ELECTRIC POWER TRANSMISSION & DISTRIBUTION LINES

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Note: Subpart V, Electric Power Transmission and Distribution, covers the construction of electric power transmission and distribution lines and equipment. The term "construction" includes the erection of new electric transmission and distribution lines and equipment, and the alteration, conversion, and improvement of existing electric transmission and distribution lines and equipment, except:

1. **Subpart V does not apply to electrical safety-related work practices for unqualified employees.**
2. **Line-clearance tree trimming operations and work involving electric power generation installations shall comply with § 1910.269.**

Training: All Employees:

1. Each employee shall be trained in, and familiar with, the safety-related work practices, safety procedures, and other safety requirements in Subpart V, Electric Power Transmission and Distribution, that pertain to his or her job assignments.
2. Each employee shall also be trained in and familiar with any other safety practices, including applicable emergency procedures (such as pole-top and manhole rescue), that are not specifically addressed by Subpart V but that are related to his or her work and are necessary for his or her safety.
3. The degree of training shall be determined by the risk to the employee for the hazard involved.

Training: Qualified Employees:

Each qualified employee shall also be trained and competent in:

1. The skills and techniques necessary to distinguish exposed live parts from other parts of electric equipment,
2. The skills and techniques necessary to determine the nominal voltage of exposed live parts,

Note: An employee must have had the training, see above, to be considered a qualified person.

3. The minimum approach distances specified in this subpart corresponding to the voltages to which the qualified employee will be exposed and the skills and techniques necessary to maintain those distances,
4. 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
5. 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: Our job site safety person/competent person 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 Subpart V.

Additional Training:

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

1. If the supervision or annual inspections, see above, indicate that the employee is not complying with the safety-related work practices required by this Subpart V, or
2. 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
3. If he or she must employ safety related work practices that are not normally used during his or her regular job duties.

Note: The Occupational Safety and Health Administration considers tasks that are performed less often than once per year to necessitate retraining before the performance of the work practices involved.

Training will be classroom or on-the-job. The goal of training is to establish employee proficiency in the work practices required by Subpart V and shall introduce the procedures necessary for compliance with Subpart V.

Note: Though they are <u>not</u> <u>required</u>, employment records that indicate that an employee has successfully completed the required training are one way of keeping track of when an employee has demonstrated proficiency.

Note: For an employee with previous training, we may determine that that employee has demonstrated the proficiency using the following process: (1) Confirm that the employee has the required training, see above, (2) 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 Subpart V, and (3) supervise the employee closely until that employee has demonstrated proficiency.

<u>Information transfer:</u>

<u>Host employer responsibilities:</u>

Before work begins, the host employer shall inform contract employers of:

The characteristics of the host employer's installation that are related to the safety of the work to be performed including:

1. The nominal voltages of lines and equipment,
2. The maximum switching-transient voltages,
3. The presence of hazardous induced voltages,
4. The presence of protective grounds and equipment grounding conductors,
5. The locations of circuits and equipment, including electric supply lines, communication lines, and fire protective signaling circuits.

Note: <u>The host employer MUST OBTAIN the information listed in paragraphs 1. through 5., above, if it does not have this information in existing records.</u>

Conditions that are related to the safety of the work to be performed, that are listed in paragraphs 6., 7. & 8., below, that are known to the host employer;

6. The condition of protective grounds and equipment grounding conductors,
7. The condition of poles, and
8. Environmental conditions relating to safety.

Note: To comply with paragraphs 6., 7., & 8., above, 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. The host employer is <u>not required</u> to make inspections of worksite conditions to obtain this information.

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

Note: The above paragraph <u>requires</u> the host employer <u>to obtain</u> 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.

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: 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. The above paragraph <u>does not require</u> the host employer to make inspections of worksite conditions to obtain this information.

<u>Contract employer responsibilities:</u>

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, see above.

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

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 above. Specifically: the characteristics of the host employer's installation that are related to the safety of the work to be performed including: 1.) The nominal voltages of lines and equipment, 2.) The maximum switching-transient voltages, 3.) The presence of hazardous induced voltages, 4.) The presence of protective grounds and equipment grounding conductors, and 5.) The locations of circuits and equipment, including electric supply lines, communication lines, and fire protective signaling circuits.

<u>The contract employer shall provide this information to the host employer within 2 working days after discovering the hazardous condition.</u>

<u>Joint host- and contract-employer responsibilities:</u>

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 Subpart V.

Job Briefings:

Before each job:

1. In assigning an employee or a group of employees to perform a job, we shall provide the employee in charge of the job with all available information that relates to the determination of existing characteristics and conditions, see Information Transfer, above.
2. **All briefings, short or extensive, must cover at least the following subjects: Hazards associated with the job, work procedures involved, special precautions, energy-source controls, and personal protective equipment requirements.**

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.

A brief discussion is satisfactory if the work involved is routine and if the employees, 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:

1. If the work is complicated or particularly hazardous, or
2. If the employee cannot be expected to recognize and avoid the hazards involved in the job.

Note: An employee working alone need not conduct a job briefing. However, it shall be ensured that the tasks to be performed are planned as if a briefing were required.

