves at any time. All blankets before storage must be wiped clean and rolled, not folded, before being placed in the container or box.

(14) Protective line equipment of material other than rubber shall be kept clean and visually inspected before each use.

(15) If protective line equipment of material other than rubber is found to be substantially defective or unsuitable for the purpose for which it is designed and intended, said protective line equipment shall not be used for personal protection of employees as may be required in Table ((~~1~~)) 2 of this chapter. Said protective line equipment shall be marked defective but may be otherwise used unless the defect or damage to said protective line equipment creates additional safety hazards.

AMENDATORY SECTION (Amending WSR 09-05-071, filed 2/17/09, effective 4/1/09)

WAC 296-45-25505 Personal protective equipment. (1) General. Personal protective equipment (PPE) shall meet the requirements of chapter 296-24 WAC, Part L and the PPE requirements in chapter 296-800 WAC. PPE required by these chapters or a hazard assessment will be provided by the employer at no cost to the employee.

(2) All protective hats shall be in accordance with the specifications of ANSI ((~~Z89.2-1971 Edition Industrial Protective Helmets for Electrical Workers~~)) Z89.1-2014, American National Standard for Industrial Head Protection Type II, Class ((~~B~~)) E, and shall be worn at the job site by employees who are exposed to overhead or electrical hazards.

(3) ((~~Wearing apparel.~~)) Goggles, hearing protection, respirators, rubber gloves, and other such personal protective devices shall not be interchanged among employees unless they have been sanitized.

AMENDATORY SECTION (Amending WSR 13-04-073, filed 2/4/13, effective 4/1/13)

WAC 296-45-25510 Fall protection. (1) Personal fall arrest ((~~equipment~~)) systems shall meet the requirements of chapter 296-155 WAC, Part C-1, Fall protection requirements for construction.

(2) ((~~Specific requirements for lineman's belts, safety straps and lanyards.~~

~~(a)All fabric used for safety straps must withstand an A.C. dielectric test of not less than 25,000 volts per foot "dry" for 3 minutes, without visible deterioration.~~

~~(b)All fabric and leather used must be tested for leakage current and must not exceed 1 milliampere when a potention of 3,000 volts is applied to the electrodes positioned 12 inches apart.~~

~~(c)Direct current tests may be permitted in lieu of alternating current tests.~~

~~(d)The cushion part of the body belt must:~~

~~(i) Contain no exposed rivets on the inside;~~

~~(ii) Be at least three (3) inches in width;~~

(iii)~~Be at least five thirty-seconds (5/32) inch thick, if made of leather; and~~

(iv)~~Have pocket tabs that extended at least 1 1/2 inches down and three (3) inches back of the inside of circle of each D ring for riveting on plier or tool pockets. On shifting D belts, this measurement for pocket tabs must be taken when the D ring section is centered.~~

~~(e)A maximum of four (4) tool loops must be so situated on the body belt that four (4) inches of the body belt in the center of the back, measuring from D ring to D ring, must be free of tool loops, and any other attachments.~~

~~(f)Suitable copper, steel, or equivalent liners must be used around bar of D rings to prevent wear between these members and the leather or fabric enclosing them.~~

~~(g)All stitching must be of a minimum 42-pound weight nylon or equivalent thread and must be lock stitched. Stitching parallel to an~~

~~edge must not be less than three-sixteenths (3/16) inch from edge of narrowest member caught by the thread. The use of cross stitching on leather is prohibited.~~

~~(h)The keeper of snaphooks must have a spring tension that will not allow the keeper to begin to open with a weight of 2 1/2 pounds or less, but the keeper of snaphooks must begin to open with a weight of four (4) pounds, when the weight is supported on the keeper against the end of the nose.~~

~~(i)Testing of lineman's safety straps, body belts and lanyards must be in accordance with the following procedure:~~

~~(i)Attach one end of the safety strap or lanyard to a rigid support, the other end must be attached to a 250-pound canvas bag of sand;~~

~~(ii)Allow the 250-pound canvas bag of sand to free fall 4 feet for (safety strap test) and 6 feet for (lanyard test); in each case stopping the fall of the 250-pound bag;~~

~~(iii)Failure of the strap or lanyard must be indicated by any breakage, or slippage sufficient to permit the bag to fall free of the strap or lanyard. The entire "body belt assembly" must be tested using one D ring. A safety strap or lanyard must be used that is capable of passing the "impact loading test" and attached as required in (i)(i) of this subsection. The body belt must be secured to the 250-pound bag of sand at a point to simulate the waist of a man and allowed to drop as stated in (i)(ii) of this subsection. Failure of the body belt must be indicated by any breakage, or slippage sufficient to permit the bag to fall free of the body belt.~~

(3)~~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.~~

(4)~~Employees shall not wear climbers while doing work where they are not required. Employees shall not continue to wear their climbers while working on the ground; except for momentary or short periods of time on the ground.~~

(5)~~Employees, when working from a hook ladder, must either belt themselves securely to the ladder, attach themselves to the structures by means of a safety line, or belt themselves to ladder safety equipment, which shall consist of a safety rope or belting threaded through the rungs or secured to the ladder at intervals of not more than three feet.~~

(6)~~Before an employee throws his/her weight on a belt, the employee shall determine that the snap or fasteners are properly engaged.~~

(7)~~Safety straps shall not be placed around poles above the cross-arm except where it is not possible for the strap to slide or be slipped over the top of the pole by inadvertence of the employee. Neither end of the strap shall be allowed to hang loose or dangle while the employee is ascending or descending poles or other structures.~~

(8)~~Body belts and safety straps shall not be stored with sharp-edged tools or near sharp objects. When a body belt, safety strap and climbers are kept in the same container, they shall be stored in such a manner as to avoid cutting or puncturing the material of the body belt or safety strap with the gaffs or climbers.~~

(9)~~Employees shall not attach metal hooks or other metal devices to body belts. Leather straps or rawhide thongs shall have hardwood or fibre crossbars. Leather straps and rawhide thongs shall not have metal or other conductive crossbars on them.~~

(10)~~Climbing gaffs shall be kept properly sharpened and shall be at least 1-1/8 inches in length.~~

(11)~~Lifelines shall be protected against being cut or abraded.~~

~~(12) 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. Fall protection equipment is not required to be used by a qualified employee climbing or changing location on poles, towers, or similar structures, unless conditions, such as, but not limited to, ice, high winds, the design of the structure (for example, no provision for holding on with hands), or the presence of contaminants on the structure, could cause the employee to lose his or her grip or footing.~~

~~Note 1:~~ ~~This subsection applies to structures that support overhead electric power generation, transmission, and distribution lines and equipment. It does not apply to portions of buildings, such as loading docks, to electric equipment, such as transformers and capacitors, nor to aerial lifts. Requirements for fall protection associated with walking and working surfaces are contained in chapter 296-155 WAC, Part C-1, Fall protection requirements for construction requirements for fall protection associated with aerial lifts are contained in chapter 296-869 WAC, Elevating work platforms.~~

~~Note 2:~~ ~~Employees undergoing training are not considered "qualified employees" for the purposes of this provision. Unqualified employees (including trainees) are required to use fall protection any time they are more than 4 feet (1.2 m) above the ground.~~

~~(13)The following requirements apply to personal fall arrest systems:~~

~~(a)When stopping or arresting a fall, personal fall arrest systems shall limit the maximum arresting force on an employee to 1800 pounds (8 kN) if used with a body harness.~~

~~(b)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.~~

~~(14)If vertical lifelines or droplines are used, not more than one employee may be attached to any one lifeline.~~

~~(15)Snaphooks may not be connected to loops made in webbing-type lanyards.~~

~~(16)Snaphooks may not be connected to each other.~~)) Personal fall arrest equipment used by employees who are exposed to hazards from flames or electric arcs, as determined by the employer under WAC 296-45-325(13), shall be capable of passing a drop test equivalent to that required by subsection (3)(l) of this section after exposure to an electric arc with a heat energy of 40±5 cal/cm^2.

(3)Body belts and positioning straps for work-positioning equipment shall meet the following requirements:

(a)Hardware for body belts and positioning straps shall meet the following requirements:

(i)Hardware shall be made of drop-forged steel, pressed steel, formed steel, or equivalent material.

(ii)Hardware shall have a corrosion-resistant finish.

(iii)Hardware surfaces shall be smooth and free of sharp edges.

(b) Buckles shall be capable of withstanding an 8.9 kilonewton (2,000 pound-force) tension test with a maximum permanent deformation no greater than 0.4 millimeters (0.0156 inches).

(c)D-rings shall be capable of withstanding a 22 kilonewton (5,000 pound-force) tensile test without cracking or breaking.

(d)Snaphooks shall be capable of withstanding a 22 kilonewton (5,000 pound-force) tension test without failure.

Note: Distortion of the snaphook sufficient to release the keeper is considered to be tensile failure of a snaphook.

(e)Top grain leather or leather substitute may be used in the manufacture of body belts and positioning straps; however, leather and leather substitutes may not be used alone as a load-bearing component of the assembly.

(f) Plied fabric used in positioning straps and in load-bearing parts of body belts shall be constructed in such a way that no raw edges are exposed and the plies do not separate.

(g) Positioning straps shall be capable of withstanding the following tests:

(i) A dielectric test of 819.7 volts, AC, per centimeter (25,000 volts per foot) for three minutes without visible deterioration;

(ii) A leakage test of 98.4 volts, AC, per centimeter (3,000 volts per foot) with a leakage current of no more than 1 mA;

Note: Positioning straps that pass direct-current tests at equivalent voltages are considered as meeting this requirement.

(iii) Tension tests of 20 kilonewtons (4,500 pounds-force) for sections free of buckle holes and of 15 kilonewtons (3,500 pounds-force) for sections with buckle holes;

(iv) A buckle-tear test with a load of 4.4 kilonewtons (1,000 pounds-force); and

(v) A flammability test in accordance with Table 1.

Table 1 – Flammability Test

Test Method	Criteria for Passing the Test
Vertically suspend a 500 mm (19.7 inch) length of strapping supporting a 100 kg (220.5 lb) weight.	Any flames on the positioning strap shall self extinguish. The positioning strap shall continue to support the 100 kg (220.5 lb) mass.
Use a butane or propane burner with a 76 mm (3 inch) flame.	
Direct the flame to an edge of the strapping at a distance of 25 mm (1 inch).	
Remove the flame after 5 seconds.	
Wait for any flames on the positioning strap to stop burning.	

(h) The cushion part of the body belt shall contain no exposed rivets on the inside and shall be at least 76 millimeters (3 inches) in width.

(i) Tool loops shall be situated on the body of a body belt so that the 100 millimeters (4 inches) of the body belt that is in the center of the back, measuring from D-ring to D-ring, is free of tool loops and any other attachments.

(j) Copper, steel, or equivalent liners shall be used around the bars of D-rings to prevent wear between these members and the leather or fabric enclosing them.

(k) Snaphooks shall be of the locking type meeting the following requirements:

(i) The locking mechanism shall first be released, or a destructive force shall be placed on the keeper, before the keeper will open.

(ii) A force in the range of 6.7 N (1.5 lbf) to 17.8 N (4 lbf) shall be required to release the locking mechanism.

(iii) With the locking mechanism released and with a force applied on the keeper against the face of the nose, the keeper may not begin to open with a force of 11.2 N (2.5 lbf) or less and shall begin to open with a maximum force of 17.8 N (4 lbf).

(l) Body belts and positioning straps shall be capable of withstanding a drop test as follows:

(i) The test mass shall be rigidly constructed of steel or equivalent material with a mass of 100 kg (220.5 lbm). For work-positioning equipment used by employees weighing more than 140 kg (310 lbm) fully equipped, the test mass shall be increased proportionately (that is, the test mass must equal the mass of the equipped worker divided by 1.4).

(ii) For body belts, the body belt shall be fitted snugly around the test mass and shall be attached to the test-structure anchorage point by means of a wire rope.

(iii) For positioning straps, the strap shall be adjusted to its shortest length possible to accommodate the test and connected to the test-structure anchorage point at one end and to the test mass on the other end.

(iv) The test mass shall be dropped an unobstructed distance of 1 meter (39.4 inches) from a supporting structure that will sustain minimal deflection during the test.

(v) Body belts shall successfully arrest the fall of the test mass and shall be capable of supporting the mass after the test.

(vi) Positioning straps shall successfully arrest the fall of the test mass without breaking, and the arrest force may not exceed 17.8 kilonewtons (4,000 pounds-force). Additionally, snaphooks on positioning straps may not distort to such an extent that the keeper would release.

Note: When used by employees weighing no more than 140 kg (310 lbm) fully equipped, body belts and positioning straps that conform to American Society of Testing and Materials *Standard Specifications for Personal Climbing Equipment*, ASTM F887-12^{e1}, are deemed to be in compliance with (l) of this subsection.

(4) The following requirements apply to the care and use of personal fall protection equipment.

(a) Work-positioning equipment shall be inspected before use each day to determine that the equipment is in safe working condition. Work-positioning equipment that is not in safe working condition may not be used.

Note: Work-Positioning Equipment Inspection Guidelines are located in Appendix E of this chapter.

(b) Personal fall arrest systems shall be used in accordance with chapter 296-155 WAC, Part C-1.

Note: Fall protection equipment rigged to arrest falls is considered a fall arrest system and must meet the applicable requirements for the design and use of those systems. Fall protection equipment rigged for work positioning is considered work-positioning equipment and must meet the applicable requirements for the design and use of that equipment.

(c) The employer shall ensure that employees use fall protection systems as follows:

(i) Each employee working from an aerial lift shall use a fall restraint system or a personal fall arrest system.

(ii) Except as provided in (c)(iii) of this subsection, each employee in elevated locations more than 1.2 meters (4 feet) above the ground on poles, towers, or similar structures shall use a personal fall arrest system, work-positioning equipment, or fall restraint system, as appropriate, if the employer has not provided other fall protection meeting chapter 296-155 WAC, Part C-1.

(iii) Each qualified electrical employee climbing or changing location on poles, towers, or similar structures must use fall protection equipment unless the employer can demonstrate that climbing or changing location with fall protection is infeasible or creates a greater hazard than climbing or changing location without it.

Notes: • These subsections apply to structures that support overhead electric power transmission and distribution lines and equipment. They do not apply to portions of buildings, such as loading docks, or to electric equipment, such as transformers and capacitors. Chapter 296-155 WAC, Part C-1 contains the duty to provide fall protection associated with walking and working surfaces.
•Until the employer ensures that employees are proficient in climbing and the use of fall protection under WAC 296-45-065(8), the employees are not considered "qualified electrical employees" for the purposes of (c)(ii) and (iii) of this subsection. These subsections require unqualified employees (including trainees) to use fall protection any time they are more than 1.2 meters (4 feet) above the ground.

(d)Work-positioning systems shall be rigged so that an employee can free fall no more than 0.6 meters (2 feet).

(e)Anchorages for work-positioning equipment shall be capable of supporting at least twice the potential impact load of an employee's fall, or 13.3 kilonewtons (3,000 pounds-force), whichever is greater.

Note: Wood-pole fall-restriction devices meeting American Society of Testing and Materials *Standard Specifications for Personal Climbing Equipment*, ASTM F887-12^{e1}, are deemed to meet the anchorage-strength requirement when they are used in accordance with manufacturers' instructions.

(f)Unless the snaphook is a locking type and designed specifically for the following connections, snaphooks on work-positioning equipment may not be engaged:

(i) Directly to webbing, rope, or wire rope;

(ii) To each other;

(iii)To a D-ring to which another snaphook or other connector is attached;

(iv)To a horizontal lifeline; or

(v)To any object that is incompatibly shaped or dimensioned in relation to the snaphook such that accidental disengagement could occur should the connected object sufficiently depress the snaphook keeper to allow release of the object.

(5)Employees shall not wear climbers while doing work where they are not required. Employees shall not continue to wear their climbers while working on the ground; except for momentary or short periods of time on the ground.

(6)Employees, when working from a hook ladder, must either belt themselves securely to the ladder, attach themselves to the structures by means of a safety line, or belt themselves to ladder safety equipment, which shall consist of a safety rope or belting threaded through the rungs or secured to the ladder at intervals of not more than three feet.

(7)Before an employee throws their weight on a belt, the employee shall determine that the snap or fasteners are properly engaged.

(8)Safety straps shall not be placed around poles above the cross-arm except where it is not possible for the strap to slide or be slipped over the top of the pole by inadvertence of the employee. Neither end of the strap shall be allowed to hang loose or dangle while the employee is ascending or descending poles or other structures.

(9)Body belts and safety straps shall not be stored with sharp-edged tools or near sharp objects. When a body belt, safety strap and climbers are kept in the same container, they shall be stored in such a manner as to avoid cutting or puncturing the material of the body belt or safety strap with the gaffs or climbers.

(10)Employees shall not attach metal hooks or other metal devices to body belts. Leather straps or rawhide thongs shall have hardwood or fibre crossbars. Leather straps and rawhide thongs shall not have metal or other conductive crossbars on them.

(11)Climbing gaffs shall be kept properly sharpened and shall be at least 1-1/8 inches in length.

(12)Lifelines shall be protected against being cut or abraded.

(13) 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.

AMENDATORY SECTION (Amending WSR 01-11-038, filed 5/9/01, effective 9/1/01)

WAC 296-45-275 Ladders, platforms, and manhole steps. (1) General. Requirements for ladders contained in chapter ((~~296-24~~)) 296-876 WAC((~~, Part J-1, and WAC 296-800-290~~)) apply, except as specifically noted in subsection (2) of this section.

(2) Special ladders and platforms. Portable ladders and platforms used on structures or conductors in conjunction with overhead line work need not meet chapter ((~~296-24~~)) 296-876 WAC((~~, Part J-1, chapter 296-155 WAC, Part J or WAC 296-800-290~~)). However, these ladders and platforms shall meet the following requirements:

(a) Ladders and platforms shall be secured to prevent their becoming accidentally dislodged.

(b) Ladders and platforms may not be loaded in excess of the working loads for which they are designed.

(c) Ladders and platforms may be used only in applications for which they were designed.

(d) In the configurations in which they are used, ladders and platforms shall be capable of supporting without failure at least 2.5 times the maximum intended load.

(e) All ladders shall be handled and stored in such a manner as to prevent damage to the ladder.

(f) When ascending or descending a ladder, the employee shall face the ladder and have free use of both hands.

(g) All defective ladders shall be taken out of service and labeled as defective.

(h) When a ladder is being used which is not fixed or otherwise secured, there shall be an attendant to hold the ladder and watch traffic when the work is being done on streets, alleys, sidewalks, or in industrial plants or other places where there exists the possibility of accidental contact with the ladder by third persons or vehicles.

(i) When working on the ladder, employees shall, where possible, tie the top of the ladder to a substantial object to prevent falling unless the ladder is equipped with approved hooks which may be used for the same purpose.

(j) Portable ladders shall not be moved with employees on the ladder.

(k) No employee shall ascend or descend a rolling ladder while it is moving.

(l) No employee shall stand on the top two steps of a step ladder.

(m) No employee shall use a step ladder as a straight ladder.

(n) Ladders shall always be placed on a secure footing with both legs resting firmly on the lower surface.

(o) Ladders made by fastening cleats or similar devices across a single rail shall not be used.

(3) Conductive ladders. Portable metal ladders and other portable conductive ladders may not be used near exposed energized lines or equipment. However, in specialized high-voltage work, conductive lad-

ders shall be used where the employer can demonstrate that nonconductive ladders would present a greater hazard than conductive ladders.

Note: A greater electrical hazard would be static electricity such as might be found in extra high voltage substations.

(4) All conductive or metal ladders shall be prominently marked and identified as being conductive and shall be grounded when used near energized lines or equipment.

Note: See chapter ((~~296-24~~)) 296-876 WAC for additional ladder requirements.

AMENDATORY SECTION (Amending WSR 98-07-009, filed 3/6/98, effective 5/6/98)

WAC 296-45-295 Gasoline engine power chain saws. (1) Each chain saw placed into initial service after February 9, 1995, shall be equipped with a chain brake and shall otherwise meet the requirements of the ANSI ((~~B175.1-1991~~)) B175.1-2012 "Safety Requirements for Gasoline-Powered Chain Saws." Each chain saw placed into service before February 9, 1995, shall be equipped with a protective device that minimizes chain saw kickback, i.e., reduced kickback bar, chains, bar tip guard or chain brake. No chain-saw kickback device shall be removed or otherwise disabled.

(2) Gasoline-engine power saw operations shall meet the requirements of WAC ((~~296-54-515~~)) 296-54-537(10).

(3) The chain saw shall be operated and adjusted in accordance with the manufacturer's instructions.

(4) The employer must ensure that each chain saw, including any chain saw provided by an employee, is inspected before initial use during each workshift. At a minimum, the inspection shall include the following:

(a) Chain-saw chains, to assure proper adjustment;

(b) Chain-saw mufflers, to assure that they are operational and in place;

(c) Chain brakes and nose shielding devices, to assure that they are in place and function properly;

(5) The chain saw shall be fueled at least 10 feet (3 m) from any open flame or other source of ignition.

(6) The chain saw shall be started at least 10 feet (3 m) from the fueling area.

(7) The chain saw shall be started on the ground or where otherwise firmly supported. Drop-starting a chain saw is prohibited.

(8) The chain saw shall be started with the chain brake engaged.

(9) The chain saw shall be held with the thumbs and fingers of both hands encircling the handles during operation unless the employer demonstrates that a greater hazard is posed by keeping both hands on the chain saw in that particular situation.

(10) The chain-saw operator shall be certain of footing before starting to cut. The chain saw shall not be used in a position or at a distance that could cause the operator to become off-balance, to have insecure footing, or to relinquish a firm grip on the saw.

(11) Prior to felling any tree, the chain saw operator shall clear away brush or other potential obstacles which might interfere with cutting the tree or using the retreat path.

(12) The chain saw shall not be used to cut directly overhead.

(13) The chain saw shall be carried in a manner that will prevent operator contact with the cutting chain and muffler.

(14) The chain saw shall be shut off or at idle before the feller starts their retreat.

(15) The chain saw shall be shut down or the chain brake shall be engaged whenever a saw is carried further than 50 feet (15.2 m). The chain saw shall be shut down or the chain brake shall be engaged when a saw is carried less than 50 feet if conditions such as, but not limited to, the terrain, underbrush and slippery surfaces, may create a hazard for an employee.

Note: When an employee working aloft in trees or on poles when supported by climbing spurs and climbing belt, or when an employee is working from a vehicle mounted elevating and rotating work platform meeting the requirements of chapter 296-869 WAC, Elevating work platforms, leg protection covering the full length of the thigh to the top of the boot on each leg to protect against contact with a moving chain saw is not required.

(16) Each power saw weighing more than 15 pounds (6.8 kilograms, service weight) that is used in trees shall be supported by a separate line, except when work is performed from an aerial lift and except during topping or removing operations where no supporting limb will be available, and the following:

(a) Each power saw shall be equipped with a control that will return the saw to idling speed when released;

(b) Each power saw shall be equipped with a clutch and shall be so adjusted that the clutch will not engage the chain drive at idling speed;

(c) Drop starting of saws over 15 pounds (6.8 kg) is permitted outside of the bucket of an aerial lift only if the area below the lift is clear of personnel;

(d) A power saw engine may be started and operated only when all employees other than the operator are clear of the saw;

(e) A power saw may not be running when the saw is being carried up into a tree by an employee; and

(f) Power saw engines shall be stopped for all cleaning, refueling, adjustments, and repairs to the saw or motor, except as the manufacturer's servicing procedures require otherwise.

AMENDATORY SECTION (Amending WSR 98-07-009, filed 3/6/98, effective 5/6/98)

WAC 296-45-305 Live-line tools. (1) Design of tools. Live-line tool rods, tubes, and poles shall be designed and constructed to withstand the following minimum tests:

(a) 100,000 volts per foot (3281 volts per centimeter) of length for 5 minutes if the tool is made of fiberglass-reinforced plastic (FRP); or

(b) 75,000 volts per foot (2461 volts per centimeter) of length for 3 minutes if the tool is made of wood; or

(c) Other tests that the employer can demonstrate are equivalent.

Note: Live-line tools using rod and tube that meet ASTM ((~~F711-89~~)) F711-02 (2013), Standard Specification for Fiberglass-Reinforced Plastic (FRP) Rod and Tube Used in Live-Line Tools, conform to subsection (1)(a) of this section.

(2) Condition of tools.

(a) Each live-line tool shall be wiped clean and visually inspected for defects before use each day.

(b) If any defect or contamination that could adversely affect the insulating qualities or mechanical integrity of the live-line tool

is present after wiping, the tool shall be removed from service and examined and tested according to this section before being returned to service.

(c) Live-line tools used for primary employee protection shall be removed from service every two years and whenever required under this ((~~subsection~~)) section for examination, cleaning, repair, and testing as follows:

(i) Each tool shall be thoroughly examined for defects.

(ii) If a defect or contamination that could adversely affect the insulating qualities or mechanical integrity of the live-line tool is found, the tool shall be repaired and refinished or shall be permanently removed from service. If no such defect or contamination is found, the tool shall be cleaned and waxed.

(iii) The tool shall be tested in accordance with this section under the following conditions:

(A) After the tool has been repaired or refinished; and

(B) After the examination if repair or refinishing is not performed, unless the tool is made of FRP rod or foam-filled FRP tube and the employer can demonstrate that the tool has no defects that could cause it to fail in use.

(iv) The test method used shall be designed to verify the tool's integrity along its entire working length and, if the tool is made of fiberglass-reinforced plastic, its integrity under wet conditions.

(v) The voltage applied during the tests shall be as follows:

(A) 75,000 volts per foot (2461 volts per centimeter) of length for one minute if the tool is made of fiberglass; or

(B) 50,000 volts per foot (1640 volts per centimeter) of length for one minute if the tool is made of wood; or

(C) Other tests that the employer can demonstrate are equivalent.

Note: Guidelines for the examination, cleaning, repairing, and in-service testing of live-line tools are contained in the Institute of Electrical and Electronics Engineers Guide for In-Service Maintenance and Electrical Testing of Live-Line Tools, IEEE Std. ((~~978-1984~~)) 516-2009.

(d) Live-line tools and rope shall be stored and maintained and used in such a manner as to prevent damage. Live-line tools and ropes shall not be used for purposes other than line work.

AMENDATORY SECTION (Amending WSR 05-17-038, filed 8/9/05, effective 10/1/05)

WAC 296-45-315 Materials handling and storage. (1) General. Material handling and storage shall conform to the requirements of chapter 296-24 WAC, Part D.

(2) Materials storage near energized lines or equipment. In areas not restricted to qualified ((~~persons~~)) electrical employees 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:

(a) For lines and equipment energized at 50 kV or less, the distance is 10 feet (305 cm).

(b) 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.

(c) In areas restricted to qualified electrical employees, material may not be stored within the working space about energized lines or equipment.

Note: Requirements for the size of the working space are contained in WAC 296-45-475(1) and 296-45-48515.

(3) Prior to unloading steel, poles, crossarms and similar materials, the load shall be thoroughly examined to determine if the load has shifted, binders or stakes have broken or the load is otherwise hazardous to employees. The hoist rope shall not be wrapped around the load. This provision shall not apply to electric construction crews when setting or removing poles.

(4) Pole handling.

(a) During pole hauling operations, all loads shall be secured to prevent displacement, and a red flag shall be displayed at the trailing end of the longest pole.

(b) While loading and unloading materials, roadways shall not be blocked unless approved traffic control is used.

(c) When hauling poles during darkness, illuminated warning devices shall be attached to the trailing end of the longest pole in accordance with the state of Washington motor vehicle code.

(d) Framing. During framing operations, employees must not work under a pole or a structure suspended by a crane, A-frame or similar equipment unless the pole or structure is adequately supported.

(5) Tag lines. When necessary to control loads, tag lines or other approved devices shall be used.