Enclosed Spaces:

Note: Enclosed Spaces covers enclosed spaces that may be entered by employees. It does not apply to vented vaults if a determination IS MADEthat the ventilation system is operating to protect employees before they enter the space. This section applies to routine entry into enclosed spaces. If, after the employer takes the precautions given in this section and in § 1926.965, Underground electrical installations, 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 paragraphs (d) through (k) of § 1910.146.

Note: Entries into enclosed spaces conducted in accordance with the permit-space entry requirements of paragraphs (d) through (k) of § 1910.146 of this chapter are considered as complying with § 1926.953, Enclosed Spaces.

Additional Requirements for Working in Underground Electrical Installations:

1. Employees must use a ladder or other climbing device to enter and exit a manhole or subsurface vault exceeding 4 feet in depth. No employee may climb into or out of a manhole or vault by stepping on cables or hangers.
2. 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.
3. Before anyone lowers tools or material 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.
4. Attendants for manholes and vaults are required while work is being performed in a manhole or vault containing energized electric equipment. An employee with first-aid training shall be available on the surface in the immediate vicinity of the manhole or vault entrance to render emergency assistance.

Note: First-aid training:

In addition to the requirements for first aid training found in Section I of our safety program, when employees are performing work on, or associated with, exposed lines or equipment energized at 50 volts or more, persons with first-aid training shall be available as follows: (i) For field work involving two or more employees at a work location, at least two trained persons shall be available.

Note: Occasionally, the employee on the surface may briefly enter a manhole or vault to provide nonemergency assistance.

Note: For the purpose of inspection, housekeeping, taking readings, or similar work, an employee working alone may enter, for brief periods of time, a manhole or vault where energized cables or equipment are in service if it can demonstrate that the employee will be protected from all electrical hazards.

Note: Paragraph (b)(1)(ii) of § 1926.960 requires employees entering manholes or vaults containing unguarded, uninsulated energized lines or parts of electric equipment operating at 50 volts or more to be qualified.

5. Reliable communications, through two-way radios or other equivalent means, among all employees involved in the job will be maintained.
6. If employees use duct rods, they will install the duct rods in the direction presenting the least hazard to themselves. An employee shall be stationed at the far end of the duct line being rodded to ensure that the employees maintain the required minimum approach distances.
7. 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, in addition to the one being worked, shall be protected from damage.

8. Except when paragraph 2, Protection Against Faults, below, permits employees to perform work that could cause a fault in an energized cable in a manhole or vault, employees must inspect energized cables to be moved for abnormalities.

Protection Against Faults:

Where a cable in a manhole or vault has one or more abnormalities that could lead to a fault or be an indication of an impending fault, the cable with the abnormality shall be deenergized before any employee may work in the manhole or vault, 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 or vault provided they are protected from the possible effects of a failure using shields or other devices that are capable of containing the adverse effects of a fault. The following abnormalities shall be treated as indications of impending faults unless it can be demonstrated that the conditions could not lead to a fault: Oil or compound leaking from cable or joints, broken cable sheaths or joint sleeves, hot localized surface temperatures of cables or joints, or joints swollen beyond normal tolerance.

If the work employees will perform in a manhole or vault could cause a fault in a cable, that cable shall be deenergized before any employee works in the manhole or vault, 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 or vault provided they are protected from the possible effects of a failure using shields or other devices that are capable of containing the adverse effects of a fault.

When employees perform work on buried cable or on cable in a manhole or vault, metallic-sheath continuity will be maintained or the cable sheath shall be treated as energized.

Working On or Near Exposed Energized Parts:

Only qualified employees may work on or with [or near enough to be exposed to hazards they present] exposed energized lines or parts of equipment. Only qualified employees may work in areas containing unguarded, uninsulated energized lines or parts of equipment operating at 50 volts or more.

Electric lines and equipment shall be considered and treated as energized unless they have been deenergized in accordance with § 1926.961, see below:

Deenergizing of transmission and distribution lines and equipment for the purpose of protecting employees will be as follows:

Note: Conductors and parts of electric equipment that have been deenergized under procedures other than those required by § 1926.961 shall be treated as energized.

Deenergizing Lines and Equipment per § 1926.961:

The employee that the employer designates as being in charge of the clearance shall make a request of the system operator to deenergize the particular section of line or equipment. The designated employee becomes the employee in charge and is responsible for the clearance.

The employer shall ensure that 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 are open. The employer shall render such means inoperable, unless its design does not so permit, and then ensure that such means are tagged to indicate that employees are at work.

The employer shall ensure that automatically and remotely controlled switches that could cause the opened disconnecting means to close are also tagged at the points of control. The employer shall render the automatic or remote control feature inoperable, unless its design does not so permit.

The employer need not use the tags 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:

1. Every network protector is maintained so that it will immediately trip open if closed when a primary conductor is deenergized;
2. 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
3. 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.

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

After the above requirements have been followed and the system operator gives a clearance to the employee in charge, the employer shall ensure that

the lines and equipment are deenergized by testing the lines and equipment to be worked with a device designed to detect voltage.

The employer shall ensure the installation of protective grounds as required by § 1926.962.

After the above steps have been taken, the lines and equipment involved may be considered deenergized.