(6) Oil filled equipment. During construction or repair of oil filled equipment, the oil may be stored in temporary containers other than those required by WAC 296-155-270, such as pillow tanks.

(7) Storage of tools and materials. All tools and materials shall be stored in a safe and orderly manner in yards for equipment and other areas.

AMENDATORY SECTION (Amending WSR 05-17-038, filed 8/9/05, effective 10/1/05)

WAC 296-45-325 Working on or near exposed energized parts. This section applies to work on exposed live parts, or near enough to them, to expose the employee to any hazard they present.

(1) General. Only qualified electrical employees may work on or with exposed energized lines or parts of equipment. Only qualified electrical 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 the provisions of WAC 296-45-175 through 296-45-17565 or 296-45-335 have been followed.

(2) Except as provided in subsection (3) of this section, at least two qualified electrical employees shall be present while the following types of work are being performed:

(a) Installation, removal, or repair of lines that are energized at more than 600 volts;

(b) Installation, removal, or repair of deenergized lines if an employee is exposed to contact with other parts energized at more than 600 volts;

(c) Installation, removal, or repair of equipment, such as transformers, capacitors, and regulators, if an employee is exposed to contact with parts energized at more than 600 volts;

(d) Work involving the use of mechanical equipment, other than insulated aerial lifts, near parts energized at more than 600 volts; and

(e) Other work that exposes an employee to electrical hazards greater than or equal to those posed by operations that are specifically listed in subsection (2)(a) through (d) of this section.

((~~Note 1:~~)) Notes:

- One qualified electrical employee will serve principally as a standby person who must be so located that they may physically reach the other qualified electrical employee in the event of an accident either with their hand or with a hot stick twelve feet or less in length. The standby person will be so positioned as to be able to observe the other employee, their bodily movements, and verbally warn of any impending dangers. In no case when working in pairs will qualified electrical employees work simultaneously on energized wires or parts of different phases or polarity;

((~~Note 2:~~))

- When installing or removing a hot line clamp connection on a multiphase system, it is permissible for the second qualified electrical employee to stand by at the lower controls of the aerial lift provided the connection or disconnection does not interrupt or pick up the load. The hot line clamp and connecting jumper must be constructed so it cannot make contact with any other energized parts. The work must not be performed above lines or apparatus energized at more than 600 V.

((~~Note 3:~~))

- In cases of necessity the standby person may temporarily assist the other qualified electrical employee provided that they both work on wires or parts of the same phase or polarity. Both qualified electrical employees shall so position themselves so that the presence of the second person does not increase the hazard.

(3) The provisions of WAC 296-45-325(2) do not apply to (a) through (e) of this subsection. In addition to the requirements of subsection (4) of this section, a qualified electrical employee working under this subsection (3), must position themselves so that ((~~he/she is~~)) they are neither within reach of nor otherwise exposed to contact with energized parts.

(a) When re-fusing circuits or equipment with a hot stick.

(b) When operating switches by means of operating handle or switch sticks.

(c) When installing or removing a hot line clamp connection with an approved hot stick on a single-phase line or apparatus, providing that the connection or disconnection does not interrupt or pick up a load.

((~~Note 1:~~)) Notes:

- The hot line clamp and connecting jumper must be constructed so that it cannot make contact with any other energized parts.

((~~Note 2:~~))

- On a multiphase feed this applies only when one single-phase line or apparatus is present on the load side.

(d) When installing or removing by hot stick simple load metering devices provided the connection does not interrupt or pickup load.

(e) Emergency repairs to the extent necessary to safeguard the general public.

(4) "Minimum approach distances." The employer shall ensure that no employee approaches or takes any conductive object closer to exposed energized parts than set forth in Table ((~~1 through Table 4~~)) 2, unless:

(a) The employee is insulated from the energized part (insulating gloves or insulating gloves and sleeves worn in accordance with subsection (6) of this section are considered insulation of the employee only with regard to the energized part upon which work is being performed); or

(b) The energized part is insulated from the employee and from any other conductive object at a different potential.

Table 2
AC Live Work Minimum Approach Distance

	Distance to Employee					
Voltage in Kilovolts Phase to Phase*	**Phase to Ground**			**Phase to Phase**		
	(m)	**(ft-1/10)**	**(ft-in)**	**(m)**	**(ft-1/10)**	**(ft-in)**
Table 2-A For Voltages of 72.5 KV and Less ([1,2,3,4])						

	Distance to Employee					
Voltage in Kilovolts Phase to Phase*	**Phase to Ground**			**Phase to Phase**		
	(m)	**(ft-1/10)**	**(ft-in)**	**(m)**	**(ft-1/10)**	**(ft-in)**
0 to 0.050	not specified			not specified		
0.051 to 0.300	avoid contact			avoid contact		
0.301 to 0.750	0.33	1.09	(1'-2")	0.33	1.09	(1'-2")
0.751 to 5	0.63	2.07	(2'-1")	0.63	2.07	(2'-1")
5.1 to 15.0	0.65	2.14	(2'-2")	0.68	2.24	(2'-3")
15.1 to 36	0.77	2.53	(2'-7")	0.89	2.92	(3'-0")
36.1 to 46.0	0.84	2.76	(2'-10")	0.98	3.22	(3'-3")
46.1 to 72.5	1.00**	3.29**	(3'-3")	1.20	3.94	(4'-0")
[1]Employers may use the minimum approach distances in this table provided the worksite is at an elevation of 900 meters (3,000 feet) or less. If employees will be working at elevations greater than 900 meters (3,000 feet) above mean sea level, the employer shall determine minimum approach distances by multiplying the distances in this table by the correction factor in Table 3 below. A corresponding to the altitude of the work.						
[2]For single-phase systems, use voltage-to-ground.						
[3]For single-phase lines off three phase systems, use the phase-to-phase voltage of the system.						
[4]The 46.1 to 72.5 kV phase-to-ground 3-3 distance contains a 1-3 electrical component and a 2-0 inadvertent movement component.						
Table 2-B For Voltages of 72.6 KV ([1,2,3])						
72.6 to 121	1.13**	3.71**	(3'-9")	1.42	4.66	(4'-8")
121.1 to 145.0	1.30	4.27	(4'-4")	1.64	5.38	(5'-5")
145.1 to 169.0	1.46	4.79	(4'-10")	1.94	6.36	(6'-5")
169.1 to 242.0	2.01	6.59	(6'-8")	3.08	10.10	(10'-2")
242.1 to 362.0	3.41	11.19	(11'-3")	5.52	18.11	(18'-2")
362.1 to 420.0	4.25	13.94	(14'-0")	6.81	22.34	(22'-5")
420.1 to 550.0	5.07	16.63	(16'-8")	8.24	27.03	(27'-1")
550.1 to 800.0	6.88	22.57	(22'-7")	11.38	37.34	(37'-5")
[1]Employers may use the minimum approach distances in this table provided the worksite is at an elevation of 900 meters (3,000 feet) or less. If employees will be working at elevations greater than 900 meters (3,000 feet) above mean sea level, the employer shall determine minimum approach distances by multiplying the distances in this table by the correction factor in Table 3 below. A corresponding to the altitude of the work.						
[2]Employers may use the phase-to-phase minimum approach distances in this table provided that no insulated tool spans the gap and no large conductive object is in the gap.						
[3]The 72.6 to 121 kV phase-to-ground 3-2 distance contains a 2-2 electrical component and a 1-0 inadvertent movement component.						
Note: The clear live-line tool distance shall equal or exceed the values for the indicated voltage ranges.						

Table 3 – Altitude Correction Factors

Altitude above sea level (m)	*A*
0 to 900	1.00
901 to 1,200	1.02
1,201 to 1,500	1.05
1,501 to 1,800	1.08
1,801 to 2,100	1.11
2,101 to 2,400	1.14
2,401 to 2,700	1.17
2,701 to 3,000	1.20

3,001 to 3,600	1.25
3,601 to 4,200	1.30
4,201 to 4,800	1.35
4,801 to 5,400	1.39
5,401 to 6,000	1.44

((~~Note 1:~~)) Notes:

• WAC 296-45-475 (5)(a) and 296-45-48525(1) contain requirements for the guarding and isolation of live parts. Par meet these two provisions are not considered as "exposed" unless a guard is removed or an employee enters the spac isolation from the live parts.

((~~Note 2:~~)) • When an employee is required to work on or within reach of any unprotected conductors that are or may become en volts and less than 600 volts between phases, they shall take the following precautions:

((~~1:~~)) - They shall wear approved insulating gloves or insulating gloves and sleeves during the time they are working on su

((~~2:~~)) - They shall cover, with approved devices, any adjacent unprotected conductor that could be touched by any part of t insulated tools.

((~~3:~~)) - Cables which are properly insulated for the voltages to which they are energized, shall be considered as an effective employees and Table ((1)) 2 need not apply.

• Appendix A of this chapter contains additional information relating to working on exposed energized parts.

(5) Initial determination.

(a) Before any work is performed, the location of energized lines and their condition, the location and condition of energized equipment, the condition of the poles, the location of circuits and equipment including power communication lines, CATV and fire alarm circuits, shall be determined as shall any other particular hazard of a particular work site.

(b) No work shall be performed on energized lines or parts until the voltage of such equipment and lines is determined.

(6) Type of insulation. If the employee is to be insulated from energized parts by the use of insulating gloves (under subsection (4) of this section), insulating sleeves shall also be used. However, insulating sleeves need not be used under the following conditions:

(a) If exposed energized parts on which work is not being performed are insulated from the employee; and

(b) If such insulation is placed from a position not exposing the employee's upper arm to contact with other energized parts.

(7) Working position. The employer shall ensure that each employee, to the extent that other safety-related conditions at the worksite permit, works 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.

(8) Making connections. The employer shall ensure that connections are made as follows:

(a) In connecting deenergized equipment or lines to an energized circuit by means of a conducting wire or device, an employee shall first attach the wire to the deenergized part;

(b) When disconnecting equipment or lines from an energized circuit by means of a conducting wire or device, an employee shall remove the source end first; and

(c) When lines or equipment are connected to or disconnected from energized circuits, loose conductors shall be kept away from exposed energized parts.

(9) Rubber gloves can only be used on 5,000 volts or less between phases.

(10) It shall not be permissible to consider one part of a high voltage switch or disconnect as deenergized for the purpose of doing work on it if the remainder of the switch or disconnect remains energized unless approved barriers are erected which will prevent employees who are doing the work on such equipment from coming in direct contact with the energized parts.

(11) Conductor support tools such as link sticks, strain carriers, and insulator cradles may be used: Provided, That the clear insu-

lation is at least as long as the insulator string or the minimum distance specified in Table ((~~1~~)) 2 for the operating voltage.

(12) Apparel.

(a) When work is performed within reaching distance of exposed energized parts of equipment, the employer shall ensure that each employee removes or renders nonconductive all exposed conductive articles, such as key or watch chains, rings, or wrist watches or bands, unless such articles do not increase the hazards associated with contact with the energized parts.

(b) ((~~The employer shall train each employee who is exposed to the hazards of flames or electric arcs in the hazards involved.~~

(c)~~The employer shall ensure that each employee who is exposed to the hazards of flames or electric arcs does not wear clothing that, when exposed to flames or electric arcs, could increase the extent of injury that would be sustained by the employee.~~

~~Note: Clothing made from the following types of fabrics, either alone or in blends, is prohibited by this subsection, unless the employer can demonstrate that the fabric has been treated to withstand the conditions that may be encountered or that the clothing is worn in such a manner as to eliminate the hazard involved: Acetate, nylon, polyester, rayon.~~

~~(d)~~)) Workers shall wear clothing appropriate to the season and the kind of work being performed. Shirts or jumpers must have full length sleeves that are rolled down. Protective hard hats and eye protection shall be worn when working on or near live parts or while climbing poles.

(13) Protection from flames and electric arcs.

(a) The employer shall assess the workplace to identify employees exposed to hazards from flames or from electric arcs.

(b) For each employee exposed to hazards from electric arcs, the employer shall make a reasonable estimate of the incident heat energy to which the employee would be exposed.

Notes:
- Appendix D of this chapter provides guidance on estimating available heat energy. The department will deem employers following the guidance in Appendix D to be in compliance with (b) of this subsection. An employer may choose a method of calculating incident heat energy not included in Appendix D if the chosen method reasonably predicts the incident energy to which the employee would be exposed.
- This subsection does not require the employer to estimate the incident heat energy exposure for every job task performed by each employee. The employer may make broad estimates that cover multiple system areas provided the employer uses reasonable assumptions about the energy-exposure distribution throughout the system and provided the estimates represent the maximum employee exposure for those areas. For example, the employer could estimate the heat energy just outside a substation feeding a radial distribution system and use that estimate for all jobs performed on that radial system.

(c) The employer shall ensure that each employee who is exposed to hazards from flames or electric arcs does not wear clothing that could melt onto their skin or that could ignite and continue to burn when exposed to flames or the heat energy estimated under (b) of this subsection.

Note: This subsection prohibits clothing made from acetate, nylon, polyester, rayon and polypropylene, either alone or in blends, unless the employer demonstrates that the fabric has been treated to withstand the conditions that may be encountered by the employee or that the employee wears the clothing in such a manner as to eliminate the hazard involved.

(d) The employer shall ensure that the outer layer of clothing worn by an employee, except for clothing not required to be arc rated under (e)(i) through (v) of this subsection, is flame resistant under any of the following conditions:

(i) The employee is exposed to contact with energized circuit parts operating at more than 600 volts;

(ii) An electric arc could ignite flammable material in the work area that, in turn, could ignite the employee's clothing;

(iii) Molten metal or electric arcs from faulted conductors in the work area could ignite the employee's clothing; or

Note: This subsection does not apply to conductors that are capable of carrying, without failure, the maximum available fault current for the time the circuit protective devices take to interrupt the fault.

(iv) The incident heat energy estimated under (b) of this subsection exceeds 2.0 cal/cm^2.

(e) The employer shall ensure that each employee exposed to hazards from electric arcs wears protective clothing and other protective equipment with an arc rating greater than or equal to the heat energy estimated under (b) of this subsection whenever that estimate exceeds 2.1 cal/cm^2. This protective equipment shall cover the employee's entire body, except as follows:

(i) Arc-rated protection is not necessary for the employee's hands when the employee is wearing rubber insulating gloves with protectors or, if the estimated incident energy is no more than 14 cal/cm^2, heavy-duty leather work gloves with a weight of at least 407 gm/m^2 (12 oz/yd^2);

(ii) Arc-rated protection is not necessary for the employee's feet when the employee is wearing heavy-duty work shoes or boots;

(iii) Arc-rated protection is not necessary for the employee's head when the employee is wearing head protection meeting WAC 296-800-16055 if the estimated incident energy is less than 9 cal/cm^2 for exposures involving single-phase arcs in open air or 5 cal/cm^2 for other exposures;

(iv) The protection for the employee's head may consist of head protection meeting WAC 296-800-16055 and a faceshield with a minimum arc rating of 8 cal/cm^2 if the estimated incident-energy exposure is less than 13 cal/cm^2 for exposures involving single-phase arcs in open air or 9 cal/cm^2 for other exposures; and

(v) For exposures involving singlephase arcs in open air, the arc rating for the employee's head and face protection may be 4 cal/cm^2 less than the estimated incident energy.

Note: See Appendix D of this chapter for further information on the selection of appropriate protection.

(14) 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 employer shall ensure that tools or gloves rated for the voltage are used. When expulsion-type fuses are installed with one or both terminals energized at more than 300 volts, the employer shall ensure that each employee wears eye protection meeting the requirements of WAC 296-45-25505(1), uses a tool rated for the voltage, and is clear of the exhaust path of the fuse barrel.

((~~(14)~~)) (15) Covered (noninsulated) conductors. The requirements of this section which pertain to the hazards of exposed live parts also apply when work is performed in the proximity of covered (noninsulated) wires.

((~~(15)~~)) (16) Noncurrent-carrying metal parts. Noncurrent-carrying 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 employer inspects the installation and determines that these parts are grounded before work is performed.

((~~(16)~~)) (17) Opening circuits under load. Devices used to open circuits under load conditions shall be designed to interrupt the current involved.

((~~Table 1: AC Live Work Minimum Approach Distance~~

~~Voltage in kilovolts phase to phase*~~	~~Distance to employee~~			
	~~Phase to ground~~		~~Phase to Phase~~	
	~~(m)~~	~~(ft-in)~~	~~(m)~~	~~(ft-in)~~

~~0 to 0.050~~	~~not specified~~		~~not specified~~	
~~0.051 to 0.300~~	~~avoid contact~~		~~avoid contact~~	
~~0.301 to 0.750~~	~~0.31~~	~~1-0~~	~~0.31~~	~~1-0~~
~~0.751 to 15~~	~~0.65~~	~~2-2~~	~~0.67~~	~~2-3~~
~~15.1 to 36.0~~	~~0.77~~	~~2-7~~	~~0.86~~	~~2-10~~
~~36.1 to 46.0~~	~~0.84~~	~~2-9~~	~~0.96~~	~~3-2~~
~~46.1 to 72.5~~	~~1.00**~~	~~3-3**~~	~~1.20~~	~~3-11~~
~~72.6 to 121~~	~~0.95**~~	~~3-2**~~	~~1.29~~	~~4-3~~
~~138 to 145~~	~~1.09~~	~~3-7~~	~~1.50~~	~~4-11~~
~~161 to 169~~	~~1.22~~	~~4-0~~	~~1.71~~	~~5-8~~
~~230 to 242~~	~~1.59~~	~~5-3~~	~~2.27~~	~~7-6~~
~~345 to 362~~	~~2.59~~	~~8-6~~	~~3.80~~	~~12-6~~
~~500 to 550~~	~~3.42~~	~~11-3~~	~~5.50~~	~~18-1~~
~~765 to 800~~	~~4.53~~	~~14-11~~	~~7.91~~	~~26-0~~

~~*For single-phase systems, use the highest voltage a~~vailable.

~~For single-phase lines off three phase systems, use the phase-to-phase voltage of the s~~ystem.

~~**The 46.1 to 72.5 kV phase-to-ground 3-3 distance contains a 1-3 electrical component and a 2-0 inadvertent movement component while the 72.6 to 121 kV phase-to-ground 3-2 distance contains a 2-2 electrical component and a 1-0 inadvertent movement c~~omponent.

~~Note 1:~~ ~~These distances take into consideration the highest switching surge an employee will be exposed to on any system with air as the insulating medium and the maximum voltages s~~hown.

~~Note 2:~~ ~~The clear live-line tool distance shall equal or exceed the values for the indicated voltage r~~anges.

~~Note 3:~~ ~~See Appendix B to this section for information on how the minimum approach distances listed in the tables were d~~erived.))

AMENDATORY SECTION (Amending WSR 98-07-009, filed 3/6/98, effective 5/6/98)

WAC 296-45-335 Deenergizing lines and equipment for employee protection. (1) Application. This section applies to the deenergizing of transmission and distribution lines and equipment for the purpose of protecting employees. Control of hazardous energy sources used in the generation of electric energy is covered in WAC 296-45-175. Conductors and parts of electric equipment that have been deenergized under procedures other than those required by WAC 296-45-175 or 296-45-335, as applicable, shall be treated as energized.

(2) "General."

(a) If a system operator is in charge of the lines or equipment and their means of disconnection, all of the requirements of subsection (3) of this section shall be observed, in the order given.

(b) If no system operator is in charge of the lines or equipment and their means of disconnection, one employee in the crew shall be designated as being in charge of the clearance. All of the requirements of subsection (3) of this section apply, in the order given, except as provided in subsection (2)(c) of this section. The employee in charge of the clearance shall take the place of the system operator, as necessary.

(c) If only one crew will be working on the lines or equipment and if the means of disconnection is accessible and visible to and under the sole control of the employee in charge of the clearance, subsection (3)(a), (c), and (d) of this section do not apply. Additionally, tags required by the remaining provisions of subsection (3) of this section need not be used.

(d) Any disconnecting means that are accessible to persons outside the employer's control (for example, the general public) shall be

rendered inoperable while they are open for the purpose of protecting employees.

(3) Deenergizing lines and equipment.

(a) In all cases, switching orders must be given directly to the employees in charge of operating the switches by the system operator who has jurisdiction and such communications must be repeated back word for word to the speaker. When requesting clearance on lines under the control of the system operator, a person requesting the clearance shall obtain the name of the system operator to whom the request was made and the system operator shall obtain the name of the person requesting the clearance; and assure that the person is qualified to receive such a clearance. A ((~~designated~~)) qualified electrical employee shall make a request of the system operator to have the particular section of line or equipment deenergized. The ((~~designated~~)) qualified electrical employee becomes the employee in charge (as this term is used in subsection (2)(b) of this section) and is responsible for the clearance. In giving a clearance, the system operator shall make certain that the person to whom the clearance is given is fully aware of the extent or the limits of the clearance.

(b) All switches, disconnectors, jumpers, taps, and other means through which known sources of electric energy may be supplied to the particular lines and equipment to be deenergized shall be opened. Such means shall be rendered inoperable, unless its design does not so permit, and tagged to indicate that employees are at work.

(c) Automatically and remotely controlled switches that could cause the opened disconnecting means to close shall also be tagged at the point of control. The automatic or remote control feature shall be rendered inoperable, unless its design does not so permit.

(d) Tags shall prohibit operation of the disconnecting means and shall indicate that employees are at work.

(e) After the applicable requirements in subsection (3)(a) through (d) of this section have been followed and the employee in charge of the work has been given a clearance by the system operator, the lines and equipment to be worked shall be tested to ensure that they are deenergized.

(4) The system operator shall order clearance tags printed on red cardboard, or equivalent, not less than 2-1/4 inches by 4-1/2 inches, attached to all switches opened or checked open to provide clearance on any line or equipment for employees to work thereon.

(5) Clearance tags attached to substation control devices and to line switches beyond the switchyard of any substation; indicating the limits of the clearance involved; shall state the designation of the switch opened or checked open and tagged; the name of the person to whom the clearance is to be issued; the date and time the switch was opened or checked open; the name of the dispatcher ordering the switching and tagging; and the name of the person doing the switching and tagging.

(6) Protective grounds shall be installed as required by WAC 296-45-345.

(7) After the applicable requirements of subsection (3)(a) through (d) of this section have been followed, the lines and equipment involved may be worked as deenergized.

(8) If two or more independent crews will be working on the same lines or equipment, each crew shall independently comply with the requirements in subsection (3) of this section.

(9) 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 system operator; employees in the crew shall be informed of the transfer; and the new employee in charge shall be responsible for the clearance.

(10) To release a clearance, the employee in charge shall:

(a) Notify employees under his or her direction that the clearance is to be released;

(b) Determine that all employees in the crew are clear of the lines and equipment;

(c) Determine that all protective grounds installed by the crew have been removed; and

(d) Report this information to the system operator and release the clearance.

(11) The person releasing a clearance shall be the same person that requested the clearance, unless responsibility has been transferred under subsection (9) of this section.

(12) Tags may not be removed unless the associated clearance has been released under subsection (10) of this section.

(13) Only after all protective grounds have been removed, after all crews working on the lines or equipment have released their clearances, after all employees are clear of the lines and equipment, and after all protective tags have been removed from a given point of disconnection, may action be initiated to reenergize the lines or equipment at that point of disconnection.

(14) To meet unforeseen conditions, it will be permissible to tag isolated switches for the system operator and issue clearances against this tag. In tagging out inter-utility tie lines, the open switches on the foreign end of the line shall be tagged for the foreign system operator requesting the outage who will issue clearances to individuals of the organization against this tag.

(15) Network protectors. The employer need not use the tags mentioned in subsection (3)(d) and (e) of this section on a network protector for work on the primary feeder for the network protector's associated network transformer when the employer can demonstrate all of the following conditions:

(a) Every network protector is maintained so that it will immediately trip open if closed when a primary conductor is deenergized;

(b) Employees cannot manually place any network protector in a closed position without the use of tools, and any manual override position is blocked, locked, or otherwise disabled; and

(c) The employer has procedures for manually overriding any network protector that incorporate provisions for determining, before anyone places a network protector in a closed position, that: The line connected to the network protector is not deenergized for the protection of any employee working on the line; and (if the line connected to the network protector is not deenergized for the protection of any employee working on the line) the primary conductors for the network protector are energized.

(16) Metal-clad, draw-out switchgear of over 600 volts in which the physical separation of the disconnecting parts is not visible may be used to clear a line or equipment, provided the switchgear is equipped with:

(a) A positive positioning means to insure that the disconnecting contacts are separated;

(b) An isolating shutter which moves into place between the separated contact for circuit isolation; and

(c) A mechanically((—)) connected indicating means to show that the shutter is in place.

((~~(16)~~)) (17) In all other cases, only a visible break of all phases shall be regarded as clearing a line or equipment.

((~~(17)~~)) (18) No person shall make contact with a circuit or equipment that has not been taken out of service to be worked on until ((~~he/she has~~)) they have the circuit or equipment cleared and tagged for themselves or is working directly under the supervision of one who has the circuit or equipment cleared and tagged for themselves.

AMENDATORY SECTION (Amending WSR 98-07-009, filed 3/6/98, effective 5/6/98)

WAC 296-45-345 Grounding for the protection of employees. (1) Application. This section applies to the grounding of transmission and distribution lines and equipment for the purpose of protecting employees. Subsection (4) of this section also applies to the protective grounding of other equipment as required elsewhere in this section.

(2) General. For the employee to work lines or equipment as deenergized, the lines or equipment shall be deenergized under the provisions of WAC 296-45-335 and shall be grounded as specified in subsections (3) through (9) of this section. However, if the employer 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 deenergized provided all of the following conditions are met:

(a) The lines and equipment have been deenergized under the provisions of WAC 296-45-335.

(b) There is no possibility of contact with another energized source.

(c) The hazard of induced voltage is not present.

(3) Equipotential zone. Temporary protective grounds and bonding jumpers 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.

Note: This may require bonding equipment together.

(4) Protective grounding equipment.

(a) Protective grounding equipment shall be capable of conducting the maximum fault current that could flow at the point of grounding for the time necessary to clear the fault. This equipment shall have an ampacity greater than or equal to that of No. 2 AWG copper.

(b) Grounding jumpers shall have approved ferrules and grounding clamps that provide mechanical support for jumper cables independent of the electrical connection.

Note: Guidelines for protective grounding equipment are contained in American Society for Testing and Materials Standard Specifications for Temporary Grounding Systems to be Used on Deenergized Electric Power Lines and Equipment, ASTM ((~~F855-1990~~)) F855-2015.

(c) 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.

(5) Testing. Before any ground is installed, lines and equipment shall be tested and found absent of nominal voltage, unless a previously installed ground is present.

(a) Inspection before use: Grounding equipment shall be given a visual inspection and all mechanical connections shall be checked for tightness before each use.

(b) Ground surface cleaning: The surface to which the ground is to be attached shall be clean before the grounding clamp is installed; otherwise, a self-cleaning clamp shall be used.

(6) Order of connection. ((~~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.~~)) The employer shall ensure that, when an employee attaches a ground to a line or to equipment, the employee attaches the ground-end connection first and then attaches the other end by means of a live-line tool. For lines or equipment operating at 600 volts or less, the employer may permit the employee to use insulating equipment other than a live-line tool if the employer ensures that the line or equipment is not energized at the time the ground is connected or if the employer can demonstrate that each employee is protected from hazards that may develop if the line or equipment is energized.

(7) "Order of removal." 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.

(8) "Additional precautions." 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.

(9) Removal of grounds for test. Grounds may be removed temporarily during tests. During the test procedure, the employer shall ensure that each employee uses insulating equipment and is isolated from any hazards involved, and the employer shall institute any additional measures as may be necessary to protect each exposed employee in case the previously grounded lines and equipment become energized.

(10) Conductor separation: In cases where the conductor separation at any pole or structure is so great as to make it impractical to apply shorts on all conductors, and where only one conductor is to be worked on, only that conductor which is to be worked on needs to be grounded.