To transfer the clearance, the employee in charge (or the employee's supervisor if the employee in charge must leave the worksite due to illness or other emergency) shall inform the system operator and employees in the crew; and the new employee in charge shall be responsible for the clearance.

To release a clearance, the employee in charge shall:

1. Notify each employee under that clearance of the pending release of the clearance;
2. Ensure that all employees under that clearance are clear of the lines and equipment;
3. Ensure that all protective grounds protecting employees under that clearance have been removed; and
4. Report this information to the system operator and then release the clearance.

Only the employee in charge who requested the clearance may release the clearance, unless the employer transfers responsibility, see above paragraphs.

Removal of tags. No one may remove tags without the release of the associated clearance, see above.

The employer shall ensure that no one initiates action to reenergize the lines or equipment at a point of disconnection until all protective grounds have been removed, all crews working on the lines or equipment release their clearances, all employees are clear of the lines and equipment, and all protective tags are removed from that point of disconnection.

Except as provided 1926.960 (b)(3)(ii), at least two employees shall be present while any employees perform the following types of work:

Note: 1926.960 (b)(3)(ii) excludes: a) routine circuit switching, when we can demonstrate that conditions at the site allow safe performance of this work, b) work performed with live-line tools when the position of the employee is such that he or she is neither within reach of, nor otherwise exposed to contact with, energized parts, and c) Emergency repairs to the extent necessary to safeguard the general public.

1. Installation, removal, or repair of lines energized at more than 600 volts,
2. Installation, removal, or repair of deenergized lines if an employee is exposed to contact with other parts energized at more than 600 volts,

3. 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,
4. Work involving the use of mechanical equipment, other than insulated aerial lifts, near parts energized at more than 600 volts, and
5. Other work that exposes an employee to electrical hazards greater than, or equal to, the electrical hazards posed by operations listed in the above 4 subparagraphs.

Live Work:

Minimum approach distances no less than the distances computed by Table V-2 for ac systems or Table V-7 for dc systems.

Legacy tables. Employers may use the minimum approach distances in Table 6 until March 31, 2015.

TABLE 6-MINIMUM APPROACH DISTANCES UNTIL MARCH 31, 2015

Voltage range phase to phase (kV)	Phase-to-ground exposure		Phase-to-ground exposure	
	m	ft	m	ft
2.1 to 15.0	0.64	2.1	0.61	2.0
15.1 to 35.0	0.71	2.3	0.71	2.3
35.1 to 46.0	0.76	2.5	0.76	2.5
46.1 to 72.5	0.91	3.0	0.91	3.0
72.6 to 121	1.02	3.3	1.37	4.5
138 to 145	1.07	3.5	1.52	5.0
161 to 169	1.12	3.7	1.68	5.5
230 to 242	1.52	5.0	2.54	8.3

345 to 362 *	2.13	7.0	4.06	13.3
500 to 552 *	3.35	11.0	6.10	20.0
700 to 765 *	4.57	15.0	9.45	31.0

***Note: The minimum approach distance may be the shortest distance between the energized part and the grounded surface.**

Note: Employers may use the minimum approach distances in Table V-6, except that the employer may not use the minimum approach distances in Table V-6 for phase-to-phase exposures if an insulated tool spans the gap or if any large conductive object is in the gap. If the worksite is at an elevation of more than 900 meters (3000 feet), see footnote 1 to Table V-6. Employers may use the minimum approach distance in Table 7 through Table 14 in Appendix B to this subpart, which calculated MAD for various values of *T*, provided the employer follows the notes to those tables.

Note: No later than April 1, 2015, for voltages over 72.5 kilovolts, the employer shall 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 V-8. When the employer uses portable protective gaps to control the maximum transient overvoltage, the value of the maximum anticipated per-unit transient overvoltage, phase-to-ground, must provide for five standard deviations between the statistical sparkover voltage of the gap and the statistical withstand voltage corresponding to the electrical component of the minimum approach distance. The employer shall make any engineering analysis conducted to determine maximum anticipated perunit transient overvoltage available upon request to employees and to the Assistant Secretary or designee for examination and copying.

Note: No later than April 1, 2015 all approach distances will be computed using information, tables, formulas, assumptions, notes found in Working on or near exposed energized parts. - 1926.960 and Appendix B to Subpart V of Part 1926-Working on Exposed Energized Parts. Click to access. Appendix B contains information on how to calculate the maximum anticipated per-unit transient overvoltage, phase-to-ground, when the employer uses portable protective gaps to reduce maximum transient overvoltages.

We shall ensure that no employee approaches or takes any conductive object closer to exposed energized parts than our established minimum approach distance, unless:

1. The employee is insulated from the energized part (rubber insulating gloves or rubber insulating gloves and sleeves worn as described in

Type of Insulation, below, constitutes insulation of the employee from the energized part upon which the employee is working provided that the employee has control of the part in a manner sufficient to prevent exposure to uninsulated portions of the employee's body), or

2. The energized part is insulated from the employee and from any other conductive object at a different potential, or

3. The employee is insulated from any other exposed conductive object in accordance with the requirements for live-line barehand work.

Type of Insulation:

Note: See subparagraph 1, above.

When an employee uses rubber insulating gloves as insulation from energized parts he must also uses rubber insulating sleeves. However, an employee need not use rubber insulating sleeves if exposed energized parts on which the employee is not working are insulated from the employee **and** the employee installs the insulation from a position that does not expose his or her upper arm to contact with other energized parts.

When an employee uses rubber insulating gloves or rubber insulating gloves and sleeves as insulation from energized parts that employee must put on the rubber insulating gloves and sleeves in a position where he or she cannot reach into the minimum approach distance, established for the work, and **not remove** the rubber insulating gloves and sleeves until he or she is in a position where he or she cannot reach into the minimum approach distance

Each employee, to the extent that other safety-related conditions at the worksite permit, **must work** in a position from which a slip or shock will not bring the employee's body into contact with exposed, uninsulated parts energized at a potential different from the employee's.

When an employee performs work near exposed parts energized at more than 600 volts, but not more than 72.5 kilovolts, and is not wearing rubber insulating gloves, being protected by insulating equipment covering the energized parts, performing work using live-line tools, or performing live-line barehand work the employee must work from a position where he or she cannot reach into the minimum approach distance.

Connections must be made as follows:

1. 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;
2. 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

3. When lines or equipment are connected to or disconnected from energized circuits, an employee shall keep loose conductors away from exposed energized parts.

Note: When an employee performs work within reaching distance of exposed energized parts of equipment, the employee must remove or render nonconductive all exposed conductive articles, such as keychains or watch chains, rings, or wrist watches or bands, unless such articles do not increase the hazards associated with contact with the energized parts.

Protection for Flames and Electric Arcs:

We must assess the workplace to identify employees exposed to hazards from flames or from electric arcs.

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

Note: The obligation in the paragraph above to make reasonable estimates of incident energy commences January 1, 2015.

Note: Appendix E to Subpart V of Part 1926 - Protection From Flames and Electric Arcs (click here) **provides guidance on estimating available heat energy. The Occupational Safety and Health Administration will deem employers following the guidance in Appendix E to be in compliance with the requirement to make a reasonable estimate of the incident heat energy to which the employee would be exposed. An employer may choose a method of calculating incident heat energy not included in Appendix E if the chosen method reasonably predicts the incident energy to which the employee would be exposed.**

Note: Appendix E to Subpart V of Part 1926 - Protection From Flames and Electric Arcs (click here) **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.**

When an employee must install or remove fuses with one or both terminals energized at more than 300 volts, or with exposed parts energized at more than 50 volts, the employee **must** use tools or gloves rated for the voltage. When an employee installs or removes expulsion-type fuses with one or both terminals energized at more than 300 volts, the employee **must** wear eye protection meeting the requirements of Subpart E, use a tool rated for the voltage, and be clear of the exhaust path of the fuse barrel.

The requirements of that pertain to the hazards of exposed live parts also apply when an employee performs work in proximity to covered (noninsulated) wires.

Non-current-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 these parts are exposed, unless inspect the installation and determine that these parts are grounded before employees begin performing the work.

We shall **ensure** that devices used by employees to **open** circuits under load conditions are designed to interrupt the current involved and that devices used by employees to **close** circuits under load conditions are designed to safely carry the current involved.

Grounding for the Protection of Employees:

The following applies to grounding of transmission and distribution lines and equipment for the purpose of protecting employees.

For any employee to work transmission and distribution lines or equipment as deenergized, we must ensure that the lines or equipment are deenergized, see above, and ensure the proper grounding of the lines or equipment as specified below:

1. Temporary protective grounds shall be placed at such locations and arranged in such a manner that the it can demonstrated that they will prevent each employee from being exposed to hazardous differences in electric potential.

Note: Appendix C to Subpart V of Part 1926-Protection From Hazardous Differences in Electric Potential (click here) **contains guidelines for establishing the equipotential zone required by this paragraph. The Occupational Safety and Health Administration will deem grounding practices meeting these guidelines as complying with the above paragraph.**

2. 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.
3. Protective grounding equipment shall have an ampacity greater than or equal to that of No. 2 AWG copper.
4. Protective grounds shall have an impedance low enough so that they do not delay the operation of protective devices in case of accidental energizing of the lines or equipment.

Note: American Society for Testing and Materials Standard Specifications for Temporary Protective Grounds to Be Used on De-Energized Electric Power Lines and Equipment, ASTM F855-09, contains guidelines for protective grounding equipment. The Institute of Electrical Engineers Guide for Protective Grounding of Power Lines, IEEE Std 1048-2003, contains guidelines for selecting and installing protective grounding equipment.

5. We will ensure that, unless a previously installed ground is present, employees test lines and equipment and verify the absence of nominal voltage before employees install any ground on those lines or that equipment.
6. We will 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, we may permit the employee to use insulating equipment other than a live-line tool if we ensure that the line or equipment is not energized at the time the ground is connected or if it can be demonstrated that each employee is protected from hazards that may develop if the line or equipment is energized.
7. We shall ensure that, when an employee performs work on a cable at a location remote from the cable terminal, the cable is not grounded at the cable terminal if there is a possibility of hazardous transfer of potential should a fault occur.
8. We may permit employees to remove grounds temporarily during tests. During the test procedure, we shall ensure that each employee uses insulating equipment, shall isolate each employee from any hazards involved, and shall implement any additional measures necessary to protect each exposed employee in case the previously grounded lines and equipment become energized.