(11) Ground personnel: In cases where ground rods or pole grounds are utilized for personal protective grounding, personnel working on the ground should maintain sufficient distance from such equipment or utilize other approved procedures designed to prevent "touch-and step potential" hazards.

Note: See ((~~the Appendix for tables~~)) Appendix B of this chapter for protection from step and touch potentials.

AMENDATORY SECTION (Amending WSR 98-07-009, filed 3/6/98, effective 5/6/98)

WAC 296-45-355 Underground grounding. (1) Grounding. A capacitance charge can remain in the high voltage cables after it has been disconnected from the circuit and a static-type arc can occur when grounds are applied to such cables.

(2) When work is to be done on cables or equipment of a high-voltage underground system, precautions to prevent back-feed shall be taken. This shall include either isolating or grounding of the secondary conductors.

(3) After grounding the cable, if the worker is to work on cable between terminations, ((~~he/she~~)) they must first spike the cable or use other approved methods of testing. If the cable is to be cut, it shall be cut only with approved hot cutters.

(4) Additional precautions. 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.

AMENDATORY SECTION (Amending WSR 98-07-009, filed 3/6/98, effective 5/6/98)

WAC 296-45-365 Testing and test facilities. (1) Application. This section provides for safe work practices for high-voltage and high-power testing performed in laboratories, shops, and substations, and in the field and on electric transmission and distribution lines and equipment. It applies only to testing involving interim measurements utilizing high voltage, high power, or combinations of both, and not to testing involving continuous measurements as in routine metering, relaying, and normal line work.

Note: Routine inspection and maintenance measurements made by qualified electrical employees are considered to be routine line work and are not included in the scope of this section, as long as the hazards related to the use of intrinsic high-voltage or high-power sources require only the normal precautions associated with routine operation and maintenance work required in the other subsections of this section. Two typical examples of such excluded test work procedures are "phasing-out" testing and testing for a "no-voltage" condition.

(2) General requirements.

(a) The employer shall establish and enforce work practices for the protection of each worker from the hazards of high-voltage or high-power testing at all test areas, temporary and permanent. Such work practices shall include, as a minimum, test area guarding, grounding, and the safe use of measuring and control circuits. A means providing for periodic safety checks of field test areas shall also be included.

(b) Employees shall be trained in safe work practices upon their initial assignment to the test area, with periodic reviews and updates provided as required by subsections of this section.

(3) Guarding of test areas.

(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:

(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;

(ii) The test area shall be guarded by a barrier or barricade that limits access to the test area to a degree equivalent, physically and visually, to the barricade specified in this section; 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 barriers required by this section shall be removed when the protection they provide is no longer needed.

(d) Guarding shall be provided within test areas to control access to test equipment or to apparatus under test that may become energized as part of the testing by either direct or inductive cou-

pling, in order to prevent accidental employee contact with energized parts.

(4) Grounding practices.

(a) The employer shall establish and implement safe grounding practices for the test facility.

(i) All conductive parts accessible to the test operator during the time the equipment is operating at high voltage shall be maintained at ground potential except for portions of the equipment that are isolated from the test operator by guarding.

(ii) Wherever ungrounded terminals of test equipment or apparatus under test may be present, they shall be treated as energized until determined by tests to be deenergized.

(b) Visible grounds shall be applied, either automatically or manually with properly insulated tools, to the high-voltage circuits after they are deenergized and before work is performed on the circuit or item or apparatus under test. Common ground connections shall be solidly connected to the test equipment and the apparatus under test.

(c) In high-power testing, an isolated ground-return conductor system shall be provided so that no intentional passage of current, with its attendant voltage rise, can occur in the ground grid or in the earth. However, an isolated ground-return conductor need not be provided if the employer can demonstrate that both the following conditions are met:

(i) An isolated ground-return conductor cannot be provided due to the distance of the test site from the electric energy source; and

(ii) Employees are protected from any hazardous step and touch potentials that may develop during the test.

Note: See Appendix B of this chapter for information on measures that can be taken to protect employees from hazardous step and touch potentials.

(d) In tests in which grounding of test equipment by means of the equipment grounding conductor located in the equipment power cord cannot be used due to increased hazards to test personnel or the prevention of satisfactory measurements, a ground that the employer can demonstrate affords equivalent safety shall be provided, and the safety ground shall be clearly indicated in the test set up.

(e) When the test area is entered after equipment is deenergized, a ground shall be placed on the high-voltage terminal and any other exposed terminals.

(i) High capacitance equipment or apparatus shall be discharged through a resistor rated for the available energy.

(ii) A direct ground shall be applied to the exposed terminals when the stored energy drops to a level at which it is safe to do so.

(f) If a test trailer or test vehicle is used in field testing, its chassis shall be grounded. Protection against hazardous touch potentials with respect to the vehicle, instrument panels, and other conductive parts accessible to employees shall be provided by bonding, insulation, or isolation.

(5) Control and measuring circuits.

(a) Control wiring, meter connections, test leads and cables may not be run from a test area unless they are contained in a grounded metallic sheath and terminated in a grounded metallic enclosure or unless other precautions are taken that the employer can demonstrate as ensuring equivalent safety.

(b) Meters and other instruments with accessible terminals or parts shall be isolated from test personnel to protect against hazards arising from such terminals and parts becoming energized during testing. If this isolation is provided by locating test equipment in metal

compartments with viewing windows, interlocks shall be provided to interrupt the power supply if the compartment cover is opened.

(c) The routing and connections of temporary wiring shall be made secure against damage, accidental interruptions and other hazards. To the maximum extent possible, signal, control, ground, and power cables shall be kept separate.

(d) If employees will be present in the test area during testing, a test observer shall be present. The test observer shall be capable of implementing the immediate deenergizing of test circuits for safety purposes.

(6) Safety check.

(a) Safety practices governing employee work at temporary or field test areas shall provide for a routine check of such test areas for safety at the beginning of each series of tests.

(b) 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;

(v) That personal protective equipment is provided and used;

(vi) That signal, ground, and power cables are properly separated.

AMENDATORY SECTION (Amending WSR 98-07-009, filed 3/6/98, effective 5/6/98)

WAC 296-45-375 Mechanical equipment, including aerial manlift equipment. (1) General requirements.

(a) Other applicable requirements. Mechanical equipment shall be operated in accordance with applicable requirements in other chapters, including chapter 296-155 WAC, Parts L, M, and R, and chapter 296-869 WAC, except that WAC 296-155-605 (1)(h) and 296-155-77100 (1)(h) do not apply to operations performed by qualified electrical employees.

(b) The critical safety components of mechanical elevating and rotating equipment shall receive a thorough visual inspection and operational test before use on each shift.

Note: Critical safety components of mechanical elevating and rotating equipment are components whose failure would result in a free fall or free rotation of the boom.

((~~(b)~~)) (c) No vehicular equipment having an obstructed view to the rear may be operated on off-highway job sites where any employee is exposed to the hazards created by the moving vehicle, unless:

(i) The vehicle has a reverse signal alarm audible above the surrounding noise level; or

(ii) The vehicle is backed up only when a designated employee signals that it is safe to do so.

((~~(c)~~)) (d) The operator of an electric line truck may not leave ((~~his or her~~)) their position at the controls while a load is suspended, unless the employer can demonstrate that no employee (including the operator) might be endangered.

((~~(d)~~)) (e) Rubber-tired, self-propelled scrapers, rubber-tired front-end loaders, rubber-tired dozers, wheel-type agricultural and industrial tractors, crawler-type tractors, crawler-type loaders, and motor graders, with or without attachments, shall have rollover protective structures that meet the requirements of chapter 296-155 WAC, Part V.

(2) Outriggers.

(a) Vehicular equipment, if provided with outriggers, shall be operated with the outriggers extended and firmly set as necessary for the stability of the specific configuration of the equipment. Outriggers may not be extended or retracted outside of clear view of the operator unless all employees are outside the range of possible equipment motion.

(b) If the work area or the terrain precludes the use of outriggers, the equipment may be operated only within its maximum load ratings for the particular configuration of the equipment without outriggers.

(3) Applied loads. Mechanical equipment used to lift or move lines or other material shall be used within its maximum load rating and other design limitations for the conditions under which the work is being performed.

(4) Hydraulic fluids. All hydraulic fluids used for the insulated section of derrick trucks, aerial lifts, and hydraulic tools which are used on or around energized lines or equipment shall be of the insulating type.

(5) Mechanical adjustment or repairs shall not be attempted or performed in the field except by a person qualified to perform such work.

(6) Malfunction or needed repairs of manlift equipment shall be reported to the employee responsible for such repairs as soon as is reasonably possible. Use of equipment which is known to be in need of repairs or is malfunctioning is prohibited when such deficiency creates an unsafe operating condition.

(7) When any aerial manlift equipment is parked for operation at the job site, the brakes shall be set. Wheel chocks shall be used to prevent accidental movement while parked on an incline.

(8) Employees shall not sit or stand on the basket edge, stand on materials placed in or across the basket, or work from a ladder set inside the basket.

(9) The basket shall not be rested on a fixed object(s) so that the weight of the boom is either totally or partially supported by the basket.

(10) Operations near energized lines or equipment.

(a) Mechanical equipment shall be operated so that the minimum approach distances of Table ((~~1 through Table 4~~)) 2, located in WAC 296-45-325, are maintained from exposed energized lines and equipment. However, the insulated upper portion excluding the basket/bucket of an aerial lift operated by a qualified electrical employee in the lift is exempt from this requirement.

(b) A designated employee other than the equipment operator shall observe the approach distance to exposed lines and equipment and give timely warnings before the minimum approach distance required by subsection (10)(a) of this section is reached, unless the employer can demonstrate that the operator can accurately determine that the minimum approach distance is being maintained.

(c) If, during operation of the mechanical equipment, the equipment could become energized, the operation shall also comply with at least one of the following:

(i) The energized lines exposed to contact shall be covered with insulating protective material that will withstand the type of contact that might be made during the operation.

(ii) The equipment shall be insulated for the voltage involved. The equipment shall be positioned so that its uninsulated portions cannot approach the lines or equipment any closer than the minimum approach distances specified in Table ((~~1 through 4~~)) 2, located in WAC 296-45-325.

(iii) Each employee shall be protected from hazards that might arise from equipment contact with the energized lines. The measures used shall ensure that employees will not be exposed to hazardous differences in potential. Unless the employer can demonstrate that the methods in use protect each employee from the hazards that might arise if the equipment contacts the energized line, the measures used shall include all of the following techniques:

(A) Using the best available ground to minimize the time the lines remain energized;

(B) Bonding mechanical equipment together to minimize potential differences;

(C) Providing ground mats to extend areas of equipotential; and

(D) Employing insulating protective equipment or barricades to guard against any remaining hazardous potential differences.

Note: Appendix B of this chapter contains information on hazardous step and touch potentials and on methods of protecting employees from hazards resulting from such potentials.

(11) While working in aerial equipment, employees shall wear a full body harness and a lanyard attached to the boom or basket, in a secure manner.

(12) No component of aerial devices shall be operated from the ground without permission from the employee in the basket except in case of emergency.

(13) Operating levers or controls shall be kept clear of tools, materials or obstructions.

(14) Employees shall not climb into or out of the basket or platform while it is elevated or change from one basket to another on dual basket equipment, except in case of emergency or when the employees involved agree that this is the safest way to perform the work. This exception shall not be used to circumvent safety rules.

(15) Existing safety rules governing the use of hot line tools, rubber and other protective equipment and safe work practices while performing work from poles or structures shall also apply to work done from aerial manlift equipment.

(16) The basket shall be kept clean and all tools not in use shall be secured or removed.

(17) Approved warning light shall be operating when the boom leaves the cradle. This light shall be visible to approaching traffic when the boom is in position over any traveled area.

(18) All aerial manlift equipment shall have both upper and lower controls (except ladder trucks need not have upper controls). The upper controls shall not be capable of rendering the lower controls inoperative. The lower controls should be located at or near the base of the aerial structure. If the lower controls are used, the operator shall have a view of the elevated employee(s) or there shall be communication between the operator and the employee in the elevated aerial structure: Provided, That no employee shall be raised, lowered, or

moved into or from the elevated position in any aerial manlift equipment unless there is another employee, not in the elevated aerial structure, available at the site to operate the lower controls, except as follows:

(a) Where there is a fixed method permanently attached to or part of the equipment which will permit an employee to descend from the elevated position without lowering the elevated structure; or

(b) Where there is a system which will provide operation from the elevated position in the event of failure or malfunction of the primary system.

Note: This section shall not be interpreted as an exception to any other rule in this chapter.

(19) Controls in aerial manlift equipment shall be protected from accidental operation. Controls of the outriggers shall also be protected from accidental operation. Such protection may be by guarding or equivalent means.

(20) The manufacturer's recommended maximum load limit shall be posted at a conspicuous place near each set of controls and shall be kept in a legible condition.

(21) The manufacturer's operator's instructional manual shall be kept on the vehicle.

(22) Operating instructions, proper sequence and maintenance procedures prescribed by the manufacturer for operation of the equipment shall be followed.

AMENDATORY SECTION (Amending WSR 05-17-038, filed 8/9/05, effective 10/1/05)

WAC 296-45-385 Overhead lines. This section provides additional requirements for work performed on or near overhead lines and equipment.

(1) General.

(a) Before elevated structures and adjacent structures, such as poles or towers of the adjacent supporting poles, structures, and conductor supporting hardware, are subjected to such stresses as climbing or the installation or removal of equipment may impose, the employer 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.

Note: Appendix C of this chapter contains test methods that can be used in ascertaining whether a wood pole is capable of sustaining the forces that would be imposed by an employee climbing the pole. This ((~~paragraph~~)) section also requires the employer to ascertain that the pole can sustain all other forces that will be imposed by the work to be performed.

(b) When poles are set, moved, or removed near exposed energized overhead conductors, the pole may not contact the conductors.

(c) When a pole is set, moved, or removed near an exposed energized overhead conductor, the employer shall ensure that each employee wears electrical protective equipment or uses insulated devices when handling the pole and that no employee contacts the pole with uninsulated parts of ((~~his or her~~)) their body.

(d) 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.

(2) Installing and removing overhead lines. The following provisions apply to the installation and removal of overhead conductors or cable.

(a) The employer shall use the tension stringing method, barriers, or other equivalent measures to minimize the possibility that conductors and cables being installed or removed will contact energized power lines or equipment.

(b) When conductors are being strung in or removed, they shall be kept under positive control to prevent accidental contact with energized circuit.

(c) The protective measures required by WAC 296-45-375 (10)(c) for mechanical equipment shall also be provided for conductors, cables, and pulling and tensioning equipment when the conductor or cable is being installed or removed close enough to energized conductors that any of the following failures could energize the pulling or tensioning equipment or the wire or cable being installed or removed:

(i) Failure of the pulling or tensioning equipment;

(ii) Failure of the wire or cable being pulled; or

(iii) Failure of the previously installed lines or equipment.

(d) When conductors being installed or removed cross over energized conductors in excess of 600 volts, rope nets or guard structures must be installed unless provision is made to isolate or insulate the worker or the energized conductor. Where the design of the circuit-interrupting devices protecting the lines so permits, the automatic-reclosing feature of these devices must be made inoperative. In addition, the line being strung must be grounded on either side of the crossover or considered and worked as energized.

(e) Before lines are installed parallel to existing energized lines, the employer shall make a determination of the approximate voltage to be induced in the new lines, or work shall proceed on the assumption that the induced voltage is hazardous. Unless the employer can demonstrate that the lines being installed are not subject to the induction of a hazardous voltage or unless the lines are treated as energized, ((~~the following requirements also apply:~~

~~(i)Each bare conductor shall be grounded in increments so that no point along the conductor is more than 2 miles (3.22 km) from a ground.~~

~~(ii)The grounds required in subsection (2)(e)(i) of this section shall be left in place until the conductor installation is completed between dead ends.~~

~~(iii)The grounds required in subsection (2)(e)(i) of this section shall be removed as the last phase of aerial cleanup.~~

~~(iv)If employees are working on bare conductors, grounds shall also be installed at each location where these employees are working, and grounds shall be installed at all open dead-end or catch-off points or the next adjacent structure.~~

~~(v)If two bare conductors are to be spliced, the conductors shall be bonded and grounded before being spliced~~)) temporary protective grounds shall be placed at such locations and arranged in such a manner that the employer can demonstrate will prevent exposure of each employee to hazardous differences in electric potential.

Notes:
- If the employer takes no precautions to protect employees from hazards associated with involuntary reactions from electric shock, a hazard exists if the induced voltage is sufficient to pass a current of 1 milliampere through a 500-ohm resistor. If the employer protects employees from injury due to involuntary reactions from electric shock, a hazard exists if the resultant current would be more than 6 milliamperes.
- Appendix B of this chapter contains guidelines for protecting employees from hazardous differences in electric potential as required by this section.

(f) Reel handling equipment, including pulling and tensioning devices, shall be in safe operating condition and shall be leveled and aligned.

(g) Load ratings of stringing lines, pulling lines, conductor grips, load-bearing hardware and accessories, rigging, and hoists may not be exceeded.

(h) Each pull must be snubbed or dead ended at both ends before subsequent pulls.

(3) Pulling lines and accessories shall be inspected prior to each use and replaced or repaired when damaged or when there is a reasonable basis to doubt the dependability of such lines or accessories.

(4) Conductor grips may not be used on wire rope, unless the grip is specifically designed for this application.

(5) Reliable communications, through two-way radios or other equivalent means, shall be maintained between the reel tender and the pulling rig operator.

(6) The pulling rig may only be operated when it is safe to do so.

Note: Examples of unsafe conditions include employees in locations prohibited by subsection (7) of this section, conductor and pulling line hang-ups, and slipping of the conductor grip.

(7) While the conductor or pulling line is being pulled (in motion) with a power-driven device, employees are not permitted directly under overhead operations or on the cross arm, except as necessary to guide the stringing sock or board over or through the stringing sheave.

(8) Live-line bare-hand work is prohibited.

(9) When winches, trucks, or tractors are being used to raise poles, materials, to pull in wires, to pull slack or in any other operation, there shall be an operator at the controls unless the machinery or process is stopped.

(10) Leadworkers shall designate an employee to give signals when required.

(11) Raising poles, towers or fixtures in the close proximity of high voltage conductors shall be done under the supervision of a qualified electrical employee.

(12) Employees shall not crawl over insulator strings but shall use a platform or other approved device to work from when making dead ends or doing other work beyond strings of insulators, at such distance that they cannot reach the work from the pole or fixture. While working on the platform or other device, they shall be secured with safety straps or a rope to prevent falling. The provision of this subsection does not apply to extra high voltage bundle conductors when the use of such equipment may produce additional hazard. Climbing over dead end assemblies is permissible only after they have been completed and pinned in the final position.

(13) Towers and structures. The following requirements apply to work performed on towers or other structures which support overhead lines.

(a) The employer shall ensure that no employee is under a tower or structure while work is in progress, except where the employer can demonstrate that such a working position is necessary to assist employees working above.

(b) Tag lines or other similar devices shall be used to maintain control of tower sections being raised or positioned, unless the employer can demonstrate that the use of such devices would create a greater hazard.

(c) The loadline may not be detached from a member or section until the load is safely secured.

(d) No one ((~~must~~)) shall be permitted to remain in the footing while equipment is being spotted for placement.

(e) A designated employee must be utilized to determine that required clearance is maintained in moving equipment under or near energized lines.

(14) All conductors, subconductors, and overhead ground conductors must be bonded to the tower at any isolated tower where it may be necessary to complete work on the transmission line.

(15) A transmission clipping crew shall have a minimum of two structures clipped in between the crew and the conductor being sagged.

(16) While on patrol at night and operating a motor vehicle on public ((~~highways~~)) roadways, there shall be two employees, at least one of whom shall be a ((~~journey level lineworker or otherwise~~)) qualified electrical employee. If repair to line or equipment is found to be of such nature as to require two ((~~lineworkers~~)) qualified electrical employees, work shall not proceed until additional help has been obtained provided that in cases of emergency where delay would increase the danger to life, limb, or substantial property, one employee may clear the hazard without assistance.

(17) Except during emergency restoration procedures, work shall be discontinued when adverse weather conditions would make the work hazardous in spite of the work practices required by this section.

Note: ((~~-~~))Thunderstorms in the immediate vicinity, high winds, snow storms, and ice storms are examples of adverse weather conditions that are presumed to make this work too hazardous to perform, except under emergency conditions.

AMENDATORY SECTION (Amending WSR 99-09-080, filed 4/20/99, effective 8/1/99)

WAC 296-45-455 Line-clearance tree-trimming operations. This section provides additional requirements for line-clearance tree-trimming operations and for equipment used in these operations.

This section does not apply to qualified electrical employees.

(1) Before an employee climbs, enters, or works around any tree, a determination shall be made of the nominal voltage of electric power lines posing a hazard to employees. However, a determination of the maximum nominal voltage to which an employee will be exposed may be made instead, if all lines are considered as energized at this maximum voltage.

(2) There shall be a second line-clearance tree trimmer within normal ((~~(that is~~)), unassisted((~~)~~)) voice communication under any of the following conditions:

(a) If a line-clearance tree trimmer is to approach more closely than 10 feet (305 cm) any conductor or electrical apparatus energized at more than 600 volts; or

(b) If branches or limbs being removed are closer to lines energized at more than 600 volts than the distances listed in Table ((~~1, Table 4, and Table 5~~)) 2, located in WAC 296-45-325; or

(c) If roping is necessary to remove branches or limbs ((~~from~~)) near such conductors or apparatus.

(3) Line-clearance tree trimmers shall maintain the minimum approach distances from energized conductors given in Table ((~~1, Table 4, and Table 5~~)) 2, located in WAC 296-45-325.

(4) Branches that are contacting exposed energized conductors or equipment or that are within the distances specified in Table ((~~1, Table 4, and Table 5~~)) 2, located in WAC 296-45-325 may be removed only through the use of insulating equipment.

Note: A tool constructed of a material that the employer can demonstrate has insulating qualities meeting WAC 296-45-305(1) are considered as insulated under this section if the tool is clean and dry.

(5) Ladders, platforms, and aerial devices may not be brought closer to an energized part than the distances listed in Table ((~~1, Table 4, and Table 5~~)) 2, located in WAC 296-45-325.

(6) Line-clearance tree-trimming work may not be performed when adverse weather conditions make the work hazardous in spite of the work practices required by this section. Each employee performing line-clearance tree-trimming work in the aftermath of a storm or under similar emergency conditions shall be trained in the special hazards related to this type of work.

Note: Thunderstorms in the immediate vicinity, high winds, snow storms, and ice storms are examples of adverse weather conditions that are presumed to make line-clearance tree-trimming work too hazardous to perform safely.

(7) A tree trimmer may climb out of a basket into a tree or from a tree back into the basket so long as he is properly tied into the tree during the entire maneuver and the employer can demonstrate that this is the safest way to perform the work.

AMENDATORY SECTION (Amending WSR 98-07-009, filed 3/6/98, effective 5/6/98)

WAC 296-45-45505 Brush chippers. (1) Brush chippers shall be equipped with a locking device in the ignition system.

(2) Access panels for maintenance and adjustment of the chipper blades and associated drive train shall be in place and secure during operation of the equipment. Servicing and maintenance shall be performed according to chapter 296-803 WAC, Lockout/tagout (control of hazardous energy).

(3) Brush chippers not equipped with a mechanical infeed system shall be equipped with an infeed hopper of length sufficient to prevent employees from contacting the blades or knives of the machine during operation.

(4) Trailer chippers detached from trucks shall be chocked or otherwise secured.

(5) Each employee in the immediate area of an operating chipper feed table shall wear personal protective equipment as required by ((~~Subpart I~~)) WAC 296-45-25505 of this ((~~Part~~)) chapter.

AMENDATORY SECTION (Amending WSR 09-10-077, filed 5/5/09, effective 7/1/09)

WAC 296-45-475 Substations. This section provides additional requirements for substations and for work performed in them.

(1) Access and working space. Sufficient access and working space shall be provided and maintained about electric equipment to permit ready and safe operation and maintenance of such equipment.

Note: Guidelines for the dimensions of access and working space about electric equipment in substations are contained in American National Standard-National Electrical Safety Code, ANSI ((~~C2-1997~~)) C2-2012. Installations meeting the ANSI provisions comply with WAC 296-45-475(1). An installation that does not conform to this ANSI standard will, nonetheless, be considered as complying with WAC 296-45-475(1) if the employer can demonstrate that the installation provides ready and safe access based on the following evidence:

(a) That the installation conforms to the edition of ANSI C2 that was in effect at the time the installation was made;

(b) That the configuration of the installation enables employees to maintain the minimum approach distances required by WAC 296-45-325(5) while they are working on exposed, energized parts; and

(c) That 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 ((~~C2-1997~~)) C2-2012.

(d) Precaution must be taken to prevent accidental operation of relays or other protective devices due to jarring, vibration, or improper wiring.

(2) Draw-out-type circuit breakers. 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.

(3) Substation fences. Conductive fences around substations must be grounded. When a substation fence must be expanded or removed fence continuity must be maintained and bonding must be used to prevent electrical discontinuity. A temporary fence affording similar protection when the site is unattended, must be provided. Adequate interconnection with ground must be maintained between temporary fence and permanent fence.

(4) Guarding of rooms containing electric supply equipment.

(a) Rooms and spaces in which electric supply lines or equipment are installed shall meet the requirements of subsection (4)(b) through (e) of this section 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;

(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, as permitted under subsection (5)(a) of this section; or

(iii) If live parts operating at more than 600 volts are located within the room or space, unless:

(A) The live parts are enclosed within grounded, metal-enclosed equipment whose only openings are designed so that foreign objects inserted in these openings will be deflected from energized parts; or

(B) The live parts 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.

(b) The rooms and spaces shall be so enclosed within fences, screens, partitions, or walls as to minimize the possibility that unqualified persons will enter.

(c) Signs warning unqualified persons to keep out shall be displayed at entrances to the rooms and spaces.

(d) Entrances to rooms and spaces that are not under the observation of an attendant shall be kept locked.

(e) Unqualified persons may not enter the rooms or spaces while the electric supply lines or equipment are energized.

(5) Guarding of energized parts.

(a) 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.

Note: Guidelines for the dimensions of clearance distances about electric equipment in substations are contained in American National Standard-National Electrical Safety Code, ANSI ((~~C2-1997~~)) C2-2012. Installations meeting the ANSI provisions comply with subsection (5)(a) of this section. An installation that does not conform to this ANSI standard will, nonetheless, be considered as complying with subsection (5)(a) of this section if the employer can demonstrate that the installation provides sufficient clearance based on the following evidence:

(i) That the installation conforms to the edition of ANSI C2 that was in effect at the time the installation was made;

(ii) That each employee is isolated from energized parts at the point of closest approach; and

(iii) That the precautions taken when work is performed on the installation provide protection equivalent to the protection that would be provided by horizontal and vertical clearances meeting ANSI ((~~C2-1997~~)) C2-2012.

(b) Except for fuse replacement and other necessary access by qualified ((~~persons~~)) electrical employees, the guarding of energized parts within a compartment shall be maintained during operation and maintenance functions to prevent accidental contact with energized parts and to prevent tools or other equipment from being dropped on energized parts.

(c) 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.

(6) Substation entry.

(a) Upon entering an attended substation, each employee other than those regularly working in the station shall report his or her presence to the employee in charge in order to receive information on special system conditions affecting employee safety.

(b) The job briefing required by WAC 296-45-135 shall cover such additional subjects as the location of energized equipment in or adjacent to the work area and the limits of any deenergized work area.

(c) Nonqualified persons may only approach exposed energized electrical equipment located in substations or switch yards up to the distances set forth in Table((~~s 1 through 4~~)) 2, located in WAC 296-45-325, when under the direct supervision of a qualified ((~~person~~)) electrical employee acting as a safety watch. The safety watch will make sure that the nonqualified person does not encroach or take conductive objects closer to exposed energized parts than set forth in Table((~~s 1 through 4~~)) 2, located in WAC 296-45-325.