However, if it can demonstrated that installation of a ground is impracticable or that the conditions resulting from the installation of a ground would present greater hazards to employees than working without grounds, the lines and equipment may be treated as deenergized provided that it can be established that all of the following conditions apply:

1. It can be ensured that the lines and equipment are deenergized under the provisions of § 1926.961.
2. There is no possibility of contact with another energized source.
3. The hazard of induced voltage is not present.

Personal Protective Equipment:

Note: At no cost, and replaced as necessary, personal protective equipment will be provided to the erection of new electric transmission and distribution lines and equipment, and the alteration, conversion, and improvement of existing electric transmission and distribution lines and equipment.

Personal fall arrest equipment used by employees who are exposed to hazards from flames or electric arcs shall be capable of passing a drop test equivalent to that required by paragraph (b)(2)(xii) of this section after exposure to an electric arc with a heat energy of 40±5 cal/cm^2.

When used by employees weighing no more than 310 pounds, 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 paragraph (b)(2) of 1926.954.

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: Appendix F to Subpart V of Part 1926 - Work-Positioning Equipment Inspection Guidelines (Click Here) **contains guidelines for inspecting work-positioning equipment.**

Personal fall arrest systems shall be used in accordance with our normal Fall Protection Program found in Section III of our Safety Program.

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.

Employees use fall protection systems as follows:

1. Each employee working from an aerial lift shall use a fall restraint system or a personal fall arrest system.
2. Except as provided in paragraph (b)(3)(iii)(C) of this section, each employee in elevated locations more than 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, per our Fall Protection Program found in Section III of our Safety Program.

1926.954(b)(3)(iii)(C):
Until March 31, 2015, a qualified employee climbing or changing location on poles, towers, or similar structures need not use fall protection equipment, 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. On and after April 1, 2015, each qualified employee climbing or changing location on poles, towers, or similar structures 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.

Note: The preceding two (2) paragraphs 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. Subpart M of this part contains the duty to provide fall protection associated with walking and working surfaces. Until it is assured that employees are proficient in climbing and the use of fall protection under Â§ 1926.950(b)(7), the employees are not considered "qualified employees" for the purposes of the two (2) paragraphs, above. These paragraphs require

unqualified employees (including trainees) to use fall protection any time they are more than 4 feet above the ground.

On and after April 1, 2015, Work-positioning systems shall be rigged so that an employee can free fall no more than 2 feet.

Anchorages for work-positioning equipment shall be capable of supporting at least twice the potential impact load of an employee's fall, 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.

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

1. Directly to webbing, rope, or wire rope;
2. To each other;
3. To a D ring to which another snaphook or other connector is attached;
4. To a horizontal lifeline; or
5. 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.

Hand and Portable Power Equipment:

Cord- and plug-connected equipment not covered by Subpart K - Electrical of this part shall comply with one of the following instead of § 1926.302(a)(1):

1. The equipment shall be equipped with a cord containing an equipment grounding conductor connected to the equipment frame and to a means for grounding the other end of the conductor (however, this option may not be used where the introduction of the ground into the work environment increases the hazard to an employee); or
2. The equipment shall be of the double-insulated type conforming to Subpart K of this part; or
3. The equipment shall be connected to the power supply through an isolating transformer with an ungrounded secondary of not more than 50 volts.

Portable and vehicle-mounted generators used to supply cord- and plug-connected equipment, **above**, shall meet the following requirements:

1. The generator may only supply equipment located on the generator or the vehicle and cord- and plug-connected equipment through receptacles mounted on the generator or the vehicle.
2. The non-current-carrying metal parts of equipment and the equipment grounding conductor terminals of the receptacles shall be bonded to the generator frame.
3. For vehicle-mounted generators, the frame of the generator shall be bonded to the vehicle frame.
4. Any neutral conductor shall be bonded to the generator frame.

The statement: "*The fluid used in hydraulic powered tools shall be fire-resistant fluids approved under Schedule 30 of the U.S. Bureau of Mines, Department of the Interior, and shall retain its operating characteristics at the most extreme temperatures to which it will be exposed*" does not apply to hydraulic fluid used in insulating sections of hydraulic tools.

Safe operating pressures for hydraulic and pneumatic tools, hoses, valves, pipes, filters, and fittings may not be exceeded.

Note: If any hazardous defects are present, no operating pressure is safe, and the hydraulic or pneumatic equipment involved may not be used. In the absence of defects, the maximum rated operating pressure is the maximum safe pressure.

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

The hydraulic system supplying a hydraulic tool used where it may contact exposed live parts shall provide protection against loss of insulating value, for the voltage involved, due to the formation of a partial vacuum in the hydraulic line.

Note: Use of hydraulic lines that do not have check valves and that have a separation of more than 35 feet between the oil reservoir and the upper end of the hydraulic system promotes the formation of a partial vacuum.

A pneumatic tool used on energized electric lines or equipment, or used where it may contact exposed live parts, shall provide protection against the accumulation of moisture in the air supply.

Pressure shall be released before connections are broken, unless quick-acting, self-closing connectors are used.