(i) Nonqualified persons must have hazard recognition training and attend a documented tailgate meeting prior to entering the substation.

(ii) The safety watch must be a qualified electrical employee as defined by WAC 296-45-035.

(iii) The safety watch will have the responsibility and authority to monitor work on a continuous basis and/or stop work until the hazard is eliminated or protected.

(iv) The safety watch will maintain a direct line of sight and voice communications with all nonqualified persons under their direct supervision. If the safety watch cannot meet these requirements, additional safety watches must be assigned or work must be stopped. Each safety watch will monitor no more than four persons.

(v) The safety watch will perform no other duties while acting as a safety watch.

AMENDATORY SECTION (Amending WSR 98-07-009, filed 3/6/98, effective 5/6/98)

WAC 296-45-48515 Access and working space. Sufficient access and working space shall be provided and maintained about electric equipment to permit ready and safe operation and maintenance of such equipment.

Note: Guidelines for the dimensions of access and workspace about electric equipment in generating stations are contained in American National Standard-National Electrical Safety Code, ANSI ((~~C2-1997~~)) C2-2012. Installations meeting the ANSI provisions comply with this section. An installation that does not conform to this ANSI standard will, nonetheless, be considered as complying with this section if the employer can demonstrate that the installation provides ready and safe access based on the following evidence:

(1) That the installation conforms to the edition of ANSI C2 that was in effect at the time the installation was made;

(2) That the configuration of the installation enables employees to maintain the minimum approach distances required by this section while they work on exposed, energized parts; and

(3) That 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 ((~~C2-1997~~)) C2-2012.

AMENDATORY SECTION (Amending WSR 98-07-009, filed 3/6/98, effective 5/6/98)

WAC 296-45-48525 Guarding of energized parts. (1) 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.

Note: Guidelines for the dimensions of clearance distances about electric equipment in generating stations are contained in American National Standard-National Electrical Safety Code, ANSI ((~~C2-1997~~)) C2-2012. Installations meeting the ANSI provisions comply with this section. An installation that does not conform to this ANSI standard will, nonetheless, be considered as complying with this section if the employer can demonstrate that the installation provides sufficient clearance based on the following evidence:

(a) That the installation conforms to the edition of ANSI C2 that was in effect at the time the installation was made;

(b) That each employee is isolated from energized parts at the point of closest approach; and

(c) That the precautions taken when work is performed on the installation provide protection equivalent to the protection that would be provided by horizontal and vertical clearances meeting ANSI ((~~C2-1997~~)) C2-2012.

(2) Except for fuse replacement or other necessary access by qualified ((~~persons~~)) electrical employees, the guarding of energized parts within a compartment shall be maintained during operation and maintenance functions to prevent accidental contact with energized parts and to prevent tools or other equipment from being dropped on energized parts.

(3) 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.

AMENDATORY SECTION (Amending WSR 98-07-009, filed 3/6/98, effective 5/6/98)

WAC 296-45-545 Trolley maintenance, jumpering or bypassing. (1) Energized trolley wire shall be jumpered when it is to be opened or cut.

(2) Reaching over trolley wire(s) or system(s). ((~~Lineworkers~~)) Qualified electrical employees shall not reach over trolley wire(s) unless properly protected by line hose or rubber blanket.

(3) Reaching across sectional insulators. ((~~Lineworkers~~)) Qualified electrical employees shall not reach across section insulator(s), insulated spacer(s) or insulated approach.

(4) Polarity on either side of sectionalizing breakers. Since the polarity on both sides of a sectionalizing insulator may be different, it is required that prior to performance of work, tests be performed with approved testing equipment to determine whether or not the polarity is the same or different on one side of the sectional insulator as compared with the other.

(5) Working on hangers. More than one truck crew shall not work on hangers attached to the same span at the same time, without rubber protection.

(6) Workers on hangers of opposite polarity. Trolley hangers and ears of opposite polarity shall not be worked on at the same time when trolley wire is energized.

(7) Checking electric switches. When electric switches are checked for operation, making it necessary to short circuit the contactor to each trolley wire, tools with insulated handles shall be used.

(8) Short circuit due to use of noninsulated or conductive long handled tools. When a hazard of short circuit exists, due to use of noninsulated or conductive long handled tools, approved protective rubber equipment shall be used as provided in this chapter.

(9) Trolley feeders. When work is to be performed on street railway trolley feeders where it is necessary for workers to work from metal or other grounded poles or fixtures or on poles or fixtures on which grounds are maintained, the feeders shall be deenergized unless the poles or fixtures are insulated before the work is started with approved protective devices in such manner that employees cannot become grounded while working on the feeders, and employees shall wear approved rubber gloves.

(10) Truck driver shall remain at tower controls while workers are working on towers except when the aerial manlift equipment has been properly chocked to prevent uncontrolled movement. Tower trucks shall be equipped with a reliable signaling device between the employees working on the tower and the truck driver.

(11) Working on truck towers. Employees shall not stand on tower gates or railings. Work shall not be done from plank(s) placed on tower railings.

(12) Tower truck railings. Towers shall have standard railings and toeboards around the tower and all railings shall be constructed of wood, fiberglass or other nonmetallic material. All railings shall be a vertical height of not less than 36 inches or more than 42 inches from the floor of the platform to the upper surface of the top rail. Intermediate railings shall be midway between the floor and the underside of the top rail. Tower gates shall be so constructed as to prevent accidental opening.

(13) Tower truck decks shall be kept clear of tools, wire and other materials and tools shall be kept in proper storage area when not in use.

(14) ((~~Lineworkers~~)) Qualified electrical employees shall not wear climbers or spurs while working on a tower truck.

NEW SECTION

WAC 296-45-902 Appendix A—Working on exposed energized parts—Nonmandatory.

Note: This appendix is identical to 29 C.F.R. 1910.269 Appendix B, Working on Exposed Energized Parts, however all references to live-line barehand work have been deleted since it is prohibited in Washington state.

I. Introduction

Electric utilities design electric power generation, transmission, and distribution installations to meet National Electrical Safety Code (NESC), ANSI C2, requirements. Electric utilities also design transmission and distribution lines to limit line outages as required by system reliability criteria[1] and to withstand the maximum overvoltage's impressed on the system. Conditions such as switching surges, faults, and lightning can cause overvoltages. Electric utilities generally select insulator design and lengths and the clearances to structural parts so as to prevent outages from contaminated line insulation and during storms. Line insulator lengths and structural clearances have, over the years, come closer to the minimum approach distances used by workers. As minimum approach distances and structural clearances converge, it is increasingly important that system designers and system operating and maintenance personnel understand the concepts underlying minimum approach distances.

The information in this appendix will assist employers in complying with the minimum approach-distance requirements contained in § 1910.269(l)(3) and (q)(3). Employers must use the technical criteria and methodology presented in this appendix in establishing minimum approach distances in accordance with § 1910.269(l)(3)(i) and Table R-3 and Table R-8. This appendix provides essential background information and technical criteria for the calculation of the required minimum approach distances for live-line work on electric power generation, transmission, and distribution installations.

Unless an employer is using the maximum transient overvoltage's specified in Table R-9 for voltages over 72.5 kilovolts, the employer must use persons knowledgeable in the techniques discussed in this appendix, and competent in the field of electric transmission and distribution system design, to determine the maximum transient overvoltage.

II. General

A. *Definitions*. The following definitions from § 1910.269(x) relate to work on or near electric power generation, transmission, and distribution lines and equipment and the electrical hazards they present.

Exposed. . . . Not isolated or guarded.

Guarded. Covered, fenced, enclosed, or otherwise protected, by means of suitable covers or casings, barrier rails or screens, mats, or platforms, designed to minimize the possibility, under normal conditions, of dangerous approach or inadvertent contact by persons or objects.

Note to the definition of "guarded": Wires that are insulated, but not otherwise protected, are not guarded.

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

Note to the definition of "insulated": When any object is said to be insulated, it is understood to be insulated for the conditions to which it normally is subjected. Otherwise, it is, for the purpose of this section, uninsulated.

Isolated. Not readily accessible to persons unless special means for access are used.

Statistical sparkover voltage. A transient overvoltage level that produces a 97.72-percent probability of sparkover (that is, two standard deviations above the voltage at which there is a 50-percent probability of sparkover).

Statistical withstand voltage. A transient overvoltage level that produces a 0.14-percent probability of sparkover (that is, three standard deviations below the voltage at which there is a 50-percent probability of sparkover).

B. *Installations energized at 50 to 300 volts*. The hazards posed by installations energized at 50 to 300 volts are the same as those found in many other workplaces. That is not to say that there is no hazard, but the complexity of electrical protection required does not compare to that required for high voltage systems. The employee must avoid contact with the exposed parts, and the protective equipment used (such as rubber insulating gloves) must provide insulation for the voltages involved.

C. *Exposed energized parts over 300 volts AC*. Paragraph (l)(3)(i) of § 1910.269 requires the employer to establish minimum approach distances no less than the distances computed by Table R-3 for AC systems so that employees can work safely without risk of sparkover.[2]

Unless the employee is using electrical protective equipment, air is the insulating medium between the employee and energized parts. The distance between the employee and an energized part must be sufficient for the air to withstand the maximum transient overvoltage that can reach the worksite under the working conditions and practices the employee is using. This distance is the minimum air insulation distance, and it is equal to the electrical component of the minimum approach distance.

Normal system design may provide or include a means (such as lightning arrestors) to control maximum anticipated transient overvoltage's, or the employer may use temporary devices (portable protective gaps) or measures (such as preventing automatic circuit breaker reclosing) to achieve the same result. Paragraph (l)(3)(ii) of § 1910.269 requires the employer to determine the maximum anticipated per-unit transient overvoltage, phase-to-ground, through an engineer-

ing analysis or assume a maximum anticipated per-unit transient overvoltage, phase-to-ground, in accordance with Table R-9, which specifies the following maximums for ac systems:

72.6 to 420.0 kilovolts-3.5 per unit
420.1 to 550.0 kilovolts-3.0 per unit
550.1 to 800.0 kilovolts-2.5 per unit

See paragraph IV.A.2, later in this appendix, for additional discussion of maximum transient overvoltages.

D. *Types of exposures*. Employees working on or near energized electric power generation, transmission, and distribution systems face two kinds of exposures: Phase-to-ground and phase-to-phase. The exposure is phase-to-ground with respect to an energized part, when the employee is at ground potential.

III. Determination of Minimum Approach Distances for AC Voltages Greater Than 300 Volts

A. *Voltages of 301 to 5,000 volts*. Test data generally forms the basis of minimum air insulation distances. The lowest voltage for which sufficient test data exists is 5,000 volts, and these data indicate that the minimum air insulation distance at that voltage is 20 millimeters (1 inch). Because the minimum air insulation distance increases with increasing voltage, and, conversely, decreases with decreasing voltage, an assumed minimum air insulation distance of 20 millimeters will protect against sparkover at voltages of 301 to 5,000 volts. Thus, 20 millimeters is the electrical component of the minimum approach distance for these voltages.

B. *Voltages of 5.1 to 72.5 kilovolts*. For voltages from 5.1 to 72.5 kilovolts, the Occupational Safety and Health Administration bases the methodology for calculating the electrical component of the minimum approach distance on Institute of Electrical and Electronic Engineers (IEEE) Standard 4-1995, *Standard Techniques for High-Voltage Testing*. Table 1 lists the critical sparkover distances from that standard as listed in IEEE Std 516-2009, *IEEE Guide for Maintenance Methods on Energized Power Lines*.

TABLE 1
SPARKOVER DISTANCE FOR ROD-TO-ROD GAP

60 Hz Rod-to-Rod sparkover (kV peak)	Gap spacing from IEEE Std 4-1995 (cm)
25	2
36	3
46	4
53	5
60	6
70	8
79	10
86	12
95	14
104	16
112	18
120	20
143	25
167	30
192	35

TABLE 1 SPARKOVER DISTANCE FOR ROD-TO-ROD GAP	
60 Hz Rod-to-Rod sparkover (kV peak)	Gap spacing from IEEE Std 4-1995 (cm)
218	40
243	45
270	50
322	60

Source: IEEE Std 516-2009.

To use this table to determine the electrical component of the minimum approach distance, the employer must determine the peak phase-to-ground transient overvoltage and select a gap from the table that corresponds to that voltage as a withstand voltage rather than a critical sparkover voltage. To calculate the electrical component of the minimum approach distance for voltages between 5 and 72.5 kilovolts, use the following procedure:

1. Divide the phase-to-phase voltage by the square root of 3 to convert it to a phase-to-ground voltage.

2. Multiply the phase-to-ground voltage by the square root of 2 to convert the rms value of the voltage to the peak phase-to-ground voltage.

3. Multiply the peak phase-to-ground voltage by the maximum per-unit transient overvoltage, which, for this voltage range, is 3.0, as discussed later in this appendix. This is the maximum phase-to-ground transient overvoltage, which corresponds to the withstand voltage for the relevant exposure.[3]

4. Divide the maximum phase-to-ground transient overvoltage by 1.85 to determine the corresponding critical sparkover voltage. (The critical sparkover voltage is 3 standard deviations (or 15 percent) greater than the withstand voltage.)

5. Determine the electrical component of the minimum approach distance from Table 1 through interpolation.

Table 2 illustrates how to derive the electrical component of the minimum approach distance for voltages from 5.1 to 72.5 kilovolts, before the application of any altitude correction factor, as explained later.

TABLE 2 CALCULATING THE ELECTRICAL COMPONENT OF MAD 751 V TO 72.5 KV				
Step	Maximum system phase-to-phase voltage (kV)			
	15	36	46	72.5
1. Divide by √3	8.7	20.8	26.6	41.9
2. Multiply by √2	12.2	29.4	37.6	59.2
3. Multiply by 3.0	36.7	88.2	112.7	177.6
4. Divide by 0.85	43.2	103.7	132.6	208.9
5. Interpolate from Table 1	3+(7.2/10)*1	14+(8.7/9)*2	20+(12.6/23)*5	35+(16.9/26)*5
Electrical component of MAD (cm)	3.72	15.93	22.74	38.25

C. *Voltages of 72.6 to 800 kilovolts*. For voltages of 72.6 kilovolts to 800 kilovolts, this section bases the electrical component of minimum approach distances, before the application of any altitude correction factor, on the following formula:

Equation 1 - For voltages of 72.6 kV to 800 kV

$$D = 0.3048(C + a)\ V_{L-G}T$$

Where:

D = Electrical component of the minimum approach distance in air in meters;

C = A correction factor associated with the variation of gap sparkover with voltage;

a = A factor relating to the saturation of air at system voltages of 345 kilovolts or higher;[4]

V_{L-G} = Maximum system line-to-ground rms voltage in kilovolts - It should be the "actual" maximum, or the normal highest voltage for the range (for example, 10 percent above the nominal voltage); and

T = Maximum transient overvoltage factor in per unit.

In Equation 1, C is 0.01: (1) For phase-to-ground exposures that the employer can demonstrate consist only of air across the approach distance (gap) and (2) for phase-to-phase exposures if the employer can demonstrate that no insulated tool spans the gap and that no large conductive object is in the gap. Otherwise, C is 0.011.

In Equation 1, the term a varies depending on whether the employee's exposure is phase-to-ground or phase-to-phase and on whether objects are in the gap. The employer must use the equations in Table 3 to calculate a. Sparkover test data with insulation spanning the gap form the basis for the equations for phase-to-ground exposures, and sparkover test data with only air in the gap form the basis for the equations for phase-to-phase exposures. The phase-to-ground equations result in slightly higher values of a, and, consequently, produce larger minimum approach distances, than the phase-to-phase equations for the same value of V_{Peak}.

TABLE 3
EQUATIONS FOR CALCULATING THE SURGE FACTOR, *a*

Phase-to-ground exposures			
$V_{Peak} = T_{L-G}V_{L-G}\sqrt{2}$	635 kV or less 0	635.1 to 915 kV (V_{Peak}- 635)/140,000	915.1 to 1,050 kV (V_{Peak}-645)/135,000
a			
$V_{Peak}= T_{L-G}V_{L-G}\sqrt{2}$	More than 1,050 kV		
a	(V_{Peak}-675)/125,000		
Phase-to-phase exposures [1]			
$V_{Peak} = (1.35T_{L-G} + 0.45)V_{L-G}\sqrt{2}$ . . .	630 kV or less 0	630.1 to 848 kV (V_{Peak}-630)/155,000	848.1 to 1,131 kV (V_{Peak}-633.6)/152,207
a			
$V_{Peak} = (1.35T_{L-G} + 0.45)V_{L-G}\sqrt{2}$ . . .	1,131.1 to 1,485 kV (V_{Peak}-628)/153,846	More than 1,485 kV (V_{Peak}-350.5)/203,666	
a			

[1]Use the equations for phase-to-ground exposures (with V_{Peak} for phase-to-phase exposures) unless the employer can demonstrate that no insulated tool spans the gap and that no large conductive object is in the gap.

In Equation 1, T is the maximum transient overvoltage factor in per unit. As noted earlier, § 1910.269(l)(3)(ii) requires the employer to determine the maximum anticipated per-unit transient overvoltage, phase-to-ground, through an engineering analysis or assume a maximum anticipated per-unit transient overvoltage, phase-to-ground, in accordance with Table R-9. For phase-to-ground exposures, the employer uses this value, called T_{L-G}, as T in Equation 1. IEEE Std 516-2009

provides the following formula to calculate the phase-to-phase maximum transient overvoltage, T_{L-L}, from T_{L-G}:

$$T_{L-L} = 1.35T_{L-G} + 0.45$$

For phase-to-phase exposures, the employer uses this value as T in Equation 1.

D. *Provisions for inadvertent movement*. The minimum approach distance must include an "adder" to compensate for the inadvertent movement of the worker relative to an energized part or the movement of the part relative to the worker. This "adder" must account for this possible inadvertent movement and provide the worker with a comfortable and safe zone in which to work. Employers must add the distance for inadvertent movement (called the "ergonomic component of the minimum approach distance") to the electrical component to determine the total safe minimum approach distances used in live-line work.

The Occupational Safety and Health Administration based the ergonomic component of the minimum approach distance on response time-distance analysis. This technique uses an estimate of the total response time to a hazardous incident and converts that time to the distance traveled. For example, the driver of a car takes a given amount of time to respond to a "stimulus" and stop the vehicle. The elapsed time involved results in the car's traveling some distance before coming to a complete stop. This distance depends on the speed of the car at the time the stimulus appears and the reaction time of the driver.

In the case of live-line work, the employee must first perceive that he or she is approaching the danger zone. Then, the worker responds to the danger and must decelerate and stop all motion toward the energized part. During the time it takes to stop, the employee will travel some distance. This is the distance the employer must add to the electrical component of the minimum approach distance to obtain the total safe minimum approach distance.

At voltages from 751 volts to 72.5 kilovolts,[5] the electrical component of the minimum approach distance is smaller than the ergonomic component. At 72.5 kilovolts, the electrical component is only a little more than 0.3 meters (1 foot). An ergonomic component of the minimum approach distance must provide for all the worker's unanticipated movements. At these voltages, workers generally use rubber insulating gloves; however, these gloves protect only a worker's hands and arms. Therefore, the energized object must be at a safe approach distance to protect the worker's face. In this case, 0.61 meters (2 feet) is a sufficient and practical ergonomic component of the minimum approach distance.

For voltages between 72.6 and 800 kilovolts, employees must use different work practices during energized line work. Generally, employees use live-line tools (hot sticks) to perform work on energized equipment. These tools, by design, keep the energized part at a constant distance from the employee and, thus, maintain the appropriate minimum approach distance automatically.

The location of the worker and the type of work methods the worker is using also influence the length of the ergonomic component of the minimum approach distance. In this higher voltage range, the employees use work methods that more tightly control their movements than when the workers perform work using rubber insulating gloves. The worker, therefore, is farther from the energized line or equipment and must be more precise in his or her movements just to perform the work. For these reasons, this section adopts an ergonomic component of the

minimum approach distance of 0.31 m (1 foot) for voltages between 72.6 and 800 kilovolts.

Table 4 summarizes the ergonomic component of the minimum approach distance for various voltage ranges.

TABLE 4
ERGONOMIC COMPONENT OF MINIMUM APPROACH DISTANCE

Voltage range (kV)	Distance	
	m	ft
0.301 to 0.750	0.31	1.0
0.751 to 72.5	0.61	2.0
72.6 to 800	0.31	1.0

Note: The employer must add this distance to the electrical component of the minimum approach distance to obtain the full minimum approach distance.

The ergonomic component of the minimum approach distance accounts for errors in maintaining the minimum approach distance (which might occur, for example, if an employee misjudges the length of a conductive object he or she is holding), and for errors in judging the minimum approach distance. The ergonomic component also accounts for inadvertent movements by the employee, such as slipping. In contrast, the working position selected to properly maintain the minimum approach distance must account for all of an employee's reasonably likely movements and still permit the employee to adhere to the applicable minimum approach distance. (See Figure 1.) Reasonably likely movements include an employee's adjustments to tools, equipment, and working positions and all movements needed to perform the work. For example, the employee should be able to perform all of the following actions without straying into the minimum approach distance:

• Adjust his or her hardhat;

• Maneuver a tool onto an energized part with a reasonable amount of overreaching or underreaching;

• Reach for and handle tools, material, and equipment passed to him or her; and

• Adjust tools, and replace components on them, when necessary during the work procedure.

The training of qualified employees required under § 1910.269(a)(2), and the job planning and briefing required under § 1910.269(c), must address selection of a proper working position.

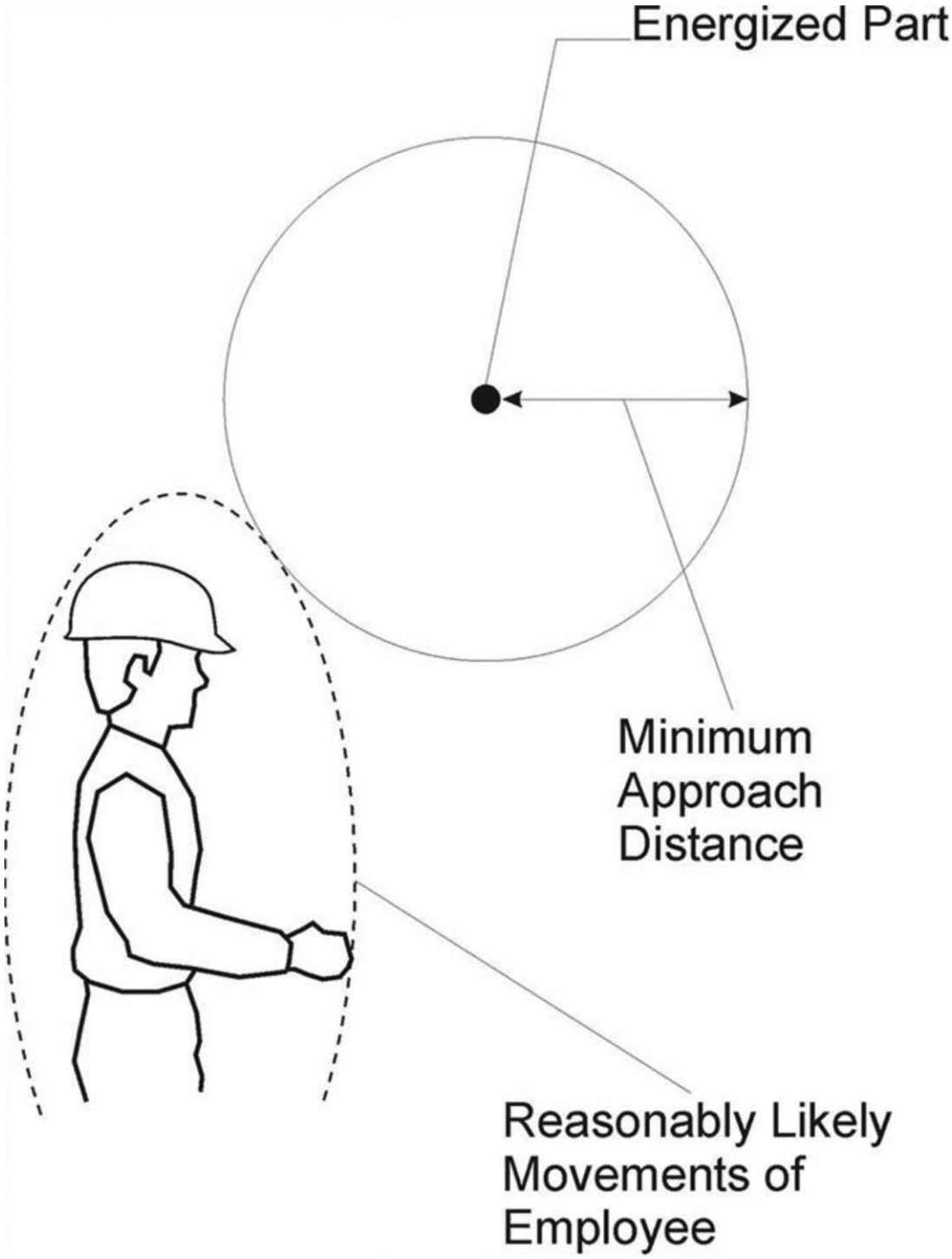


Figure 1 - Maintaining the Minimum Approach Distance

E. *Miscellaneous correction factors*. Changes in the air medium that forms the insulation influences the strength of an air gap. A brief discussion of each factor follows.

1. *Dielectric strength of air*. The dielectric strength of air in a uniform electric field at standard atmospheric conditions is approximately 3 kilovolts per millimeter.[6]

The pressure, temperature, and humidity of the air, the shape, dimensions, and separation of the electrodes, and the characteristics of the applied voltage (wave shape) affect the disruptive gradient.

2. *Atmospheric effect*. The empirically determined electrical strength of a given gap is normally applicable at standard atmospheric conditions (20°C, 101.3 kilopascals, 11 grams/cubic centimeter humidity). An increase in the density (humidity) of the air inhibits sparkover for a given air gap. The combination of temperature and air pressure that results in the lowest gap sparkover voltage is high temperature and low pressure. This combination of conditions is not likely to occur. Low air pressure, generally associated with high humidity, causes increased electrical strength. An average air pressure generally correlates with low humidity. Hot and dry working conditions normally result in reduced electrical strength. The equations for minimum approach distances in Table R-3 assume standard atmospheric conditions.

3. *Altitude*. The reduced air pressure at high altitudes causes a reduction in the electrical strength of an air gap. An employer must increase the minimum approach distance by about 3 percent per 300 meters (1,000 feet) of increased altitude for altitudes above 900 meters (3,000 feet). Table R-5 specifies the altitude correction factor that the employer must use in calculating minimum approach distances.

IV. Determining Minimum Approach Distances

A. *Factors Affecting Voltage Stress at the Worksite*.

1. *System voltage (nominal)*. The nominal system voltage range determines the voltage for purposes of calculating minimum approach distances. The employer selects the range in which the nominal system voltage falls, as given in the relevant table, and uses the highest value within that range in per unit calculations.

2. *Transient overvoltages*. Operation of switches or circuit breakers, a fault on a line or circuit or on an adjacent circuit, and similar activities may generate transient overvoltages on an electrical system. Each overvoltage has an associated transient voltage wave shape. The wave shape arriving at the site and its magnitude vary considerably.

In developing requirements for minimum approach distances, the Occupational Safety and Health Administration considered the most common wave shapes and the magnitude of transient overvoltages found on electric power generation, transmission, and distribution systems. The equations in Table R-3 for minimum approach distances use per-unit maximum transient overvoltages, which are relative to the nominal maximum voltage of the system. For example, a maximum transient overvoltage value of 3.0 per unit indicates that the highest transient overvoltage is 3.0 times the nominal maximum system voltage.

3. *Typical magnitude of overvoltages*. Table 5 lists the magnitude of typical transient overvoltages.