Employees **may not** use any part of their bodies to locate, or attempt to stop, a hydraulic leak.

Hoses may not be kinked.

Portable Ladders and Platforms:

Portable ladders and platforms used on structures or conductors in conjunction with overhead line work shall also meet the following requirements:

1. **In the configurations in which they are used, portable platforms shall be capable of supporting without failure at least 2.5 times the maximum intended load.**
2. **Portable ladders and platforms may not be loaded in excess of the working loads for which they are designed.**
3. **Portable ladders and platforms shall be secured to prevent them from becoming dislodged.**
4. **Portable ladders and platforms may be used only in applications for which they are designed.**

Portable **metal ladders** and other portable **conductive ladders may not be use**d near exposed energized lines or equipment. However, in specialized high-voltage work, conductive ladders shall be used when it can be demonstrated that nonconductive ladders would present a greater hazard to employees than conductive ladders.

Materials Handling and Storage Near Energized Lines or Equipment:

In areas to which access is not restricted to qualified persons only, materials or equipment may not be stored closer to energized lines or exposed energized parts of equipment than the following distances, plus a distance that provides for the maximum sag and side swing of all conductors and for the height and movement of material-handling equipment:

1. **For lines and equipment energized at 50 kilovolts or less, the distance is 10 feet.**
2. **For lines and equipment energized at more than 50 kilovolts, the distance is 10 feet plus 4 inches) for every 10 kilovolts over 50 kilovolts.**

In areas restricted to qualified employees, materials may not be stored within the working space about energized lines or equipment.

Note: Paragraph (b) of § 1926.966 specifies the size of the working space.

Paragraph (b) of § 1926.966

The employer shall provide and maintain sufficient access and working space about electric equipment to permit ready and safe operation and maintenance of such equipment by employees.

Note to paragraph (b): American National Standard *National Electrical Safety Code*, ANSI/IEEE C2-2012 contains guidelines for the dimensions of access and working space about electric equipment in substations. Installations meeting the ANSI provisions comply with paragraph (b) of this section. The Occupational Safety and Health Administration will determine whether an installation that does not conform to this ANSI standard complies with paragraph (b) of this section based on the following criteria:

(1) Whether the installation conforms to the edition of ANSI C2 that was in effect when the installation was made;

(2) Whether the configuration of the installation enables employees to maintain the minimum approach distances, established by the employer under § 1926.960(c)(1)(i), while the employees are working on exposed, energized parts; and

(3) Whether the precautions taken when employees perform work on the installation provide protection equivalent to the protection provided by access and working space meeting ANSI/IEEE C2-2012.

Mechanical Equipment:

Mechanical equipment shall be operated in accordance with applicable requirements in this part, including Subparts N, O, and CC of this part, except that § 1926.600(a)(6) [deals with distances for non-qualified persons] does not apply to operations performed by qualified employees.

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

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

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

Mobile equipment, if provided with outriggers, shall be operated with the outriggers extended and firmly set, except iIf the work area or the terrain precludes the use of outriggers, the equipment may be operated only within its maximum load ratings specified by the equipment manufacturer for the particular configuration of the equipment without outriggers.

Outriggers may not be extended or retracted outside of the clear view of the operator unless all employees are outside the range of possible equipment motion.

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 mechanical equipment is being used.

Mechanical equipment shall be operated so that the minimum approach distances, see Working On or Near Exposed Energized Parts, above, are maintained from exposed energized lines and equipment. However, the insulated portion of an aerial lift operated by a qualified employee in the lift is exempt from this requirement if the applicable minimum approach distance is maintained between the uninsulated portions of the aerial lift and exposed objects having a different electrical potential.

A designated employee other than the equipment operator shall observe the approach distance to exposed lines and equipment and

provide timely warnings before the minimum approach distance is reached, unless we can demonstrate that the operator can accurately determine that the minimum approach distance is being maintained.

If, during operation of the mechanical equipment, that equipment could become energized, the operation also shall comply with at least one of the three (3) subparagraphs, below:

1. The energized lines or equipment exposed to contact shall be covered with insulating protective material that will withstand the type of contact that could be made during the operation.
2. The mechanical equipment shall be insulated for the voltage involved. The mechanical equipment shall be positioned so that its uninsulated portions cannot approach the energized lines or equipment any closer than the minimum approach distances, established above
3. Each employee shall be protected from hazards that could arise from mechanical equipment contact with energized lines or equipment. The measures used shall ensure that employees will not be exposed to hazardous differences in electric potential. Unless we can demonstrate that the methods in use protect each employee from the hazards that could arise if the mechanical equipment contacts the energized line or equipment, the measures used shall include all of the following techniques:

Note: Appendix C to Subpart V of Part 1926-Protection From Hazardous Differences in Electric Potential (click here) **contains information on hazardous step and touch potentials and on methods of protecting employees from hazards resulting from such potentials.**

   a. Using the best available ground to minimize the time the lines or electric equipment remain energized,
   b. Bonding mechanical equipment together to minimize potential differences,
   c. Providing ground mats to extend areas of equipotential, and
4. Employing insulating protective equipment or barricades to guard against any remaining hazardous electrical potential differences.