TABLE 5
MAGNITUDE OF TYPICAL TRANSIENT OVERVOLTAGES

Cause	Magnitude (per unit)
Energized 200-mile line without closing resistors	3.5
Energized 200-mile line with one-step closing resistor	2.1
Energized 200-mile line with multistep resistor	2.5
Reclosing with trapped charge one-step resistor	2.2

TABLE 5 MAGNITUDE OF TYPICAL TRANSIENT OVERVOLTAGES	
Cause	Magnitude (per unit)
Opening surge with single restrike	3.0
Fault initiation unfaulted phase	2.1
Fault initiation adjacent circuit	2.5
Fault clearing	1.7 to 1.9

4. *Standard deviation-air-gap withstand*. For each air gap length under the same atmospheric conditions, there is a statistical variation in the breakdown voltage. The probability of breakdown against voltage has a normal (Gaussian) distribution. The standard deviation of this distribution varies with the wave shape, gap geometry, and atmospheric conditions. The withstand voltage of the air gap is three standard deviations (3s) below the critical sparkover voltage. (The critical sparkover voltage is the crest value of the impulse wave that, under specified conditions, causes sparkover 50 percent of the time. An impulse wave of three standard deviations below this value, that is, the withstand voltage, has a probability of sparkover of approximately 1 in 1,000.)

5. *Broken Insulators*. Tests show reductions in the insulation strength of insulator strings with broken skirts. Broken units may lose up to 70 percent of their withstand capacity. Because an employer cannot determine the insulating capability of a broken unit without testing it, the employer must consider damaged units in an insulator to have no insulating value. Additionally, the presence of a live-line tool alongside an insulator string with broken units may further reduce the overall insulating strength. The number of good units that must be present in a string for it to be "insulated" as defined by § 1910.269(x) depends on the maximum overvoltage possible at the worksite.

B. *Minimum Approach Distances Based on Known, Maximum-Anticipated Per-Unit Transient Overvoltages*.

1. *Determining the minimum approach distance for AC systems*. Under § 1910.269(l)(3)(ii), the employer must determine the maximum anticipated per-unit transient overvoltage, phase-to-ground, through an engineering analysis or must assume a maximum anticipated per-unit transient overvoltage, phase-to-ground, in accordance with Table R-9. When the employer conducts an engineering analysis of the system and determines that the maximum transient overvoltage is lower than specified by Table R-9, the employer must ensure that any conditions assumed in the analysis, for example, that employees block reclosing on a circuit or install portable protective gaps, are present during energized work. To ensure that these conditions are present, the employer may need to institute new livework procedures reflecting the conditions and limitations set by the engineering analysis.

2. *Calculation of reduced approach distance values*. An employer may take the following steps to reduce minimum approach distances when the maximum transient overvoltage on the system (that is, the maximum transient overvoltage without additional steps to control overvoltages) produces unacceptably large minimum approach distances:

Step 1. Determine the maximum voltage (with respect to a given nominal voltage range) for the energized part.

Step 2. Determine the technique to use to control the maximum transient overvoltage. (See paragraphs IV.C and IV.D of this appendix.) Determine the maximum transient overvoltage that can exist at the worksite with that form of control in place and with a confidence level of 3s. This voltage is the withstand voltage for the purpose of calculating the appropriate minimum approach distance.

Step 3. Direct employees to implement procedures to ensure that the control technique is in effect during the course of the work.

Step 4. Using the new value of transient overvoltage in per unit, calculate the required minimum approach distance from Table R-3.

C. *Methods of Controlling Possible Transient Overvoltage Stress Found on a System*.

1. *Introduction*. There are several means of controlling overvoltages that occur on transmission systems. For example, the employer can modify the operation of circuit breakers or other switching devices to reduce switching transient overvoltages. Alternatively, the employer can hold the overvoltage to an acceptable level by installing surge arresters or portable protective gaps on the system. In addition, the employer can change the transmission system to minimize the effect of switching operations. Section 4.8 of IEEE Std 516-2009 describes various ways of controlling, and thereby reducing, maximum transient overvoltages.

2. *Operation of circuit breakers*.[7] The maximum transient overvoltage that can reach the worksite is often the result of switching on the line on which employees are working. Disabling automatic reclosing during energized line work, so that the line will not be reenergized after being opened for any reason, limits the maximum switching surge overvoltage to the larger of the opening surge or the greatest possible fault-generated surge, provided that the devices (for example, insertion resistors) are operable and will function to limit the transient overvoltage and that circuit breaker restrikes do not occur. The employer must ensure the proper functioning of insertion resistors and other overvoltage-limiting devices when the employer's engineering analysis assumes their proper operation to limit the overvoltage level. If the employer cannot disable the reclosing feature (because of system operating conditions), other methods of controlling the switching surge level may be necessary.

Transient surges on an adjacent line, particularly for double circuit construction, may cause a significant overvoltage on the line on which employees are working. The employer's engineering analysis must account for coupling to adjacent lines.

3. *Surge arresters*. The use of modern surge arresters allows a reduction in the basic impulse-insulation levels of much transmission system equipment. The primary function of early arresters was to protect the system insulation from the effects of lightning. Modern arresters not only dissipate lightning-caused transients, but may also control many other system transients caused by switching or faults.

The employer may use properly designed arresters to control transient overvoltages along a transmission line and thereby reduce the requisite length of the insulator string and possibly the maximum transient overvoltage on the line.[8]

4. *Switching restrictions*. Another form of overvoltage control involves establishing switching restrictions, whereby the employer prohibits the operation of circuit breakers until certain system conditions are present. The employer restricts switching by using a tagging system, similar to that used for a permit, except that the common

term used for this activity is a "hold-off" or "restriction." These terms indicate that the restriction does not prevent operation, but only modifies the operation during the livework activity.

D. *Minimum Approach Distance Based on Control of Maximum Transient Overvoltage at the Worksite.*

When the employer institutes control of maximum transient overvoltage at the worksite by installing portable protective gaps, the employer may calculate the minimum approach distance as follows:

Step 1. Select the appropriate withstand voltage for the protective gap based on system requirements and an acceptable probability of gap sparkover.[9]

Step 2. Determine a gap distance that provides a withstand voltage[10] greater than or equal to the one selected in the first step.[11]

Step 3. Use 110 percent of the gap's critical sparkover voltage to determine the phase-to-ground peak voltage at gap sparkover ($V_{PPG\ Peak}$).

Step 4. Determine the maximum transient overvoltage, phase-to-ground, at the worksite from the following formula:

$$T = \frac{V_{PPG\,Peak}}{V_{L\text{-}G}\sqrt{2}}.$$

Step 5. Use this value of T[12] in the equation in Table R-3 to obtain the minimum approach distance. If the worksite is no more than 900 meters (3,000 feet) above sea level, the employer may use this value of T to determine the minimum approach distance from Table 14 through Table 21.

Note: All rounding must be to the next higher value (that is, always round up).

Sample protective gap calculations.

Problem: Employees are to perform work on a 500-kilovolt transmission line at sea level that is subject to transient overvoltages of 2.4 p.u. The maximum operating voltage of the line is 550 kilovolts. Determine the length of the protective gap that will provide the minimum practical safe approach distance. Also, determine what that minimum approach distance is:

Step 1. Calculate the smallest practical maximum transient overvoltage (1.25 times the crest phase-to-ground voltage):[13]

$$550kV \times \frac{\sqrt{2}}{\sqrt{3}} \times 1.25 = 561kV.$$

This value equals the withstand voltage of the protective gap.

Step 2. Using test data for a particular protective gap, select a gap that has a critical sparkover voltage greater than or equal to:

$$561kV \div 0.85 = 660kV$$

For example, if a protective gap with a 1.22-m (4.0-foot) spacing tested to a critical sparkover voltage of 665 kilovolts (crest), select this gap spacing.

Step 3. The phase-to-ground peak voltage at gap sparkover (VPPG Peak) is 110 percent of the value from the previous step:

$$665kV \times 1.10 = 732kV$$

This value corresponds to the withstand voltage of the electrical component of the minimum approach distance.

Step 4. Use this voltage to determine the worksite value of *T*:

$$T = \frac{732}{564} = 1.7\,p.u.$$

Step 5. Use this value of *T* in the equation in Table R-3 to obtain the minimum approach distance, or look up the minimum approach distance in Table 14 through Table 21:

MAD = 2.29 m (7.6 ft).

E. *Location of Protective Gaps*.

1. *Adjacent structures*. The employer may install the protective gap on a structure adjacent to the worksite, as this practice does not significantly reduce the protection afforded by the gap.

2. *Terminal stations*. Gaps installed at terminal stations of lines or circuits provide a level of protection; however, that level of protection may not extend throughout the length of the line to the worksite. The use of substation terminal gaps raises the possibility that separate surges could enter the line at opposite ends, each with low enough magnitude to pass the terminal gaps without sparkover. When voltage surges occur simultaneously at each end of a line and travel toward each other, the total voltage on the line at the point where they meet is the arithmetic sum of the two surges. A gap installed within 0.8 km (0.5 mile) of the worksite will protect against such intersecting waves. Engineering studies of a particular line or system may indicate that employers can adequately protect employees by installing gaps at even more distant locations. In any event, unless using the default values for *T* from Table R-9, the employer must determine *T* at the worksite.

3. *Worksite*. If the employer installs protective gaps at the worksite, the gap setting establishes the worksite impulse insulation strength. Lightning strikes as far as 6 miles from the worksite can cause a voltage surge greater than the gap withstand voltage, and a gap sparkover can occur. In addition, the gap can sparkover from overvoltages on the line that exceed the withstand voltage of the gap. Consequently, the employer must protect employees from hazards resulting from any sparkover that could occur.

F. *Disabling automatic reclosing*. There are two reasons to disable the automatic-reclosing feature of circuit-interrupting devices while employees are performing live-line work:

- To prevent reenergization of a circuit faulted during the work, which could create a hazard or result in more serious injuries or damage than the injuries or damage produced by the original fault;
- To prevent any transient overvoltage caused by the switching surge that would result if the circuit were reenergized.

However, due to system stability considerations, it may not always be feasible to disable the automatic-reclosing feature.

V. Minimum Approach-Distance Tables

A. *Legacy tables*. Employers may use the minimum approach distances in Table 6 through Table 13 until March 31, 2015.

TABLE 6 MINIMUM APPROACH DISTANCES UNTIL DECEMBER 31, 2014				
Voltage range phase to phase (kV)	Phase-to-ground exposure		Phase-to-phase exposure	
	m	ft	m	ft
0.05 to 1.0	Avoid Contact		Avoid Contact	
1.1 to 15.0	0.64	2.10	0.66	2.20
15.1 to 36.0	0.72	2.30	0.77	2.60
36.1 to 46.0	0.77	2.60	0.85	2.80
46.1 to 72.5	0.90	3.00	1.05	3.50
72.6 to 121	0.95	3.20	1.29	4.30
138 to 145	1.09	3.60	1.50	4.90
161 to 169	1.22	4.00	1.71	5.70
230 to 242	1.59	5.30	2.27	7.50
345 to 362	2.59	8.50	3.80	12.50
500 to 550	3.42	11.30	5.50	18.10
765 to 800	4.53	14.90	7.91	26.00

Note: The clear live-line tool distance must equal or exceed the values for the indicated voltage ranges.

TABLE 7 MINIMUM APPROACH DISTANCES UNTIL MARCH 31, 2015-72.6 TO 121.0 KV WITH OVERVOLTAGE FACTOR				
T (p.u.)	Phase-to-ground exposure		ure	
	m	ft	m	ft
2.0	0.74	2.42	1.09	3.58
2.1	0.76	2.50	1.09	3.58
2.2	0.79	2.58	1.12	3.67
2.3	0.81	2.67	1.14	3.75
2.4	0.84	2.75	1.17	3.83
2.5	0.84	2.75	1.19	3.92
2.6	0.86	2.83	1.22	4.00
2.7	0.89	2.92	1.24	4.08
2.8	0.91	3.00	1.24	4.08
2.9	0.94	3.08	1.27	4.17
3.0	0.97	3.17	1.30	4.25

Note 1: The employer may apply the distance specified in this table only where the employer determines the maximum anticipated per-unit transient overvoltage by engineering analysis. (Table 6 applies otherwise.)
Note 2: The distances specified in this table are the air and live-line tool distances.

TABLE 8 MINIMUM APPROACH DISTANCES UNTIL MARCH 31, 2015-121.1 TO 145.0 KV WITH OVERVOLTAGE FACTOR				
T (p.u.)	Phase-to-ground exposure		sure	
	m	ft	m	ft
2.0	0.84	2.75	1.24	4.08
2.1	0.86	2.83	1.27	4.17
2.2	0.89	2.92	1.30	4.25
2.3	0.91	3.00	1.32	4.33
2.4	0.94	3.08	1.35	4.42
2.5	0.97	3.17	1.37	4.50
2.6	0.99	3.25	1.40	4.58
2.7	1.02	3.33	1.42	4.67

TABLE 8
MINIMUM APPROACH DISTANCES UNTIL MARCH 31, 2015-121.1 TO 145.0 KV WITH OVERVOLTAGE FACTOR

T (p.u.)	Phase-to-ground exposure		Phase-to-ground exposure	
	m	ft	m	ft
2.8	1.04	3.42	1.45	4.75
2.9	1.07	3.50	1.47	4.83
3.0	1.09	3.58	1.50	4.92

Note 1: The employer may apply the distance specified in this table only where the employer determines the maximum anticipated per-unit transient overvoltage by engineering analysis. (Table 6 applies otherwise.)
Note 2: The distances specified in this table are the air and live-line tool distances.

TABLE 9
MINIMUM APPROACH DISTANCES UNTIL MARCH 31, 2015-145.1 TO 169.0 KV WITH OVERVOLTAGE FACTOR

T (p.u.)	Phase-to-ground exposure		ure	
	m	ft	m	ft
2.0	0.91	3.00	1.42	4.67
2.1	0.97	3.17	1.45	4.75
2.2	0.99	3.25	1.47	4.83
2.3	1.02	3.33	1.50	4.92
2.4	1.04	3.42	1.52	5.00
2.5	1.07	3.50	1.57	5.17
2.6	1.12	3.67	1.60	5.25
2.7	1.14	3.75	1.63	5.33
2.8	1.17	3.83	1.65	5.42
2.9	1.19	3.92	1.68	5.50
3.0	1.22	4.00	1.73	5.67

Note 1: The employer may apply the distance specified in this table only where the employer determines the maximum anticipated per-unit transient overvoltage by engineering analysis. (Table 6 applies otherwise.)
Note 2: The distances specified in this table are the air and live-line tool distances.

TABLE 10
MINIMUM APPROACH DISTANCES UNTIL MARCH 31, 2015-169.1 TO 242.0 KV WITH OVERVOLTAGE FACTOR

T (p.u.)	Phase-to-ground exposure		sure	
	m	ft	m	ft
2.0	1.17	3.83	1.85	6.08
2.1	1.22	4.00	1.91	6.25
2.2	1.24	4.08	1.93	6.33
2.3	1.30	4.25	1.98	6.50
2.4	1.35	4.42	2.01	6.58
2.5	1.37	4.50	2.06	6.75
2.6	1.42	4.67	2.11	6.92
2.7	1.47	4.83	2.13	7.00
2.8	1.50	4.92	2.18	7.17
2.9	1.55	5.08	2.24	7.33
3.0	1.60	5.25	2.29	7.50

Note 1: The employer may apply the distance specified in this table only where the employer determines the maximum anticipated per-unit transient overvoltage by engineering analysis. (Table 6 applies otherwise.)
Note 2: The distances specified in this table are the air and live-line tool distances.

TABLE 11 MINIMUM APPROACH DISTANCES UNTIL MARCH 31, 2015-242.1 TO 362.0 KV WITH OVERVOLTAGE FACTOR				
T (p.u.)	Phase-to-ground exposure			sure
	m	ft	m	ft
2.0	1.60	5.25	2.62	8.58
2.1	1.65	5.42	2.69	8.83
2.2	1.75	5.75	2.79	9.17
2.3	1.85	6.08	2.90	9.50
2.4	1.93	6.33	3.02	9.92
2.5	2.03	6.67	3.15	10.33
2.6	2.16	7.08	3.28	10.75
2.7	2.26	7.42	3.40	11.17
2.8	2.36	7.75	3.53	11.58
2.9	2.49	8.17	3.68	12.08
3.0	2.59	8.50	3.81	12.50

Note 1: The employer may apply the distance specified in this table only where the employer determines the maximum anticipated per-unit transient overvoltage by engineering analysis. (Table 6 applies otherwise.)
Note 2: The distances specified in this table are the air and live-line tool distances.

TABLE 12 MINIMUM APPROACH DISTANCES UNTIL MARCH 31, 2015-362.1 TO 552.0 KV WITH OVERVOLTAGE FACTOR				
T (p.u.)	Phase-to-ground exposure			sure
	m	ft	m	ft
1.5	1.83	6.00	2.24	7.33
1.6	1.98	6.50	2.67	8.75
1.7	2.13	7.00	3.10	10.17
1.8	2.31	7.58	3.53	11.58
1.9	2.46	8.08	4.01	13.17
2.0	2.67	8.75	4.52	14.83
2.1	2.84	9.33	4.75	15.58
2.2	3.02	9.92	4.98	16.33
2.3	3.20	10.50	5.23	17.17
2.4	3.43	11.25	5.51	18.08

Note 1: The employer may apply the distance specified in this table only where the employer determines the maximum anticipated per-unit transient overvoltage by engineering analysis. (Table 6 applies otherwise.)
Note 2: The distances specified in this table are the air and live-line tool distances.

TABLE 13 MINIMUM APPROACH DISTANCES UNTIL MARCH 31, 2015-552.1 TO 800.0 KV WITH OVERVOLTAGE FACTOR				
T (p.u.)	Phase-to-ground exposure			sure
	m	ft	m	ft
1.5	2.95	9.67	3.68	12.08
1.6	3.25	10.67	4.42	14.50
1.7	3.56	11.67	5.23	17.17
1.8	3.86	12.67	6.07	19.92
1.9	4.19	13.75	6.99	22.92
2.0	4.55	14.92	7.92	26.00

Note 1: The employer may apply the distance specified in this table only where the employer determines the maximum anticipated per-unit transient overvoltage by engineering analysis. (Table 6 applies otherwise.)
Note 2: The distances specified in this table are the air and live-line tool distances.

B. Alternative minimum approach distances. Employers may use the minimum approach distances in Table 14 through Table 21 provided that the employer follows the notes to those tables.

TABLE 14
AC MINIMUM APPROACH DISTANCES-72.6 TO 121.0 KV

T (p.u.)	Phase-to-ground exposure			ure
	m	ft	m	ft
1.5	0.67	2.2	0.84	2.8
1.6	0.69	2.3	0.87	2.9
1.7	0.71	2.3	0.90	3.0
1.8	0.74	2.4	0.93	3.1
1.9	0.76	2.5	0.96	3.1
2.0	0.78	2.6	0.99	3.2
2.1	0.81	2.7	1.01	3.3
2.2	0.83	2.7	1.04	3.4
2.3	0.85	2.8	1.07	3.5
2.4	0.88	2.9	1.10	3.6
2.5	0.90	3.0	1.13	3.7
2.6	0.92	3.0	1.16	3.8
2.7	0.95	3.1	1.19	3.9
2.8	0.97	3.2	1.22	4.0
2.9	0.99	3.2	1.24	4.1
3.0	1.02	3.3	1.27	4.2
3.1	1.04	3.4	1.30	4.3
3.2	1.06	3.5	1.33	4.4
3.3	1.09	3.6	1.36	4.5
3.4	1.11	3.6	1.39	4.6
3.5	1.13	3.7	1.42	4.7

TABLE 15
AC MINIMUM APPROACH DISTANCES-121.1 TO 145.0 KV

T (p.u.)	Phase-to-ground exposure			ure
	m	ft	m	ft
1.5	0.74	2.4	0.95	3.1
1.6	0.76	2.5	0.98	3.2
1.7	0.79	2.6	1.02	3.3
1.8	0.82	2.7	1.05	3.4
1.9	0.85	2.8	1.08	3.5
2.0	0.88	2.9	1.12	3.7
2.1	0.90	3.0	1.15	3.8
2.2	0.93	3.1	1.19	3.9
2.3	0.96	3.1	1.22	4.0
2.4	0.99	3.2	1.26	4.1
2.5	1.02	3.3	1.29	4.2
2.6	1.04	3.4	1.33	4.4
2.7	1.07	3.5	1.36	4.5
2.8	1.10	3.6	1.39	4.6
2.9	1.13	3.7	1.43	4.7

TABLE 15 AC MINIMUM APPROACH DISTANCES-121.1 TO 145.0				
T (p.u.)	Phase-to-ground exposure		Phase-to-ground exposure	
	m	ft	m	ft
3.0	1.16	3.8	1.46	4.8
3.1	1.19	3.9	1.50	4.9
3.2	1.21	4.0	1.53	5.0
3.3	1.24	4.1	1.57	5.2
3.4	1.27	4.2	1.60	5.2
3.5	1.30	4.3	1.64	5.4

TABLE 16 AC MINIMUM APPROACH DISTANCES-145.1 TO 169.0 KV				
T (p.u.)	Phase-to-ground exposure			ure
	m	ft	m	ft
1.5	0.81	2.7	1.05	3.4
1.6	0.84	2.8	1.09	3.6
1.7	0.87	2.9	1.13	3.7
1.8	0.90	3.0	1.17	3.8
1.9	0.94	3.1	1.21	4.0
2.0	0.97	3.2	1.25	4.1
2.1	1.00	3.3	1.29	4.2
2.2	1.03	3.4	1.33	4.4
2.3	1.07	3.5	1.37	4.5
2.4	1.10	3.6	1.41	4.6
2.5	1.13	3.7	1.45	4.8
2.6	1.17	3.8	1.49	4.9
2.7	1.20	3.9	1.53	5.0
2.8	1.23	4.0	1.57	5.2
2.9	1.26	4.1	1.61	5.3
3.0	1.30	4.3	1.65	5.4
3.1	1.33	4.4	1.70	5.6
3.2	1.36	4.5	1.76	5.8
3.3	1.39	4.6	1.82	6.0
3.4	1.43	4.7	1.88	6.2
3.5	1.46	4.8	1.94	6.4

TABLE 17 AC MINIMUM APPROACH DISTANCES-169.1 TO 242.0 KV				
T (p.u.)	Phase-to-ground exposure			ure
	m	ft	m	ft
1.5	1.02	3.3	1.37	4.5
1.6	1.06	3.5	1.43	4.7
1.7	1.11	3.6	1.48	4.9
1.8	1.16	3.8	1.54	5.1
1.9	1.21	4.0	1.60	5.2
2.0	1.25	4.1	1.66	5.4
2.1	1.30	4.3	1.73	5.7
2.2	1.35	4.4	1.81	5.9

TABLE 17
AC MINIMUM APPROACH DISTANCES-169.1 TO 242.0

T (p.u.)	Phase-to-ground exposure		Phase-to-ground exposure	
	m	ft	m	ft
2.3	1.39	4.6	1.90	6.2
2.4	1.44	4.7	1.99	6.5
2.5	1.49	4.9	2.08	6.8
2.6	1.53	5.0	2.17	7.1
2.7	1.58	5.2	2.26	7.4
2.8	1.63	5.3	2.36	7.7
2.9	1.67	5.5	2.45	8.0
3.0	1.72	5.6	2.55	8.4
3.1	1.77	5.8	2.65	8.7
3.2	1.81	5.9	2.76	9.1
3.3	1.88	6.2	2.86	9.4
3.4	1.95	6.4	2.97	9.7
3.5	2.01	6.6	3.08	10.1

TABLE 18
AC MINIMUM APPROACH DISTANCES-242.1 TO 362.0 KV

T (p.u.)	Phase-to-ground exposure		sure	
	m	ft	m	ft
1.5	1.37	4.5	1.99	6.5
1.6	1.44	4.7	2.13	7.0
1.7	1.51	5.0	2.27	7.4
1.8	1.58	5.2	2.41	7.9
1.9	1.65	5.4	2.56	8.4
2.0	1.72	5.6	2.71	8.9
2.1	1.79	6.1	2.87	9.4
2.2	1.87	6.1	3.03	9.9
2.3	1.97	6.5	3.20	10.5
2.4	2.08	6.8	3.37	11.1
2.5	2.19	7.2	3.55	11.6
2.6	2.29	7.5	3.73	12.2
2.7	2.41	7.9	3.91	12.8
2.8	2.52	8.3	4.10	13.5
2.9	2.64	8.7	4.29	14.1
3.0	2.76	9.1	4.49	14.7
3.1	2.88	9.4	4.69	15.4
3.2	3.01	9.9	4.90	16.1
3.3	3.14	10.3	5.11	16.8
3.4	3.27	10.7	5.32	17.5
3.5	3.41	11.2	5.52	18.1

TABLE 19
AC MINIMUM APPROACH DISTANCES-362.1 TO 420.0 KV

T (p.u.)	Phase-to-ground exposure		ure	
	m	ft	m	ft
1.5	1.53	5.0	2.40	7.9

TABLE 19 AC MINIMUM APPROACH DISTANCES-362.1 TO 420.0				
T (p.u.)	Phase-to-ground exposure		Phase-to-ground exposure	
	m	ft	m	ft
1.6	1.62	5.3	2.58	8.5
1.7	1.70	5.6	2.75	9.0
1.8	1.78	5.8	2.94	9.6
1.9	1.88	6.2	3.13	10.3
2.0	1.99	6.5	3.33	10.9
2.1	2.12	7.0	3.53	11.6
2.2	2.24	7.3	3.74	12.3
2.3	2.37	7.8	3.95	13.0
2.4	2.50	8.2	4.17	13.7
2.5	2.64	8.7	4.40	14.4
2.6	2.78	9.1	4.63	15.2
2.7	2.93	9.6	4.87	16.0
2.8	3.07	10.1	5.11	16.8
2.9	3.23	10.6	5.36	17.6
3.0	3.38	11.1	5.59	18.3
3.1	3.55	11.6	5.82	19.1
3.2	3.72	12.2	6.07	19.9
3.3	3.89	12.8	6.31	20.7
3.4	4.07	13.4	6.56	21.5
3.5	4.25	13.9	6.81	22.3

TABLE 20 AC MINIMUM APPROACH DISTANCES-420.1 TO 550.0 KV				
T (p.u.)	Phase-to-ground exposure			sure
	m	ft	m	ft
1.5	1.95	6.4	3.46	11.4
1.6	2.11	6.9	3.73	12.2
1.7	2.28	7.5	4.02	13.2
1.8	2.45	8.0	4.31	14.1
1.9	2.62	8.6	4.61	15.1
2.0	2.81	9.2	4.92	16.1
2.1	3.00	9.8	5.25	17.2
2.2	3.20	10.5	5.55	18.2
2.3	3.40	11.2	5.86	19.2
2.4	3.62	11.9	6.18	20.3
2.5	3.84	12.6	6.50	21.3
2.6	4.07	13.4	6.83	22.4
2.7	4.31	14.1	7.18	23.6
2.8	4.56	15.0	7.52	24.7
2.9	4.81	15.8	7.88	25.9
3.0	5.07	16.6	8.24	27.0

TABLE 21 AC MINIMUM APPROACH DISTANCES-550.1 TO 800.0 KV				
T (p.u.)	Phase-to-ground exposure		sure	
	m	ft	m	ft
1.5	3.16	10.4	5.97	19.6
1.6	3.46	11.4	6.43	21.1
1.7	3.78	12.4	6.92	22.7
1.8	4.12	13.5	7.42	24.3
1.9	4.47	14.7	7.93	26.0
2.0	4.83	15.8	8.47	27.8
2.1	5.21	17.1	9.02	29.6
2.2	5.61	18.4	9.58	31.4
2.3	6.02	19.8	10.16	33.3
2.4	6.44	21.1	10.76	35.3
2.5	6.88	22.6	11.38	37.3

Notes to Table 14 through Table 21:

1. The employer must determine the maximum anticipated per-unit transient overvoltage, phase-to-ground, through an engineering analysis, as required by § 1910.269(l)(3)(ii), or assume a maximum anticipated per-unit transient overvoltage, phase-to-ground, in accordance with Table R-9.
2. For phase-to-phase exposures, the employer must demonstrate that no insulated tool spans the gap and that no large conductive object is in the gap.

The worksite must be at an elevation of 900 meters (3,000 feet) or less above sea level.

[1]Federal, state, and local regulatory bodies and electric utilities set reliability requirements that limit the number and duration of system outages.

[2]Sparkover is a disruptive electric discharge in which an electric arc forms and electric current passes through air.

[3]The withstand voltage is the voltage at which sparkover is not likely to occur across a specified distance. It is the voltage taken at the 3s point below the sparkover voltage, assuming that the sparkover curve follows a normal distribution.

[4]Test data demonstrates that the saturation factor is greater than 0 at peak voltages of about 630 kilovolts. Systems operating at 345 kilovolts (or maximum system voltages of 362 kilovolts) can have peak maximum transient overvoltages exceeding 630 kilovolts. Table R-3 sets equations for calculating a based on peak voltage.

[5]For voltages of 50 to 300 volts, Table R-3 specifies a minimum approach distance of "avoid contact." The minimum approach distance for this voltage range contains neither an electrical component nor an ergonomic component.

[6]For the purposes of estimating arc length, § 1910.269 generally assumes a more conservative dielectric strength of 10 kilovolts per 25.4 millimeters, consistent with assumptions made in consensus standards such as the National Electrical Safety Code (IEEE C2-2012). The more conservative value accounts for variables such as electrode shape, wave shape, and a certain amount of overvoltage.

[7]The detailed design of a circuit interrupter, such as the design of the contacts, resistor insertion, and breaker timing control, are beyond the scope of this appendix. The design of the system generally accounts for these features. This appendix only discusses features that can limit the maximum switching transient overvoltage on a system.

[8]Surge arrester application is beyond the scope of this appendix. However, if the employer installs the arrester near the worksite, the application would be similar to the protective gaps discussed in paragraph IV.D of this appendix.

[9]The employer should check the withstand voltage to ensure that it results in a probability of gap flashover that is acceptable from a system outage perspective. (In other words, a gap sparkover will produce a system outage. The employer should determine whether such an outage will impact overall system performance to an acceptable degree.) In general, the withstand voltage should be at least 1.25 times the maximum crest operating voltage.

[10]The manufacturer of the gap provides, based on test data, the critical sparkover voltage for each gap spacing (for example, a critical sparkover voltage of 665 kilovolts for a gap spacing of 1.2 meters). The withstand voltage for the gap is equal to 85 percent of its critical sparkover voltage.

[11]Switch steps 1 and 2 if the length of the protective gap is known.

[12]IEEE Std 516-2009 states that most employers add 0.2 to the calculated value of *T* as an additional safety factor.

[13]To eliminate sparkovers due to minor system disturbances, the employer should use a withstand voltage no lower than 1.25 p.u. Note that this is a practical, or operational, consideration only. It may be feasible for the employer to use lower values of withstand voltage.

AMENDATORY SECTION (Amending WSR 98-07-009, filed 3/6/98, effective 5/6/98)

WAC 296-45-903 Appendix B—Protection from step and touch potentials—Nonmandatory.

Protection from Hazardous Differences in Electric Potential

I. "Introduction"

((~~When a ground fault occurs on a power line, voltage is impressed on the "grounded" object faulting the line. The voltage to which this object rises depends largely on the voltage on the line, on the impedance of the faulted conductor, and on the impedance to "true," or "absolute," ground represented by the object. If the object causing the fault represents a relatively large impedance, the voltage impressed on it is essentially the phase-to-ground system voltage. However, even faults to well grounded transmission towers or substation structures can result in hazardous voltages.~~[(1)] ~~The degree of the hazard depends upon the magnitude of the fault current and the time of exposure.~~

~~*Footnote*[(1)] This appendix provides information primarily with respect to employee protection from contact between equipment being used and an energized power line. The information presented is also relevant to ground faults to transmission towers and substation structures; however, grounding systems for these structures should be designed to minimize the step and touch potentials involved.~~))

Current passing through an impedance impresses voltage across that impedance. Even conductors have some, albeit low, value of impedance. Therefore, if a "grounded"[1] object, such as a crane or deenergized and grounded power line, results in a ground fault on a power line, voltage is impressed on that grounded object. The voltage impressed on the grounded object depends largely on the voltage on the line, on the impedance of the faulted conductor, and on the impedance to "true," or "absolute," ground represented by the object. If the impedance of the object causing the fault is relatively large, the voltage impressed on the object is essentially the phase-to-ground system voltage. However, even faults to grounded power lines or to well-grounded transmission towers or substation structures (which have relatively low values of impedance to ground) can result in hazardous voltages.[2] In all cases, the degree of the hazard depends on the magnitude of the current through the employee and the time of exposure. This document discusses methods of protecting workers against the possibility that grounded objects, such as cranes and other mechanical equipment, will contact energized power lines and that deenergized and grounded power lines will become accidentally energized.

II. "Voltage-gradient distribution"

A. *Voltage-gradient distribution curve.*

((~~The dissipation of voltage from a grounding electrode (or from the grounded end of an energized grounded object) is called the ground potential gradient. Voltage drops associated with this dissipation of voltage are called ground potentials. Figure A is a typical voltage-gradient distribution curve (assuming a uniform soil texture). This graph shows that voltage decreases rapidly with increasing distance from the grounding electrode.~~)) Absolute, or true, ground serves as a reference and always has a voltage of 0 volts above ground potential. Because there is an impedance between a grounding electrode and absolute ground, there will be a voltage difference between the grounding electrode and absolute ground under ground-fault conditions. Voltage dissipates from the grounding electrode (or from the grounding point) and creates a ground potential gradient. The voltage decreases rapidly with increasing distance from the grounding electrode. A voltage drop associated with this dissipation of voltage is a ground potential. Figure A is a typical voltage-gradient distribution curve (assuming a uniform soil texture).

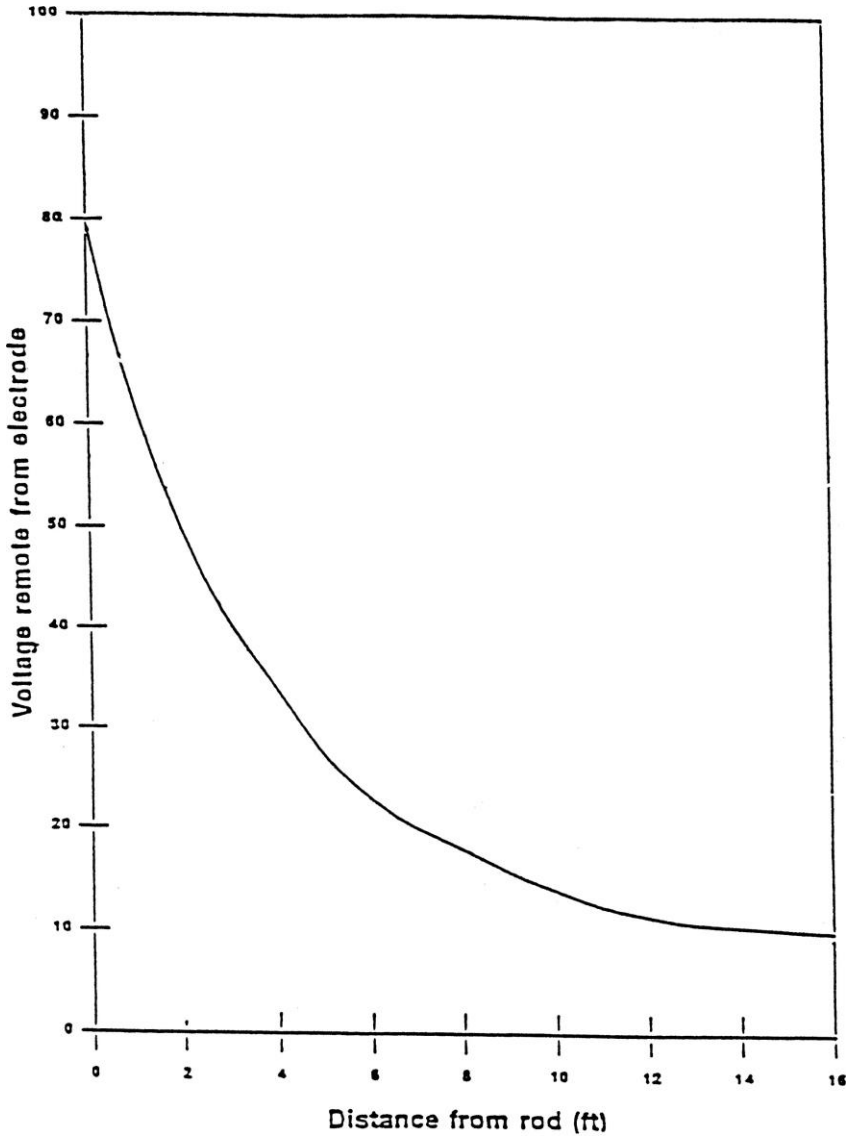


Figure A - Typical Voltage-Gradient Distribution Curve

B. *Step and touch potentials*. Figure A also shows that workers are at risk from step and touch potentials. Step potential is the voltage between the feet of a person standing near an energized grounded object (the electrode). In Figure A, the step potential is equal to the difference in voltage between two points at different distances from the electrode (where the points represent the location of each foot in relation to the electrode). A person could be at risk of injury during a fault simply by standing near the object.

Touch potential is the voltage between the energized grounded object (again, the electrode) and the feet of a person in contact with the object. In Figure A, the touch potential is equal to the difference in voltage between the electrode (which is at a distance of 0 meters) and a point some distance away from the electrode (where the point represents the location of the feet of the person in contact with the object). The touch potential could be nearly the full voltage across the grounded object if that object is grounded at a point remote from the place where the person is in contact with it. For example, a crane grounded to the system neutral and that contacts an ener-

gized line would expose any person in contact with the crane or its uninsulated load line to a touch potential nearly equal to the full fault voltage.

Figure B illustrates step and touch potentials.

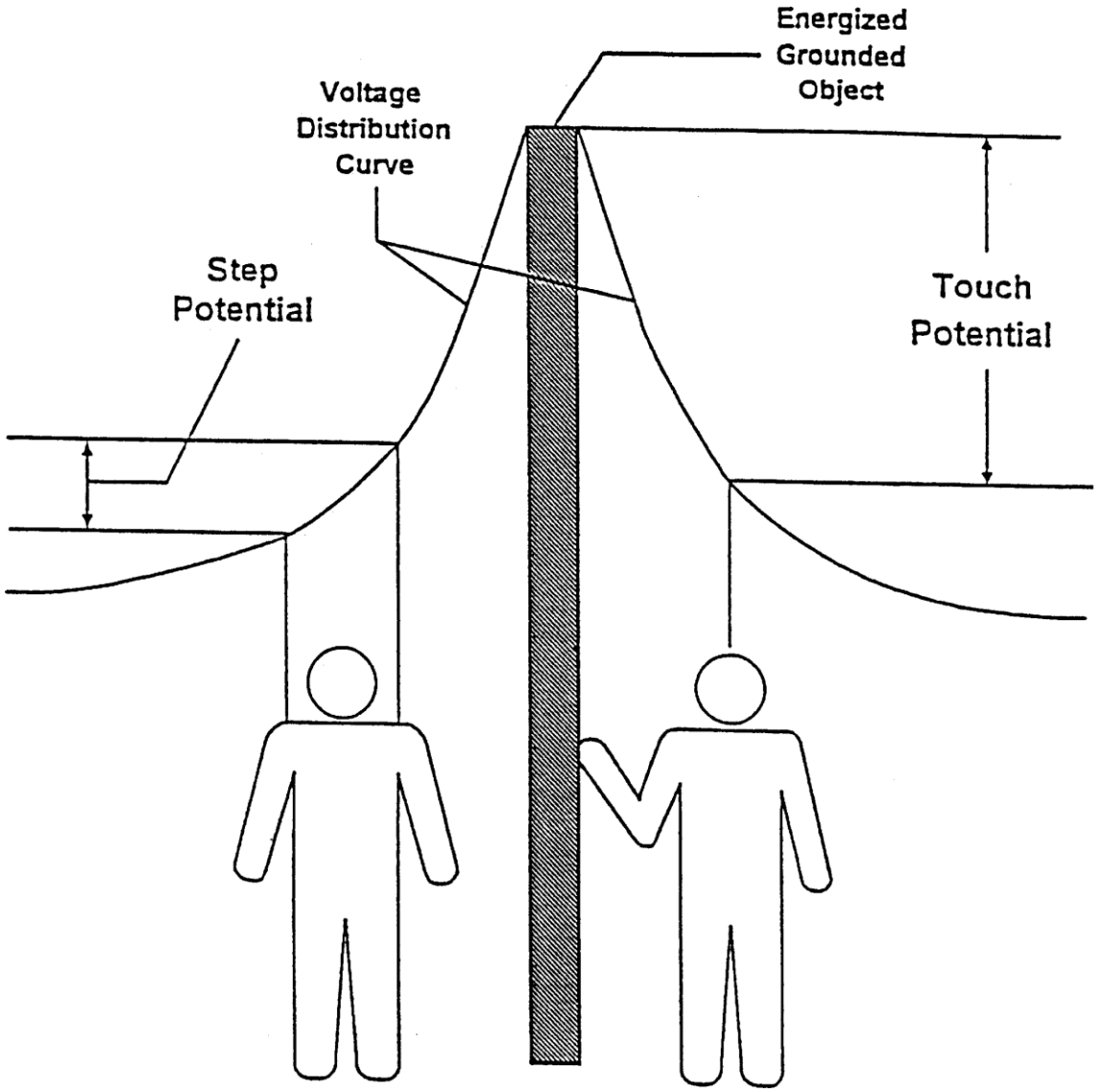


Figure B - Step and Touch Potentials

III. Protecting Workers From Hazardous Differences in Electrical Potential

A. *Definitions*. The following definitions apply to Section III of this document:

Bond. The electrical interconnection of conductive parts designed to maintain a common electric potential.

Bonding cable (bonding jumper). A cable connected to two conductive parts to bond the parts together.

Cluster bar. A terminal temporarily attached to a structure that provides a means for the attachment and bonding of grounding and bonding cables to the structure.

Ground. A conducting connection between an electric circuit or equipment and the earth, or to some conducting body that serves in place of the earth.

Grounding cable (grounding jumper). A cable connected between a deenergized part and ground. Note that grounding cables carry fault current and bonding cables generally do not. A cable that bonds two conductive parts but carries substantial fault current (for example, a jumper connected between one phase and a grounded phase) is a grounding cable.

Ground mat (grounding grid). A temporarily or permanently installed metallic mat or grating that establishes an equipotential surface and provides connection points for attaching grounds.

B.*Analyzing the hazard.* The employer can use an engineering analysis of the power system under fault conditions to determine whether hazardous step and touch voltages will develop. The analysis should determine the voltage on all conductive objects in the work area and the amount of time the voltage will be present. Based on the analysis, the employer can select appropriate measures and protective equipment, including the measures and protective equipment outlined in Section III of this document, to protect each employee from hazardous differences in electric potential. For example, from the analysis, the employer will know the voltage remaining on conductive objects after employees install bonding and grounding equipment and will be able to select insulating equipment with an appropriate rating, as described in paragraph III.C.2 of this document.

C.*Protecting workers on the ground.* The employer may use several methods, including equipotential zones, insulating equipment, and restricted work areas, to protect employees on the ground from hazardous differences in electrical potential.

1.An equipotential zone will protect workers within it from hazardous step and touch potentials. (See Figure C.) Equipotential zones will not, however, protect employees located either wholly or partially outside the protected area. The employer can establish an equipotential zone for workers on the ground, with respect to a grounded object, through the use of a metal mat connected to the grounded object. The employer can use a grounding grid to equalize the voltage within the grid or bond conductive objects in the immediate work area to minimize the potential between the objects and between each object and ground. (Bonding an object outside the work area can increase the touch potential to that object, however.) Section III.D of this document discusses equipotential zones for employees working on deenergized and grounded power lines.

2.Insulating equipment, such as rubber gloves, can protect employees handling grounded equipment and conductors from hazardous touch potentials. The insulating equipment must be rated for the highest voltage that can be impressed on the grounded objects under fault conditions (rather than for the full system voltage).

3.Restricting employees from areas where hazardous step or touch potentials could arise can protect employees not directly involved in performing the operation. The employer must ensure that employees on the ground in the vicinity of transmission structures are at a distance where step voltages would be insufficient to cause injury. Employees must not handle grounded conductors or equipment likely to become energized to hazardous voltages unless the employees are within an equipotential zone or protected by insulating equipment.

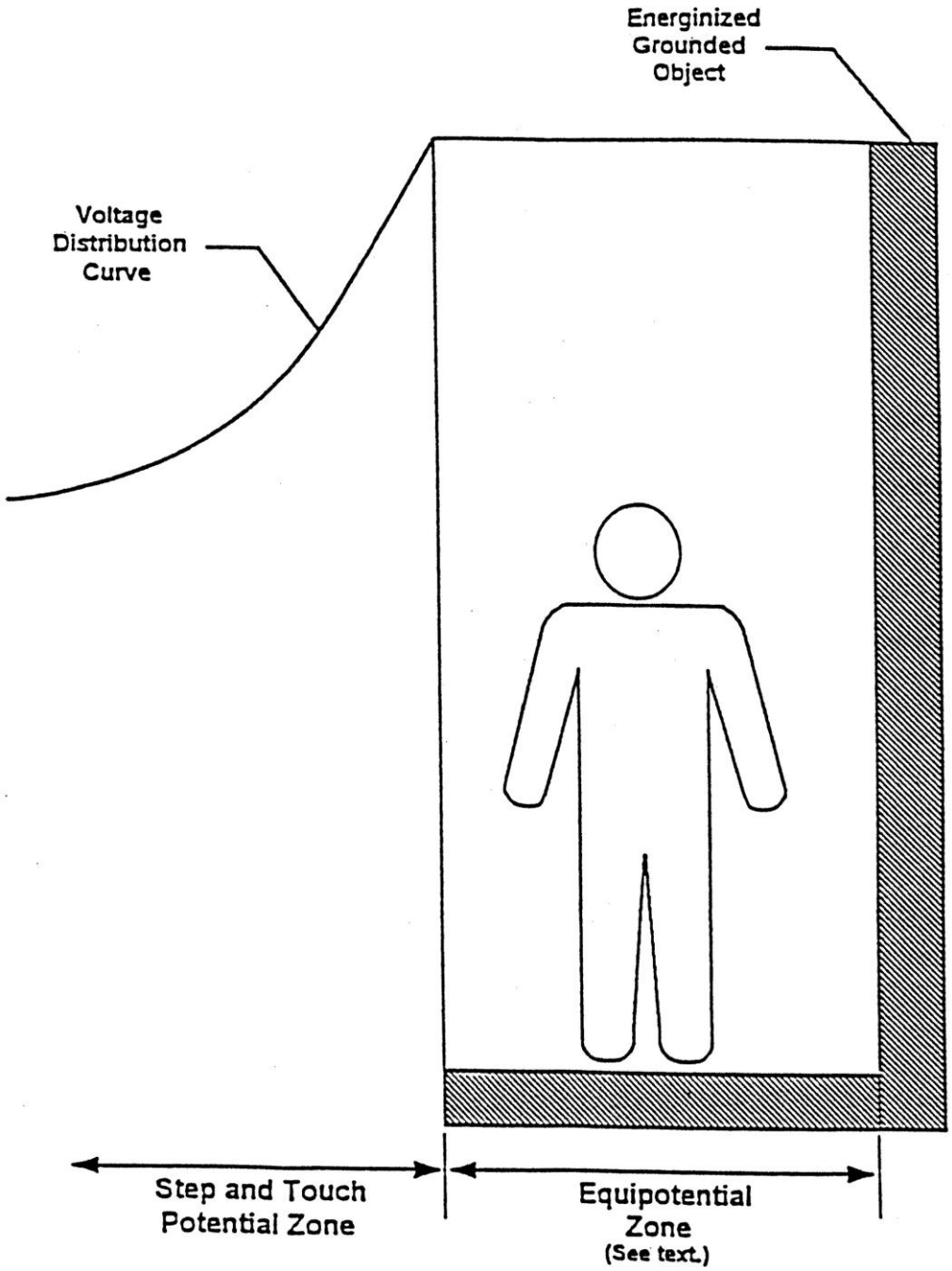


Figure C - Protection from Ground-Potential Gradients

D. *Protecting employees working on deenergized and grounded power lines*. This Section III.D of this document establishes guidelines to help employers comply with requirements in WAC 296-45-345 for using protective grounding to protect employees working on deenergized power lines. WAC 296-45-345 applies to grounding of transmission and distribution lines and equipment for the purpose of protecting workers. WAC 296-45-345(3) requires temporary protective grounds to be placed at such locations and arranged in such a manner that the employer can demonstrate will prevent exposure of each employee to hazardous differences in electric potential.[3] Sections III.D.1 and III.D.2 of this document provide guidelines that employers can use in making the dem-

onstration required by WAC 296-45-345(3). Section III.D.1 of this document provides guidelines on how the employer can determine whether particular grounding practices expose employees to hazardous differences in electric potential. Section III.D.2 of this document describes grounding methods that the employer can use in lieu of an engineering analysis to make the demonstration required by WAC 296-45-345(3). The department will consider employers that comply with the criteria in this document as meeting WAC 296-45-345(3).

Finally, Section III.D.3 of this document discusses other safety considerations that will help the employer comply with other requirements in WAC 296-45-345. Following these guidelines will protect workers from hazards that can occur when a deenergized and grounded line becomes energized.

1.*Determining safe body current limits*. This Section III.D.1 of this document provides guidelines on how an employer can determine whether any differences in electric potential to which workers could be exposed are hazardous as part of the demonstration required by WAC 296-45-345(3).

Institute of Electrical and Electronic Engineers (IEEE) Standard 1048-2003, IEEE Guide for Protective Grounding of Power Lines, provides the following equation for determining the threshold of ventricular fibrillation when the duration of the electric shock is limited:

$$I = \frac{116}{\sqrt{t}},$$

Where I is the current through the worker's body, and t is the duration of the current in seconds. This equation represents the ventricular fibrillation threshold for 95.5 percent of the adult population with a mass of 50 kilograms (110 pounds) or more. The equation is valid for current durations between 0.0083 to 3.0 seconds.

To use this equation to set safe voltage limits in an equipotential zone around the worker, the employer will need to assume a value for the resistance of the worker's body. IEEE Std 1048-2003 states that "total body resistance is usually taken as 1000 Ω for determining . . . body current limits." However, employers should be aware that the impedance of a worker's body can be substantially less than that value. For instance, IEEE Std 1048-2003 reports a minimum hand-to-hand resistance of 610 ohms and an internal body resistance of 500 ohms. The internal resistance of the body better represents the minimum resistance of a worker's body when the skin resistance drops near zero, which occurs, for example, when there are breaks in the worker's skin, for instance, from cuts or from blisters formed as a result of the current from an electric shock, or when the worker is wet at the points of contact.

Employers may use the IEEE Std 1048-2003 equation to determine safe body current limits only if the employer protects workers from hazards associated with involuntary muscle reactions from electric shock (for example, the hazard to a worker from falling as a result of an electric shock). Moreover, the equation applies only when the duration of the electric shock is limited. If the precautions the employer takes, including those required by applicable standards, do not adequately protect employees from hazards associated with involuntary reactions from electric shock, a hazard exists if the induced voltage is sufficient to pass a current of 1 milliampere through a 500-ohm resis-

tor. (The 500-ohm resistor represents the resistance of an employee. The 1-milliampere current is the threshold of perception.) Finally, if the employer protects employees from injury due to involuntary reactions from electric shock, but the duration of the electric shock is unlimited (that is, when the fault current at the work location will be insufficient to trip the devices protecting the circuit), a hazard exists if the resultant current would be more than 6 milliamperes (the recognized let-go threshold for workers[4]).

2.*Acceptable methods of grounding for employers that do not perform an engineering determination*. The grounding methods presented in this section of this document ensure that differences in electric potential are as low as possible and, therefore, meet WAC 296-45-345(3) without an engineering determination of the potential differences. These methods follow two principles: (i) The grounding method must ensure that the circuit opens in the fastest available clearing time, and (ii) the grounding method must ensure that the potential differences between conductive objects in the employee's work area are as low as possible.

WAC 296-45-345(3) does not require grounding methods to meet the criteria embodied in these principles. Instead, the paragraph requires that protective grounds be "placed at such locations and arranged in such a manner that the employer can demonstrate will prevent exposure of each employee to hazardous differences in electric potential." However, when the employer's grounding practices do not follow these two principles, the employer will need to perform an engineering analysis to make the demonstration required by WAC 296-45-345(3).

i.*Ensuring that the circuit opens in the fastest available clearing time*. Generally, the higher the fault current, the shorter the clearing times for the same type of fault. Therefore, to ensure the fastest available clearing time, the grounding method must maximize the fault current with a low impedance connection to ground. The employer accomplishes this objective by grounding the circuit conductors to the best ground available at the worksite. Thus, the employer must ground to a grounded system neutral conductor, if one is present. A grounded system neutral has a direct connection to the system ground at the source, resulting in an extremely low impedance to ground. In a substation, the employer may instead ground to the substation grid, which also has an extremely low impedance to the system ground and, typically, is connected to a grounded system neutral when one is present. Remote system grounds, such as pole and tower grounds, have a higher impedance to the system ground than grounded system neutrals and substation grounding grids; however, the employer may use a remote ground when lower impedance grounds are not available. In the absence of a grounded system neutral, substation grid, and remote ground, the employer may use a temporary driven ground at the worksite.

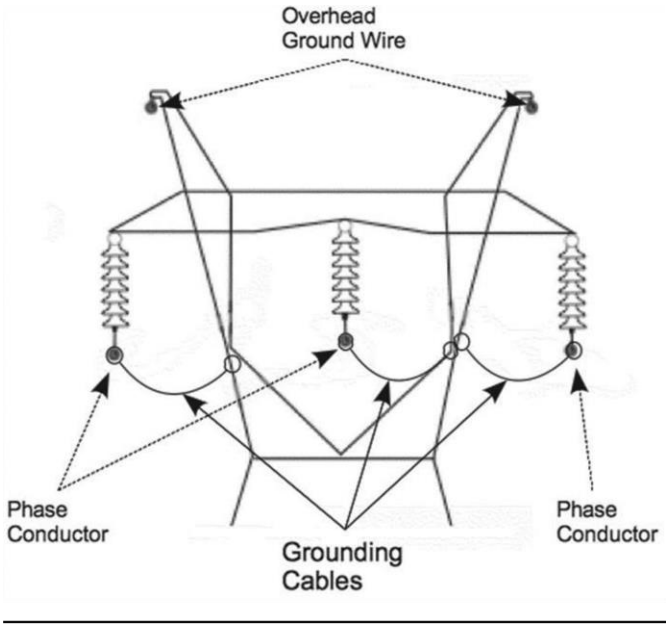
In addition, if employees are working on a three-phase system, the grounding method must short circuit all three phases. Short circuiting all phases will ensure faster clearing and lower the current through the grounding cable connecting the deenergized line to ground, thereby lowering the voltage across that cable. The short circuit need not be at the worksite; however, the employer must treat any conductor that is not grounded at the worksite as energized because the ungrounded conductors will be energized at fault voltage during a fault.

ii.*Ensuring that the potential differences between conductive objects in the employee's work area are as low as possible*. To achieve as low a voltage as possible across any two conductive objects in the

work area, the employer must bond all conductive objects in the work area. This section of this document discusses how to create a zone that minimizes differences in electric potential between conductive objects in the work area.