Live-Line Tools:

Live-line tool rods, tubes, and poles shall be designed and constructed to withstand the following minimum tests:

If the tool is made of fiberglass-reinforced plastic (FRP), it shall withstand 328,100 volts per meter (100,000 volts per foot) of length for 5 minutes, or

Note: Live-line tools using rod and tube that meet ASTM F711-02 (2007), *Standard Specification for Fiberglass-Reinforced Plastic (FRP) Rod and Tube Used in Live Line Tools*, are deemed to comply the above paragraph.

if the tool is made of wood, it shall withstand 246,100 volts per meter (75,000 volts per foot) of length for 3 minutes, or

The tool shall withstand other tests that we can demonstrate are equivalent.

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

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 testing procedures, below, before being returned to service.

Live-line tools used for primary employee protection shall be removed from service every 2 years, and whenever defects are found (see previous paragraph), for examination, cleaning, repair, and testing as follows:

Each tool shall be thoroughly examined for defects.

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.

The tool shall be tested:

1. After the tool has been repaired or refinished; and
2. After the examination if repair or refinishing is not performed, unless the tool is made of FRP rod or foam-filled FRP tube and we can demonstrate that the tool has no defects that could cause it to fail during use.

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.

The voltage applied during the tests shall be as follows:

1. 246,100 volts per meter (75,000 volts per foot) of length for 1 minute if the tool is made of fiberglass, or
2. 164,000 volts per meter (50,000 volts per foot) of length for 1 minute if the tool is made of wood, or
3. Other tests that we can demonstrate are equivalent.

Note: Guidelines for the examination, cleaning, repairing, and in-service testing of live-line tools are specified in the Institute of Electrical and Electronics Engineers' *IEEE Guide for Maintenance Methods on Energized Power Lines*, IEEE Std 516-2009.

Overhead Lines and Live-Line Barehand Work:

Following are **additional requirements** for work performed **on or near overhead lines and equipment and for live-line barehand work**.

Before allowing employees to subject elevated structures, such as poles or towers, to such stresses as climbing or the installation or removal of equipment may impose, we shall ascertain that the structures are capable of sustaining the additional or unbalanced stresses. If the pole or other structure cannot withstand the expected loads it shall be braced or otherwise supported so as to prevent failure.

Note: Appendix D to Subpart V of Part 1926-Methods of Inspecting and Testing Wood Poles (click here) **contains test methods that employers can use in ascertaining whether a wood pole is capable of sustaining the forces imposed by an employee climbing the pole. This paragraph also requires the employer to ascertain that the pole can sustain all other forces imposed by the work employees will perform.**

When a pole is set, moved, or removed near an exposed energized overhead conductor, the pole may not contact the conductor.

When a pole is set, moved, or removed near an exposed energized overhead conductor, we 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 body.

To protect employees from falling into holes used for placing poles, we shall physically guard the holes, or ensure that employees attend the holes, whenever anyone is working nearby.

The following provisions apply to the installation and removal of overhead conductors or cable (overhead lines):

1. When lines that employees are installing or removing can contact energized parts, we shall use the tension-stringing method, barriers, or other equivalent measures to minimize the possibility that conductors and cables the employees are installing or removing will contact energized power lines or equipment.
2. For conductors, cables, and pulling and tensioning equipment, we shall provide the protective measures [See Mechanical Equipment, above] when employees are installing or removing a conductor or cable close enough to energized conductors that any of the following failures could energize the pulling or tensioning equipment or the conductor or cable being installed or removed:
    a. Failure of the pulling or tensioning equipment,
    b. Failure of the conductor or cable being pulled, or
    c. Failure of the previously installed lines or equipment.

3. If the conductors that employees are installing or removing cross over energized conductors in excess of 600 volts and if the design of the circuit-interrupting devices protecting the lines so permits, we shall render inoperable the automatic-reclosing feature of these devices.
    a. Before employees install lines parallel to existing energized lines, we 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.
4. Unless we can demonstrate that the lines that employees are installing are not subject to the induction of a hazardous voltage or unless the lines are treated as energized, temporary protective grounds shall be placed at such locations and arranged in such a manner that we can demonstrate will prevent exposure of each employee to hazardous differences in electric potential.

Note **Appendix C to Subpart V of Part 1926-Protection From Hazardous Differences in Electric Potential** (click here) **contains guidelines for protecting employees from hazardous differences in electric potential as required by this paragraph.**

Note: If we take 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 we protect employees from injury due to involuntary reactions from electric shock, a hazard exists if the resultant current would be more than 6 milliamperes.

5. Reel handling equipment, including pulling and tensioning devices, shall be in safe operating condition and shall be leveled and aligned.
6. We shall ensure that employees do not exceed load ratings of stringing lines, pulling lines, conductor grips, load-bearing hardware and accessories, rigging, and hoists.
7. We shall repair or replace defective pulling lines and accessories.
8. We shall ensure that employees do not use conductor grips on wire rope unless the manufacturer specifically designed the grip for this application.
9. We shall ensure that employees maintain reliable communications, through two-way radios or other equivalent means, between the reel tender and the pulling rig operator.
10. Employees may operate the pulling rig only when it is safe to do so.