The employer must use bonding cables to bond conductive objects, except for metallic objects bonded through metal-to-metal contact. The employer must ensure that metal-to-metal contacts are tight and free of contamination, such as oxidation, that can increase the impedance across the connection. For example, a bolted connection between metal lattice tower members is acceptable if the connection is tight and free of corrosion and other contamination. Figure D shows how to create an equipotential zone for metal lattice towers.

Wood poles are conductive objects. The poles can absorb moisture and conduct electricity, particularly at distribution and transmission voltages. Consequently, the employer must either: (1) Provide a conductive platform, bonded to a grounding cable, on which the worker stands or (2) use cluster bars to bond wood poles to the grounding cable. The employer must ensure that employees install the cluster bar below, and close to, the worker's feet. The inner portion of the wood pole is more conductive than the outer shell, so it is important that the cluster bar be in conductive contact with a metal spike or nail that penetrates the wood to a depth greater than or equal to the depth the worker's climbing gaffs will penetrate the wood. For example, the employer could mount the cluster bar on a bare pole ground wire fastened to the pole with nails or staples that penetrate to the required depth. Alternatively, the employer may temporarily nail a conductive strap to the pole and connect the strap to the cluster bar. Figure E shows how to create an equipotential zone for wood poles.



Notes: 1. Employers must ground overhead ground wires that are within reach of the employee.
2. The grounding cable must be as short as practicable; therefore, the attachment points between the grounding cable and the tower may be different from that shown in the figure.

Figure D - Equipotential Zone for Metal Lattice Tower

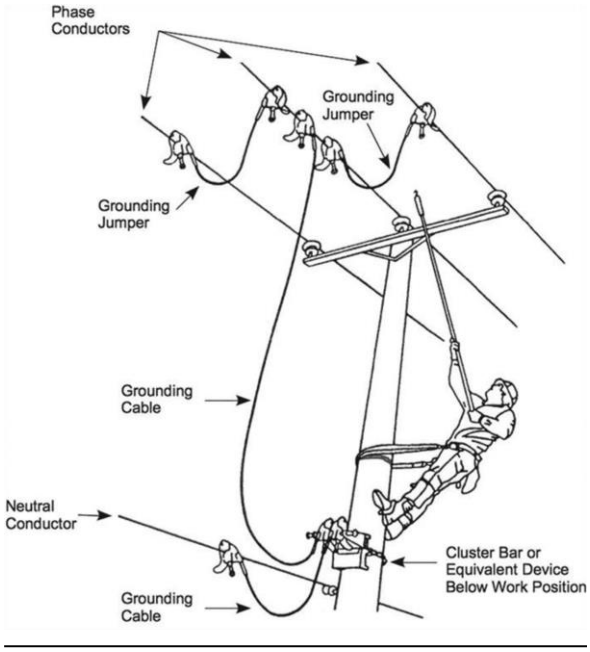


Figure E - Equipotential Grounding for Wood Poles

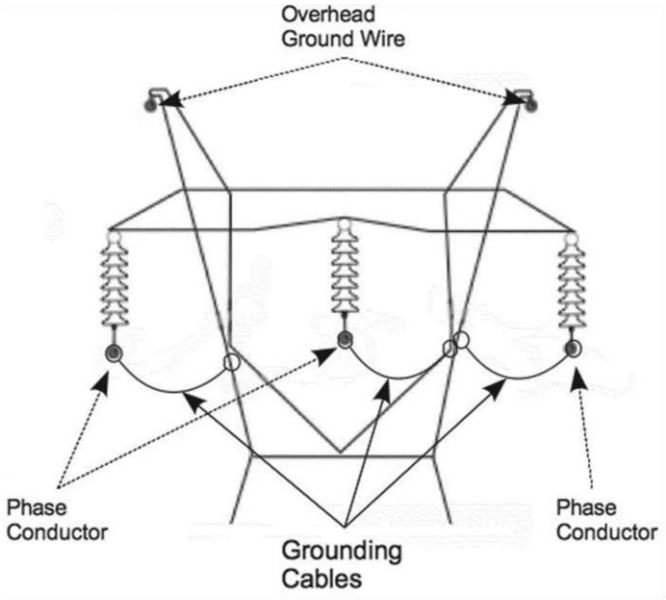


Figure reprinted with permission from Hubbell Power Systems, Inc. (Hubbell)

OSHA revised the figure from Hubbell's original.

For underground systems, employers commonly install grounds at the points of disconnection of the underground cables. These grounding points are typically remote from the manhole or underground vault where employees will be working on the cable. Workers in contact with a cable grounded at a remote location can experience hazardous potential differences if the cable becomes energized or if a fault occurs on a different, but nearby, energized cable. The fault current causes potential gradients in the earth, and a potential difference will exist between the earth where the worker is standing and the earth where

the cable is grounded. Consequently, to create an equipotential zone for the worker, the employer must provide a means of connecting the deenergized cable to ground at the worksite by having the worker stand on a conductive mat bonded to the deenergized cable. If the cable is cut, the employer must install a bond across the opening in the cable or install one bond on each side of the opening to ensure that the separate cable ends are at the same potential. The employer must protect the worker from any hazardous differences in potential any time there is no bond between the mat and the cable (for example, before the worker installs the bonds).

3. *Other safety-related considerations*. To ensure that the grounding system is safe and effective, the employer should also consider the following factors:[5]

i. *Maintenance of grounding equipment*. It is essential that the employer properly maintain grounding equipment. Corrosion in the connections between grounding cables and clamps and on the clamp surface can increase the resistance of the cable, thereby increasing potential differences. In addition, the surface to which a clamp attaches, such as a conductor or tower member, must be clean and free of corrosion and oxidation to ensure a low-resistance connection. Cables must be free of damage that could reduce their current-carrying capacity so that they can carry the full fault current without failure. Each clamp must have a tight connection to the cable to ensure a low resistance and to ensure that the clamp does not separate from the cable during a fault.

ii. *Grounding cable length and movement*. The electromagnetic forces on grounding cables during a fault increase with increasing cable length. These forces can cause the cable to move violently during a fault and can be high enough to damage the cable or clamps and cause the cable to fail. In addition, flying cables can injure workers. Consequently, cable lengths should be as short as possible, and grounding cables that might carry high fault current should be in positions where the cables will not injure workers during a fault.

Notes:

[1]This document generally uses the term "grounded" only with respect to grounding that the employer intentionally installs, for example, the grounding an employer installs on a deenergized conductor. However, in this case, the term "grounded" means connected to earth, regardless of whether or not that connection is intentional.

[2]Thus, grounding systems for transmission towers and substation structures should be designed to minimize the step and touch potentials involved.

[3]The protective grounding required by WAC 296-45-345 limits to safe values the potential differences between accessible objects in each employee's work environment. Ideally, a protective grounding system would create a true equipotential zone in which every point is at the same electric potential. In practice, current passing through the grounding and bonding elements creates potential differences. If these potential differences are hazardous, the employer may not treat the zone as an equipotential zone.

[4]Electric current passing through the body has varying effects depending on the amount of the current. At the let-go threshold, the current overrides a person's control over his or her muscles. At that level, an employee grasping an object will not be able to let go of the object. The let-go threshold varies from person to person; however, the recognized value for workers is 6 milliamperes.

[5]This document only discusses factors that relate to ensuring an equipotential zone for employees. The employer must consider other factors in selecting a grounding system that is capable of conducting the maximum fault current that could flow at the point of grounding for the time necessary to clear the fault, as required by WAC 296-45-345(4)(a). IEEE Std 1048-2003 contains guidelines for selecting and installing grounding equipment that will meet WAC 296-45-345(4)(a).

AMENDATORY SECTION (Amending WSR 98-07-009, filed 3/6/98, effective 5/6/98)

WAC 296-45-905 Appendix C——Methods of inspecting and testing wood poles——Nonmandatory.

I. "Introduction"

When ((~~work is to be performed~~)) employees are to perform work on a wood pole, it is important to determine the condition of the pole before employees climb it ((~~is climbed~~)). The weight of the employee, the weight of equipment ((~~being~~)) to be installed, and other working stresses (such as the removal or retensioning of conductors) can lead to the failure of a defective pole or ((~~one~~)) a pole that is not designed to handle the additional stresses.[1] For these reasons, it is essential that ((~~an inspection and test of the condition of a wood pole be performed before it is climbed~~)), before an employee climbs a wood pole, the employer ascertains that the pole is capable of sustaining the stresses of the work. The determination that the pole is capable of sustaining these stresses includes an inspection of the condition of the pole.

Footnote[1] ((~~A properly guyed pole in good condition should, at a minimum, be able to handle the weight of an employee climbing it.~~)) If the employer finds the pole ((~~is found~~)) to be unsafe to climb or to work from, ((~~it must be secured~~)) the employer must secure the pole so that it does not fail while an employee is on it.
The employer can secure the pole ((~~can be secured~~)) by a line truck boom, by ropes or guys, or by lashing a new pole alongside it. If a new one is lashed alongside the defective pole, employees should work ((~~should be performed~~)) from the new one.

II. "Inspection of wood poles"

((~~Wood poles should be inspected by~~)) A qualified electrical employee should inspect wood poles for the following conditions:[2]

Footnote[2] The presence of any of these conditions is an indication that the pole may not be safe to climb or to work from. The employee performing the inspection must be qualified to make a determination as to whether or not it is safe to perform the work without taking additional precautions.

A. General condition.

((~~The pole should be inspected for~~)) Buckling at the ground line ((~~and for~~)) or an unusual angle with respect to the ground((~~. Buckling and odd angles~~)) may indicate that the pole has rotted or is broken.

B. Cracks.

((~~The pole should be inspected for cracks.~~)) Horizontal cracks perpendicular to the grain of the wood may weaken the pole. Vertical ((~~ones~~)) cracks, although not normally considered to be a sign of a defective pole, can pose a hazard to the climber, and the employee should keep his or her gaffs away from them while climbing.

C. Holes.

Hollow spots and woodpecker holes can reduce the strength of a wood pole.

D. Shell rot and decay.

Rotting and decay are cutout hazards and are possible indications of the age and internal condition of the pole.

E. Knots.

One large knot or several smaller ones at the same height on the pole may be evidence of a weak point on the pole.

F. Depth of setting.

Evidence of the existence of a former ground line substantially above the existing ground level may be an indication that the pole is no longer buried to a sufficient extent.

G. Soil conditions.

Soft, wet, or loose soil around the base of the pole may indicate that the pole will not support any change((~~s of~~)) in stress ((~~on the pole~~)).

H. Burn marks.

Burning from transformer failures or conductor faults could damage the pole so that it cannot withstand changes in mechanical stress ((~~changes~~)).

III. "Testing of wood poles"

The following tests are recognized as acceptable methods of testing wood poles:

A. Hammer test.

Rap the pole sharply with a hammer weighing about 3 pounds (1.4 kg), starting near the ground line and continuing upwards circumferentially around the pole to a height of approximately 6 feet (1.8 meters). The hammer will produce a clear sound and rebound sharply when striking sound wood. Decay pockets will be indicated by a dull sound or a less pronounced hammer rebound. Also, prod the pole as near the ground line as possible using a pole prod or a screwdriver with a blade at least 5 inches (127 millimeters) long. If substantial decay is ((~~encountered~~)) present, the pole is ((~~considered~~)) unsafe.

B. Rocking test.

Apply a horizontal force to the pole and attempt to rock it back and forth in a direction perpendicular to the line. Exercise caution ((~~must be exercised~~)) to avoid causing power lines to swing together. Apply the force ((~~may be applied~~)) to the pole either by pushing with a pike pole or pulling the pole with a rope. If the pole cracks during the test, it ((~~shall be considered~~)) is unsafe.

NEW SECTION

WAC 296-45-906 Appendix D—Protection from flames and electric arcs—Nonmandatory.

I. Introduction

WAC 296-45-325(13) addresses protecting employees from flames and electric arcs. This section requires employers to: (1) Assess the workplace for flame and electric-arc hazards (WAC 296-45-325 (13)(a)); (2) estimate the available heat energy from electric arcs to which employees would be exposed (WAC 296-45-325 (13)(b)); (3) ensure that employees wear clothing that will not melt, or ignite and continue to burn, when exposed to flames or the estimated heat energy (WAC 296-45-325 (13)(c)); and (4) ensure that employees wear flame-resistant clothing[1] and protective clothing and other protective equipment that has an arc rating greater than or equal to the available heat energy under certain conditions (WAC 296-45-325 (13)(d) and (e)). This appendix contains information to help employers estimate available heat energy as required by WAC 296-45-325 (13)(b), select protective clothing and other protective equipment with an arc rating suitable for the available heat energy as required by WAC 296-45-325 (13)(e), and ensure that employees do not wear flammable clothing that could lead to burn injury as addressed by WAC 296-45-325 (13)(c) and (d).

II. Assessing the Workplace for Flame and Electric-Arc Hazards

WAC 296-45-325 (13)(a) requires the employer to assess the workplace to identify employees exposed to hazards from flames or from electric arcs. This provision ensures that the employer evaluates employee exposure to flames and electric arcs so that employees who face such exposures receive the required protection. The employer must conduct an assessment for each employee who performs work on or near exposed, energized parts of electric circuits.

A. Assessment Guidelines.

Sources electric arcs. Consider possible sources of electric arcs, including:

• Energized circuit parts not guarded or insulated;

• Switching devices that produce electric arcs in normal operation;

• Sliding parts that could fault during operation (for example, rack-mounted circuit breakers); and

• Energized electric equipment that could fail (for example, electric equipment with damaged insulation or with evidence of arcing or overheating).

Exposure to flames. Identify employees exposed to hazards from flames.

Factors to consider include:

• The proximity of employees to open flames; and

• For flammable material in the work area, whether there is a reasonable likelihood that an electric arc or an open flame can ignite the material.

Probability that an electric arc will occur. Identify employees exposed to electric-arc hazards. The department will consider an employee exposed to electric-arc hazards if there is a reasonable likelihood that an electric arc will occur in the employee's work area, in other words, if the probability of such an event is higher than it is for the normal operation of enclosed equipment. Factors to consider include:

• For energized circuit parts not guarded or insulated, whether conductive objects can come too close to or fall onto the energized parts;

• For exposed, energized circuit parts, whether the employee is closer to the part than the minimum approach distance established by the employer (as permitted by WAC 296-45-325(4));

• Whether the operation of electric equipment with sliding parts that could fault during operation is part of the normal operation of the equipment or occurs during servicing or maintenance; and

• For energized electric equipment, whether there is evidence of impending failure, such as evidence of arcing or overheating.

B. Examples.

Table 1 provides task-based examples of exposure assessments.

TABLE 1
EXAMPLE ASSESSMENTS FOR VARIOUS TASKS

Task		Is employee exposed to flame or electric arc hazard?
Normal operation of enclosed equipment, such as closing or opening a switch.	The employer properly installs and maintains enclosed equipment, and there is no evidence of impending failure.	No.
	There is evidence of arcing or overheating	Yes.
	Parts of the equipment are loose or sticking, or the equipment otherwise exhibits signs of lack of maintenance.	Yes.
Servicing electric equipment, such as racking in a circuit breaker or replacing a		es.

TABLE 1 EXAMPLE ASSESSMENTS FOR VARIOUS TASKS		
Task		Is employee exposed to flame or electric arc hazard?
Inspection of electric equipment with exposed energized parts.	The employee is not holding conductive objects and remains outside the minimum approach distance established by the employer.	No.
	The employee is holding a conductive object, such as a flashlight, that could fall or otherwise contact energized parts (irrespective of whether the employee maintains the minimum approach distance).	Yes.
	The employee is closer than the minimum approach distance established by the employer (for example, when wearing rubber insulating gloves or rubber insulating gloves and sleeves).	Yes.
Using open flames, for example, in wiping cable splice sleeves		Yes.

III. Protection Against Burn Injury

A. Estimating Available Heat Energy.

Calculation methods. WAC 296-45-325 (13)(b) provides that, for each employee exposed to an electric-arc hazard, the employer must make a reasonable estimate of the heat energy to which the employee would be exposed if an arc occurs. Table 2 lists various methods of calculating values of available heat energy from an electric circuit. The department does not endorse any of these specific methods. Each method requires the input of various parameters, such as fault current, the expected length of the electric arc, the distance from the arc to the employee, and the clearing time for the fault (that is, the time the circuit protective devices take to open the circuit and clear the fault). The employer can precisely determine some of these parameters, such as the fault current and the clearing time, for a given system. The employer will need to estimate other parameters, such as the length of the arc and the distance between the arc and the employee, because such parameters vary widely.

TABLE 2 METHODS OF CALCULATING INCIDENT HEAT ENERGY FROM AN ELECTRIC ARC
1. *Standard for Electrical Safety Requirements for Employee Workplaces*, NFPA 70E-2012, Annex D, "Sample Calculation of Flash Protection Boundary."
2. Doughty, T.E., Neal, T.E., and Floyd II, H.L., "Predicting Incident Energy to Better Manage the Electric Arc Hazard on 600 V Power Distribution Systems," *Record of Conference Papers IEEE IAS 45th Annual Petroleum and Chemical Industry Conference*, September 28-30, 1998.
3. *Guide for Performing Arc-Flash Hazard Calculations*, IEEE Std 1584-2002, 1584a-2004 (Amendment 1 to IEEE Std 1584-2002), and 1584b-2011 (Amendment 2: Changes to Clause 4 of IEEE Std 1584-2002).*
4. ARCPRO, a commercially available software program developed by Kinectrics, Toronto, ON, CA.

* This appendix refers to IEEE Std 1584-2002 with both amendments as IEEE Std 1584b-2011.

The amount of heat energy calculated by any of the methods is approximately inversely proportional to the square of the distance between the employee and the arc. In other words, if the employee is very close to the arc, the heat energy is very high; but if the employee is just a few more centimeters away, the heat energy drops substantially. Thus, estimating the distance from the arc to the employee is key to protecting employees.

The employer must select a method of estimating incident heat energy that provides a reasonable estimate of incident heat energy for the exposure involved. Table 3 shows which methods provide reasonable estimates for various exposures.

TABLE 3
SELECTING A REASONABLE INCIDENT-ENERGY CALCULATION METHOD [1]

Incident-energy calculation method	600 V and Less [2]			601 V to 15 kV [2]			More than 15 kV		
	1Φ	3Φa	3Φb	1Φ	3Φa	3Φb	1Φ	3Φa	3Φb
NFPA 70E-2012 Annex D (Lee equation)	Y-C	Y	N	Y-C	Y-C	N	N[3]	N[3]	N[3]
Doughty, Neal, and Floyd	Y-C	Y	Y	N	N	N	N	N	N
IEEE Std 1584b-2011	Y	Y	Y	Y	Y	Y	N	N	N
ARCPRO	Y	N	N	Y	N	N	Y	Y[4]	Y[4]

Key:
1Φ: Single-phase arc in open air.
3Φa: Three-phase arc in open air.
3Φb: Three-phase arc in an enclosure (box).
Y: Acceptable; produces a reasonable estimate of incident heat energy from this type of electric arc.
N: Not acceptable; does not produce a reasonable estimate of incident heat energy from this type of electric arc.
Y-C: Acceptable; produces a reasonable, but conservative, estimate of incident heat energy from this type of electric arc.

Notes:
[1]Although the department will consider these methods reasonable for enforcement purposes when employers use the methods in accordance with this table, employers should be aware that the listed methods do not necessarily result in estimates that will provide full protection from internal faults in transformers and similar equipment or from arcs in underground manholes or vaults.
[2]At these voltages, the presumption is that the arc is three-phase unless the employer can demonstrate that only one phase is present or that the spacing of the phases is sufficient to prevent a multiphase arc from occurring.
[3]Although the department will consider this method acceptable for purposes of assessing whether incident energy exceeds 2.0 cal/cm^2, the results at voltages of more than 15 kilovolts are extremely conservative and unrealistic.
[4]The department will deem the results of this method reasonable when the employer adjusts them using the conversion factors for three-phase arcs in open air or in an enclosure, as indicated in the program's instructions.

Selecting a reasonable distance from the employee to the arc. In estimating available heat energy, the employer must make some reasonable assumptions about how far the employee will be from the electric arc. Table 4 lists reasonable distances from the employee to the electric arc. The distances in Table 4 are consistent with national consensus standards, such as the Institute of Electrical and Electronic Engineers' *National Electrical Safety Code*, ANSI/IEEE C2-2012, and *IEEE Guide for Performing Arc-Flash Hazard Calculations*, IEEE Std 1584b-2011. The employer is free to use other reasonable distances, but must consider equipment enclosure size and the working distance to the employee in selecting a distance from the employee to the arc. The department will consider a distance reasonable when the employer bases it on equipment size and working distance.

TABLE 4
SELECTING A REASONABLE DISTANCE FROM THE EMPLOYEE TO THE ELECTRIC ARC

Class of equipment	Single-phase arc mm (inches)	Three-phase arc mm (inches)
Cable	*NA	455 (18)
Low voltage MCCs and panelboards	NA	455 (18)
Low-voltage switchgear	NA	610 (24)
5-kV switchgear	NA	910 (36)
15-kV switchgear	NA	910 (36)
Single conductors in air (up to 46 kilovolts), work with rubber insulating gloves	380 (15)	NA
Single conductors in air, work with live-line tools	*MAD*- (2 × *kV*× 2.54)	NA

* NA = not applicable.
† The terms in this equation are:

MAD = The applicable minimum approach distance; and
kV = The system voltage in kilovolts.

Selecting a reasonable arc gap. For a single-phase arc in air, the electric arc will almost always occur when an energized conductor approaches too close to ground. Thus, an employer can determine the arc gap, or arc length, for these exposures by the dielectric strength of air and the voltage on the line. The dielectric strength of air is approximately 10 kilovolts for every 25.4 millimeters (1 inch). For example, at 50 kilovolts, the arc gap would be 50 ÷ 10 × 25.4 (or 50 × 2.54), which equals 127 millimeters (5 inches).

For three-phase arcs in open air and in enclosures, the arc gap will generally be dependent on the spacing between parts energized at different electrical potentials. Documents such as IEEE Std 1584b-2011 provide information on these distances. Employers may select a reasonable arc gap from Table 5, or they may select any other reasonable arc gap based on sparkover distance or on the spacing between (1) live parts at different potentials or (2) live parts and grounded parts (for example, bus or conductor spacings in equipment). In any event, the employer must use an estimate that reasonably resembles the actual exposures faced by the employee.

TABLE 5
SELECTING A REASONABLE ARC GAP

Class of equipment	Single-phase arc mm (inches)	Three-phase arc mm[1] (inches)
Cable	NA[2]	13 (0.5).
Low voltage MCCs and panelboards	NA	25 (1.0).
Low-voltage switchgear	NA	32 (1.25).
5-kV switchgear	NA	104 (4.0).
15-kV switchgear	NA	152 (6.0).
Single conductors in air (up to 46 kilovolts), work with rubber insulating gloves	51 (2.0)	Phase conductor spacing.
Single conductors in air, work with live-line tools	*Voltage in kV × 2.54*	Phase conductor spacing.
	(Voltage in *kV*× 0.1), but no less than 51 mm (2 inches).	

[1]Source: IEEE Std 1584b-2011.
[2]NA = not applicable.

Making estimates over multiple system areas. The employer need not estimate the heat-energy exposure for every job task performed by each employee. WAC 296-45-325 (13)(b) permits the employer to make broad estimates that cover multiple system areas provided that: (1) The employer uses reasonable assumptions about the energy-exposure distribution throughout the system, and (2) the estimates represent the maximum exposure for those areas. For example, the employer can use the maximum fault current and clearing time to cover several system areas at once.

Incident heat energy for single-phase-to-ground exposures. Table 6 and Table 7 provide incident heat energy levels for openair, phase-to-ground electric-arc exposures typical for overhead systems.[2] Table 6 presents estimates of available energy for employees using rubber insulating gloves to perform work on overhead systems operating at 4 to 46 kilovolts. The table assumes that the employee will be 380 millimeters (15 inches) from the electric arc, which is a reasonable estimate for rubber insulating glove work. Table 6 also assumes that the arc length equals the sparkover distance for the maximum transient

overvoltage of each voltage range.[3] To use the table, an employer would use the voltage, maximum fault current, and maximum clearing time for a system area and, using the appropriate voltage range and fault-current and clearing time values corresponding to the next higher values listed in the table, select the appropriate heat energy (4, 5, 8, or 12 cal/cm^2) from the table. For example, an employer might have a 12,470-volt power line supplying a system area. The power line can supply a maximum fault current of 8 kiloamperes with a maximum clearing time of 10 cycles. For rubber glove work, this system falls in the 4.0-to-15.0-kilovolt range; the next-higher fault current is 10 kA (the second row in that voltage range); and the clearing time is under 18 cycles (the first column to the right of the fault current column). Thus, the available heat energy for this part of the system will be 4 cal/cm^2 or less (from the column heading), and the employer could select protection with a 5-cal/cm^2 rating to meet WAC 296-45-325 (13)(e). Alternatively, an employer could select a base incident-energy value and ensure that the clearing times for each voltage range and fault current listed in the table do not exceed the corresponding clearing time specified in the table. For example, an employer that provides employees with arc-flash protective equipment rated at 8 cal/cm^2 can use the table to determine if any system area exceeds 8 cal/cm^2 by checking the clearing time for the highest fault current for each voltage range and ensuring that the clearing times do not exceed the values specified in the 8-cal/cm^2 column in the table.

Table 7 presents similar estimates for employees using live-line tools to perform work on overhead systems operating at voltages of 4 to 800 kilovolts. The table assumes that the arc length will be equal to the sparkover distance[4] and that the employee will be a distance from the arc equal to the minimum approach distance minus twice the sparkover distance.

The employer will need to use other methods for estimating available heat energy in situations not addressed by Table 6 or Table 7. The calculation methods listed in Table 2 and the guidance provided in Table 3 will help employers do this. For example, employers can use IEEE Std 1584b-2011 to estimate the available heat energy (and to select appropriate protective equipment) for many specific conditions, including lowervoltage, phase-to-phase arc, and enclosed arc exposures.

TABLE 6
INCIDENT HEAT ENERGY FOR VARIOUS FAULT CURRENTS, CLEARING TIMES, AND VOLTAGES OF 4.0 TO 46.0 KV: RUBBER INSULATING GLOVE EXPOSURES INVOLVING PHASE-TO-GROUND ARCS IN OPEN AIR ONLY * † ‡

Voltage range (kV) **	Fault current (kA)	Maximum clearing time (cycles)			
		4 cal/cm^2	5 cal/cm^2	8 cal/cm^2	12 cal/cm^2
4.0 to 15.0	5	46	58	92	138
	10	18	22	36	54
	15	10	12	20	30
	20	6	8	13	19
15.1 to 25.0	5	28	34	55	83
	10	11	14	23	24
	15	7	8	13	20
	20	4	5	9	13

TABLE 6
INCIDENT HEAT ENERGY FOR VARIOUS FAULT CURRENTS, CLEARING TIMES, AND VOLTAGES OF 4.0 TO 46.0 KV: RUBBER INSULATING GLOVE EXPOSURES INVOLVING PHASE-TO-GROUND ARCS IN OPEN AIR ONLY * † ‡

Voltage range (kV) **	Fault current (kA)	Maximum clearing time (cycles)			
		4 cal/cm^2	5 cal/cm^2	8 cal/cm^2	12 cal/cm^2
25.1 to 36.0	5	21	26	42	62
	10	9	11	18	26
	15	5	6	10	16
	20	4	4	7	11
36.1 to 46.0	5	16	20	32	48
	10	7	9	14	21
	15	4	5	8	13
	20	3	4	6	9

Notes:* This table is for open-air, phase-to-ground electric-arc exposures. It is not for phase-to-phase arcs or enclosed arcs (arc in a box).
† The table assumes that the employee will be 380 mm (15 in.) from the electric arc. The table also assumes the arc length to be the sparkover distance for the maximum transient overvoltage of each voltage range, as follows:
4.0 to 15.0 kV 51 mm (2 in.)
15.1 to 25.0 kV 102 mm (4 in.)
25.1 to 36.0 kV 152 mm (6 in.)
36.1 to 46.0 kV 229 mm (9 in.)
‡ The Occupational Safety and Health Administration calculated the values in this table using the ARCPRO method listed in Table 2.
** The voltage range is the phase-to-phase system voltage.

TABLE 7
INCIDENT HEAT ENERGY FOR VARIOUS FAULT CURRENTS, CLEARING TIMES, AND VOLTAGES: LIVE-LINE TOOL EXPOSURES INVOLVING PHASE-TO-GROUND ARCS IN OPEN AIR ONLY * † ‡ #

Voltage range (kV) **	Fault current (kA)	Maximum clearing time (cycles)			
		4 cal/cm^2	5 cal/cm^2	8 cal/cm^2	12 cal/cm^2
4.0 to 15.0	5	197	246	394	591
	10	73	92	147	220
	15	39	49	78	117
	20	24	31	49	73
15.1 to 25.0	5	197	246	394	591
	10	75	94	150	225
	15	41	51	82	122
	20	26	33	52	78
25.1 to 36.0	5	138	172	275	413
	10	53	66	106	159
	15	30	37	59	89
	20	19	24	38	58
36.1 to 46.0	5	129	161	257	386
	10	51	64	102	154
	15	29	36	58	87
	20	19	24	38	57
46.1 to 72.5	20	18	23	36	55
	30	10	13	20	30
	40	6	8	13	19
	50	4	6	9	13

TABLE 7 INCIDENT HEAT ENERGY FOR VARIOUS FAULT CURRENTS, CLEARING TIMES, AND VOLTAGES: LIVE-LINE TOOL EXPOSURES INVOLVING PHASE-TO-GROUND ARCS IN OPEN AIR ONLY * † ‡ #					
Voltage range (kV) **	Fault current (kA)	Maximum clearing time (cycles)			
		4 cal/cm^2	5 cal/cm^2	8 cal/cm^2	12 cal/cm^2
72.6 to 121.0	20	10	12	20	30
	30	6	7	11	17
	40	4	5	7	11
	50	3	3	5	8
121.1 to 145.0	20	12	15	24	35
	30	7	9	15	22
	40	5	6	10	15
	50	4	5	8	11
145.1 to 169.0	20	12	15	24	36
	30	7	9	15	22
	40	5	7	10	16
	50	4	5	8	12
169.1 to 242.0	20	13	17	27	40
	30	8	10	17	25
	40	6	7	12	17
	50	4	5	9	13
242.1 to 362.0	20	25	32	51	76
	30	16	19	31	47
	40	11	14	22	33
	50	8	10	16	25
362.1 to 420.0	20	12	15	25	37
	30	8	10	15	23
	40	5	7	11	16
	50	4	5	8	12
420.1 to 550.0	20	23	29	47	70
	30	14	18	29	43
	40	10	13	20	30
	50	8	9	15	23
550.1 to 800.0	20	25	31	50	75
	30	15	19	31	46
	40	11	13	21	32
	50	8	10	16	24

Notes: * This table is for open-air, phase-to-ground electric-arc exposures. It is not for phase-to-phase arcs or enclosed arcs (arc in a box).
† The table assumes the arc length to be the sparkover distance for the maximum phase-to-ground voltage of each voltage range. The table also assumes that the employee will be the minimum approach distance minus twice the arc length from the electric arc.
‡ The Occupational Safety and Health Administration calculated the values in this table using the ARCPRO method listed in Table 2.
# For voltages of more than 72.6 kV, employers may use this table only when the minimum approach distance established under WAC 296-45-325(4) is greater than or equal to the following values:
72.6 to 121.0 kV 1.02 m.
121.1 to 145.0 kV 1.16 m.
145.1 to 169.0 kV 1.30 m.
169.1 to 242.0 kV 1.72 m.
242.1 to 362.0 kV 2.76 m.
362.1 to 420.0 kV 2.50 m.
420.1 to 550.0 kV 3.62 m.
550.1 to 800.0 kV 4.83 m.
** The voltage range is the phase-to-phase system voltage.

B. Selecting Protective Clothing and Other Protective Equipment.

WAC 296-45-325 (13)(e) requires employers, in certain situations, to select protective clothing and other protective equipment with an arc rating that is greater than or equal to the incident heat energy estimated under WAC 296-45-325 (13)(b). Based on laboratory testing required by ASTM F1506-10a, the expectation is that protective clothing with an arc rating equal to the estimated incident heat energy will be capable of preventing second-degree burn injury to an employee exposed to that incident heat energy from an electric arc. Note that actual electric-arc exposures may be more or less severe than the estimated value because of factors such as arc movement, arc length, arcing from reclosing of the system, secondary fires or explosions, and weather conditions. Additionally, for arc rating based on the fabric's arc thermal performance value[5] (ATPV), a worker exposed to incident energy at the arc rating has a 50-percent chance of just barely receiving a second-degree burn. Therefore, it is possible (although not likely) that an employee will sustain a second-degree (or worse) burn wearing clothing conforming to WAC 296-45-325 (13)(e) under certain circumstances. However, reasonable employer estimates and maintaining appropriate minimum approach distances for employees should limit burns to relatively small burns that just barely extend beyond the epidermis (that is, just barely a second degree burn). Consequently, protective clothing and other protective equipment meeting WAC 296-45-325 (13)(e) will provide an appropriate degree of protection for an employee exposed to electric-arc hazards.

WAC 296-45-325 (13)(e) does not require arc-rated protection for exposures of 2 cal/cm^2 or less. Untreated cotton clothing will reduce a 2-cal/cm^2 exposure below the 1.2- to 1.5-cal/cm^2 level necessary to cause burn injury, and this material should not ignite at such low heat energy levels. Although WAC 296-45-325 (13)(e) does not require clothing to have an arc rating when exposures are 2 cal/cm^2 or less, WAC 296-45-325 (13)(d) requires the outer layer of clothing to be flame resistant under certain conditions, even when the estimated incident heat energy is less than 2 cal/cm^2, as discussed later in this appendix.

Additionally, it is especially important to ensure that employees do not wear undergarments made from fabrics listed in the note to WAC 296-45-325 (13)(c) even when the outer layer is flame resistant or arc rated. These fabrics can melt or ignite easily when an electric arc occurs. Logos and name tags made from nonflame-resistant material can adversely affect the arc rating or the flame resistant characteristics of arc-rated or flame resistant clothing. Such logos and name tags may violate WAC 296-45-325 (13)(c), (d) and (e).

WAC 296-45-325 (13)(e) requires that arc-rated protection cover the employee's entire body, with limited exceptions for the employee's hands, feet, face, and head. WAC 296-45-325 (13)(e)(i) provides that arc-rated protection is not necessary for the employee's hands under the following conditions:

For any estimated incident heat energy	When the employee is wearing rubber insulating gloves with protectors.
If the estimated incident heat energy does not exceed 14 cal/cm^2	When the employee is wearing heavy-duty leather work gloves with a weight of at least 407 gm/m^2 (12 oz/yd^2).

WAC 296-45-325 (13)(e)(ii) provides that arc-rated protection is not necessary for the employee's feet when the employee is wearing heavy-duty work shoes or boots. Finally, WAC 296-45-325 (13)(e)(iii), (iv) and (v) require arc-rated head and face protection as follows:

Exposure	Minimum head and face protection		
	None*	Arc-rated faceshield with a minimum rating of 8 cal/cm^2*	Arc-rated hood or faceshield with balaclava
Single-phase, open air	2-8 cal/cm^2.....	9-12 cal/cm^2	13 cal/cm^2 or higher †.
Three-phase	2-4 cal/cm^2.....	5-8 cal/cm^2	9 cal/cm^2 or higher ‡.

* These ranges assume that employees are wearing hardhats meeting the specifications in WAC 296-800-16055 or 296-155-205, as applicable.
† The arc rating must be a minimum of 4 cal/cm^2 less than the estimated incident energy. Note that WAC 296-45-325 (13)(e)(v) permits this type of head and face protection, with a minimum arc rating of 4 cal/cm^2 less than the estimated incident energy, at any incident energy level.
‡ Note that WAC 296-45-325 (13)(e) permits this type of head and face protection at any incident energy level.

IV. Protection Against Ignition

WAC 296-45-325 (13)(c) prohibits clothing that could melt onto an employee's skin or that could ignite and continue to burn when exposed to flames or to the available heat energy estimated by the employer under WAC 296-45-325 (13)(b). Meltable fabrics, such as acetate, nylon, polyester, and polypropylene, even in blends, must be avoided. When these fibers melt, they can adhere to the skin, thereby transferring heat rapidly, exacerbating burns, and complicating treatment. These outcomes can result even if the meltable fabric is not directly next to the skin. The remainder of this section focuses on the prevention of ignition.

WAC 296-45-325 (13)(e) generally requires protective clothing and other protective equipment with an arc rating greater than or equal to the employer's estimate of available heat energy. As explained earlier in this appendix, untreated cotton is usually acceptable for exposures of 2 cal/cm^2 or less.[6] If the exposure is greater than that, the employee generally must wear flame-resistant clothing with a suitable arc rating in accordance with WAC 296-45-325 (13)(d) and (e). However, even if an employee is wearing a layer of flame-resistant clothing, there are circumstances under which flammable layers of clothing would be uncovered, and an electric arc could ignite them. For example, clothing ignition is possible if the employee is wearing flammable clothing under the flame-resistant clothing and the underlayer is uncovered because of an opening in the flame-resistant clothing. Thus, for purposes of WAC 296-45-325 (13)(c), it is important for the employer to consider the possibility of clothing ignition even when an employee is wearing flame-resistant clothing with a suitable arc rating.

Under WAC 296-45-325 (13)(c), employees may not wear flammable clothing in conjunction with flame-resistant clothing if the flammable clothing poses an ignition hazard.[7] Although outer flame-resistant layers may not have openings that expose flammable inner layers, when an outer flame-resistant layer would be unable to resist breakopen,[8] the next (inner) layer must be flame-resistant if it could ignite.

Nonflame-resistant clothing can ignite even when the heat energy from an electric arc is insufficient to ignite the clothing. For example, nearby flames can ignite an employee's clothing; and, even in the absence of flames, electric arcs pose ignition hazards beyond the hazard of ignition from incident energy under certain conditions. In addition to requiring flame-resistant clothing when the estimated incident energy exceeds 2.0 cal/cm^2, WAC 296-45-325 (13)(d) requires flame-resistant clothing when: The employee is exposed to contact with energized circuit parts operating at more than 600 volts (WAC 296-45-325 (13)(d)(i)), an electric arc could ignite flammable materi- al in the work area that, in turn, could ignite the employee's cloth-

ing (WAC 296-45-325 (13)(d)(ii)), and molten metal or electric arcs from faulted conductors in the work area could ignite the employee's clothing (WAC 296-45-325 (13)(d)(iii)). For example, grounding conductors can become a source of heat energy if they cannot carry fault current without failure. The employer must consider these possible sources of electric arcs[9] in determining whether the employee's clothing could ignite under WAC 296-45-325 (13)(d)(iii).

1 Flame-resistant clothing includes clothing that is inherently flame resistant and clothing chemically treated with a flame retardant. (See ASTM F1506-10a, *Standard Performance Specification for Flame Resistant Textile Materials for Wearing Apparel for Use by Electrical Workers Exposed to Momentary Electric Arc and Related Thermal Hazards*, and ASTM F1891-12 *Standard Specification for Arc and Flame Resistant Rainwear*.)

2 The Occupational Safety and Health Administration used metric values to calculate the clearing times in Table 6 and Table 7. An employer may use English units to calculate clearing times instead even though the results will differ slightly.

3 The Occupational Safety and Health Administration based this assumption, which is more conservative than the arc length specified in Table 5, on Table 410-2 of the 2012 NESC.

4 The dielectric strength of air is about 10 kilovolts for every 25.4 millimeters (1 inch). Thus, the employer can estimate the arc length in millimeters to be the phase-to-ground voltage in kilovolts multiplied by 2.54 (or voltage (in kilovolts) × 2.54).

5 ASTM F1506-10a defines "arc thermal performance value" as "the incident energy on a material or a multilayer system of materials that results in a 50% probability that sufficient heat transfer through the tested specimen is predicted to cause the onset of a second-degree skin burn injury based on the Stoll [footnote] curve, cal/cm^2." The footnote to this definition reads: "Derived from: Stoll, A. M., and Chianta, M. A., 'Method and Rating System for Evaluations of Thermal Protection,' Aerospace Medicine, Vol 40, 1969, pp. 1232-1238 and Stoll, A. M., and Chianta, M. A., 'Heat Transfer through Fabrics as Related to Thermal Injury,' Transactions-New York Academy of Sciences, Vol 33(7), Nov. 1971, pp. 649-670."

6 See WAC 296-45-325 (13)(d)(i), (ii) and (iii) for conditions under which employees must wear flame-resistant clothing as the outer layer of clothing even when the incident heat energy does not exceed 2 cal/cm^2.

7 WAC 296-45-325 (13)(c) prohibits clothing that could ignite and continue to burn when exposed to the heat energy estimated under WAC 296-45-325 (13)(b).

8 Breakopen occurs when a hole, tear, or crack develops in the exposed fabric such that the fabric no longer effectively blocks incident heat energy.

9 Static wires and pole grounds are examples of grounding conductors that might not be capable of carrying fault current without failure. Grounds that can carry the maximum available fault current are not a concern, and employers need not consider such grounds a possible electric arc source.

NEW SECTION

WAC 296-45-907 Appendix E—Work-positioning equipment inspection guidelines—Nonmandatory.

I. Body Belts

Inspect body belts to ensure that:

A. The hardware has no cracks, nicks, distortion, or corrosion;

B. No loose or worn rivets are present;

C. The waist strap has no loose grommets;

D. The fastening straps are not 100-percent leather; and

E. No worn materials that could affect the safety of the user are present.

II. Positioning Straps

Inspect positioning straps to ensure that:

A. The warning center of the strap material is not exposed;

B. No cuts, burns, extra holes, or fraying of strap material is present;

C. Rivets are properly secured;

D. Straps are not 100-percent leather; and

E. Snaphooks do not have cracks, burns, or corrosion.

III. Climbers

Inspect pole and tree climbers to ensure that:

A. Gaffs are at least as long as the manufacturer's recommended minimums (generally 32 and 51 millimeters (1.25 and 2.0 inches) for pole and tree climbers, respectively, measured on the underside of the gaff);

Note: Gauges are available to assist in determining whether gaffs are long enough and shaped to easily penetrate poles or trees.

B. Gaffs and leg irons are not fractured or cracked;

C. Stirrups and leg irons are free of excessive wear;

D. Gaffs are not loose;
E. Gaffs are free of deformation that could adversely affect use;
F. Gaffs are properly sharpened; and
G. There are no broken straps or buckles.

NEW SECTION

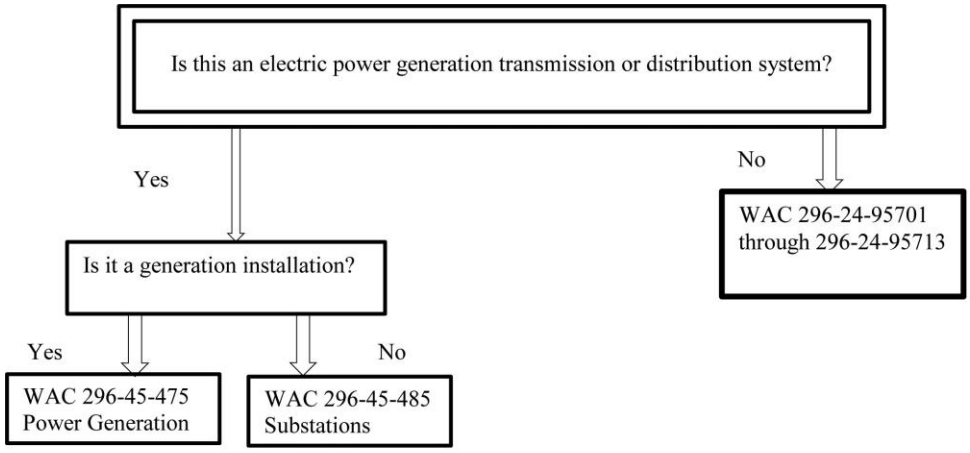
WAC 296-45-908 Appendix F—Other Applicable safety and health Washington administrative codes.

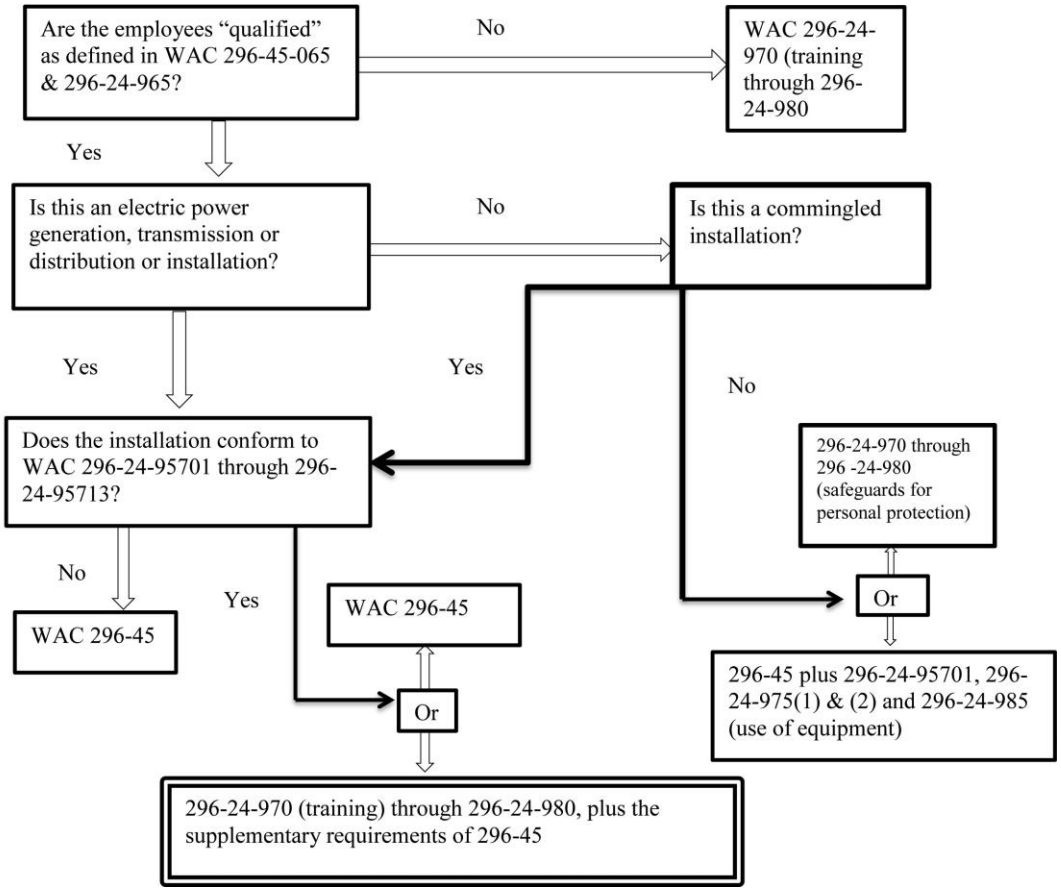
Chapter 296-24 WAC, General safety and health standards;
Chapter 296-27 WAC, Recordkeeping and reporting;
Chapter 296-32 WAC, Safety standards for telecommunications;
Chapter 296-36 WAC, Safety standards—Compressed air work;
Chapter 296-37 WAC, Standards for commercial diving operations;
Chapter 296-52 WAC, Safety standards for possession, handling, and use of explosives;
Chapter 296-54 WAC, Safety standards—Logging operations;
Chapter 296-56 WAC, Safety standards—Longshore, stevedore and waterfront related operations;
Chapter 296-59 WAC, Safety standards for ski area facilities and operations;
Chapter 296-62 WAC, General occupational health standards;
Chapter 296-63 WAC, Right to know fee assessment;
Chapter 296-65 WAC, Asbestos removal and encapsulation;
Chapter 296-67 WAC, Safety standards for process safety management of highly hazardous chemicals;
Chapter 296-78 WAC, Safety standards for sawmills and woodworking operations;
Chapter 296-79 WAC, Safety Standards for pulp, paper, and paperboard mills and converters;
Chapter 296-99 WAC, Safety standards for grain handling facilities;
Chapter 296-115 WAC, Safety requirements for charter boats;
Chapter 296-155 WAC, Safety standards for construction work;
Chapter 296-301 WAC, Safety standards for the textile industry;
Chapter 296-303 WAC, Safety standards for laundry machinery and operations;
Chapter 296-304 WAC, Safety standards for ship repairing, shipbuilding, and shipbreaking;
Chapter 296-305 WAC, Safety standards for firefighters;
Chapter 296-307 WAC, Safety standards for agriculture;
Chapter 296-360 WAC, Discrimination, pursuant to RCW 49.17.160;
Chapter 296-800 WAC, Safety and health core rules;
Chapter 296-802 WAC, Employee medical and exposure records;
Chapter 296-803 WAC, Lockout/tagout (control of hazardous energy);
Chapter 296-806 WAC, Machine safety;
Chapter 296-807 WAC, Portable power tools;
Chapter 296-809 WAC, Confined spaces;
Chapter 296-811 WAC, Fire brigades;
Chapter 296-816 WAC, Protecting trade secrets;
Chapter 296-817 WAC, Hearing loss prevention (noise);
Chapter 296-818 WAC, Abrasive blasting;

Chapter 296-823 WAC, Occupational exposure to bloodborne pathogens;
Chapter 296-824 WAC, Emergency response;
Chapter 296-826 WAC, Anhydrous ammonia;
Chapter 296-828 WAC, Hazardous chemicals in laboratories;
Chapter 296-829 WAC, Helicopters used as lifting machines;
Chapter 296-832 WAC, Late night retail worker crime prevention;
Chapter 296-833 WAC, Temporary housing for workers;
Chapter 296-835 WAC, Dipping and coating operations (dip tanks);
Chapter 296-839 WAC, Content and distribution of material safety data sheets (MSDSs) and label information;
Chapter 296-841 WAC, Airborne contaminants;
Chapter 296-842 WAC, Respirators;
Chapter 296-843 WAC, Hazardous waste operations;
Chapter 296-848 WAC, Arsenic;
Chapter 296-849 WAC, Benzene;
Chapter 296-855 WAC, Ethylene oxide;
Chapter 296-856 WAC, Formaldehyde;
Chapter 296-860 WAC, Railroad clearances and walkways in private rail yards and plants;
Chapter 296-863 WAC, Forklifts and other powered industrial trucks;
Chapter 296-864 WAC, Split (multi-piece) rim and single-piece rim wheels;
Chapter 296-865 WAC, Motor vehicles;
Chapter 296-869 WAC, Elevating work platforms;
Chapter 296-870 WAC, Powered platforms;
Chapter 296-874 WAC, Scaffolds;
Chapter 296-876 WAC, Ladders, portable and fixed;
Chapter 296-878 WAC, Safety standards for window cleaning;
Chapter 296-900 WAC, Administrative rules;
Chapter 296-901 WAC, Globally harmonized system for hazard communication.

NEW SECTION

WAC 296-45-909 Appendix G—Flow chart—Nonmandatory.





NEW SECTION

WAC 296-45-910 Appendix H—Reference documents. The references contained below provide information that can be helpful in understanding and complying with the requirements contained in this chapter. The national consensus standards referenced below contain detailed specifications that employers may follow in complying with the more per-

formance-based requirements of this chapter. Except as specifically noted in this chapter, however, the department will not necessarily deem compliance with the national consensus standards to be compliant with the provisions of this chapter.

ANSI/SIA A92.2-2009, *American National Standard for Vehicle-Mounted Elevating and Rotating Aerial Devices.*

ANSI Z133-2012, *American National Standard Safety Requirements for Arboricultural Operations-Pruning, Trimming, Repairing, Maintaining, and Removing Trees, and Cutting Brush.*

ANSI/IEEE Std 935--1989, *IEEE Guide on Terminology for Tools and Equipment to Be Used in Live Line Working.*

ASME B20.1-2012, *Safety Standard for Conveyors and Related Equipment.*

ASTM D120-09, *Standard Specification for Rubber Insulating Gloves.*

ASTM D149-09 (2013), *Standard Test Method for Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies.*

ASTM D178-01 (2010), *Standard Specification for Rubber Insulating Matting.*

ASTM D1048-12, *Standard Specification for Rubber Insulating Blankets.*

ASTM D1049-98 (2010), *Standard Specification for Rubber Insulating Covers.*

ASTM D1050-05 (2011), *Standard Specification for Rubber Insulating Line Hose.*

ASTM D1051-08, *Standard Specification for Rubber Insulating Sleeves.*

ASTM F478-09, *Standard Specification for In-Service Care of Insulating Line Hose and Covers.*

ASTM F479-06 (2011), *Standard Specification for In-Service Care of Insulating Blankets.*

ASTM F496-08, *Standard Specification for In-Service Care of Insulating Gloves and Sleeves.*

ASTM F711-02 (2007), *Standard Specification for Fiberglass-Reinforced Plastic (FRP) Rod and Tube Used in Live Line Tools.*

ASTM F712-06 (2011), *Standard Test Methods and Specifications for Electrically Insulating Plastic Guard Equipment for Protection of Workers.*

ASTM F819-10, *Standard Terminology Relating to Electrical Protective Equipment for Workers.*

ASTM F855-09, *Standard Specifications for Temporary Protective Grounds to Be Used on De-energized Electric Power Lines and Equipment.*

ASTM F887-12^{e1}, *Standard Specifications for Personal Climbing Equipment.*

ASTM F914/F914M-10, *Standard Test Method for Acoustic Emission for Aerial Personnel Devices Without Supplemental Load Handling Attachments.*

ASTM F1116-03 (2008), *Standard Test Method for Determining Dielectric Strength of Dielectric Footwear.*

ASTM F1117-03 (2008), *Standard Specification for Dielectric Footwear.*

ASTM F1236-96 (2012), *Standard Guide for Visual Inspection of Electrical Protective Rubber Products.*

ASTM F1430/F1430M-10, *Standard Test Method for Acoustic Emission Testing of Insulated and Non-Insulated Aerial Personnel Devices with Supplemental Load Handling Attachments.*

ASTM F1505-10, *Standard Specification for Insulated and Insulating Hand Tools.*

ASTM F1506-10a, *Standard Performance Specification for Flame Resistant and Arc Rated Textile Materials for Wearing Apparel for Use by Elec-*

trical Workers Exposed to Momentary Electric Arc and Related Thermal Hazards.
ASTM F1564-13, *Standard Specification for Structure-Mounted Insulating Work Platforms for Electrical Workers.*
ASTM F1701-12, *Standard Specification for Unused Polypropylene Rope with Special Electrical Properties.*
ASTM F1742-03 (2011), *Standard Specification for PVC Insulating Sheeting.*
ASTM F1796-09, *Standard Specification for High Voltage Detectors-Part 1 Capacitive Type to be Used for Voltages Exceeding 600 Volts AC.*
ASTM F1797-09$^{\varepsilon 1}$, *Standard Test Method for Acoustic Emission Testing of Insulated and Non-Insulated Digger Derricks.*
ASTM F1825-03 (2007), *Standard Specification for Clampstick Type Live Line Tools.*
ASTM F1826-00 (2011), *Standard Specification for Live Line and Measuring Telescoping Tools.*
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REPEALER

The following section of the Washington Administrative Code is repealed:

WAC 296-45-901 Appendix A——Nonmandatory.