Note: Examples of unsafe conditions include: employees in locations prohibited by subparagraph paragraph 11, below, conductor and pulling line hangups, and slipping of the conductor grip.

11. While a power-driven device is pulling the conductor or pulling line and the conductor or pulling line is in motion, we shall ensure that employees are not directly under overhead operations or on the

crossarm, except as necessary for the employees to guide the stringing sock or board over or through the stringing sheave.

In addition to other applicable provisions contained in Subpart V, Electric Power Transmission and Distribution, the following requirements apply to live-line barehand work:

1. Before an employee uses or supervises the use of the live-line barehand technique on energized circuits, we shall ensure that the employee has completed the required training, detailed above, and in the safety requirements, below.
2. Before any employee uses the live-line barehand technique on energized high-voltage conductors or parts, we shall ascertain the following information in addition to information about other existing conditions required by § 1926.950(d), see Information Transfer, above:
    a. The nominal voltage rating of the circuit on which employees will perform the work,
    b. The clearances to ground of lines and other energized parts on which employees will perform the work, and
    c. The voltage limitations of equipment employees will use.
3. We shall ensure that the insulated equipment, insulated tools, and aerial devices and platforms used by employees are designed, tested, and made for live-line barehand work and we shall ensure that employees keep tools and equipment clean and dry while they are in use.
4. We shall render inoperable the automatic-reclosing feature of circuit-interrupting devices protecting the lines if the design of the devices permits.
5. We shall ensure that employees do not perform work when adverse weather conditions would make the work hazardous even after we implements the work practices required by this subpart. Additionally, employees may not perform work when winds reduce the phase-to-phase or phase-to-ground clearances at the work location below the minimum approach distances we have established unless insulating guards cover the grounded objects and other lines and equipment.

Note: Thunderstorms in the vicinity, high winds, snow storms, and ice storms are examples of adverse weather conditions that make live-line barehand work too hazardous to perform safely even after we implements the work practices required by this subpart.

6. We shall provide and ensure that employees use a conductive bucket liner or other conductive device for bonding the insulated aerial device to the energized line or equipment.

a. The employee shall be connected to the bucket liner or other conductive device by the use of conductive shoes, leg clips, or other means.

b. Where differences in potentials at the worksite pose a hazard to employees, we shall provide electrostatic shielding designed for the voltage being worked.

7. We shall ensure that, before the employee contacts the energized part, the employee bonds the conductive bucket liner or other conductive device to the energized conductor by means of a positive connection. This connection shall remain attached to the energized conductor until the employee completes the work on the energized circuit.
8. Aerial lifts used for live-line barehand work shall have dual controls (lower and upper) as follows:
   a. The upper controls shall be within easy reach of the employee in the bucket. On a two-bucket-type lift, access to the controls shall be within easy reach of both buckets.
   b. The lower set of controls shall be near the base of the boom and shall be designed so that they can override operation of the equipment at any time.
9. Lower (ground-level) lift controls may not be operated with an employee in the lift except in case of emergency.
10. We shall ensure that, before employees elevate an aerial lift into the work position, the employees check all controls (ground level and bucket) to determine that they are in proper working condition.
11. We shall ensure that, before employees elevate the boom of an aerial lift, the employees ground the body of the truck or barricade the body of the truck and treat it as energized.
12. We shall ensure that employees perform a boom-current test before starting work each day, each time during the day when they encounter a higher voltage, and when changed conditions indicate a need for an additional test.
    a. This test shall consist of placing the bucket in contact with an energized source equal to the voltage to be encountered for a minimum of 3 minutes.
    b. The leakage current may not exceed 1 microampere per kilovolt of nominal phase-to-ground voltage.
    c. We shall immediately suspend work from the aerial lift when there is any indication of a malfunction in the equipment.

13. We shall ensure that employees maintain the minimum approach distances, established by us under § 1926.960(c)(1)(i) [See Working on or Near Exposed Energized Parts, above], from all grounded objects and from lines and equipment at a potential different from that to which the live-line barehand equipment is bonded, unless insulating guards cover such grounded objects and other lines and equipment.
14. We shall ensure that, while an employee is approaching, leaving, or bonding to an energized circuit, the employee maintains the minimum approach distances, established by us under § 1926.960(c)(1)(i) [See Working on or Near Exposed Energized Parts, above], between the employee and any grounded parts, including the lower boom and portions of the truck and between the employee and conductive objects energized at different potentials.
15. While the bucket is alongside an energized bushing or insulator string, we shall ensure that employees maintain the phase-to-ground minimum approach distances, established by us under § 1926.960(c)(1)(i), [See Working on or Near Exposed Energized Parts, above] between all parts of the bucket and the grounded end of the bushing or insulator string or any other grounded surface.
16. We shall ensure that employees do not use handlines between the bucket and the boom or between the bucket and the ground. However, employees may use nonconductive-type handlines from conductor to ground if not supported from the bucket. We shall ensure that no one uses ropes used for live-line barehand work for other purposes.
17. We shall ensure that employees do not pass uninsulated equipment or material between a pole or structure and an aerial lift while an employee working from the bucket is bonded to an energized part.
18. A nonconductive measuring device shall be readily accessible to employees performing live-line barehand work to assist them in maintaining the required minimum approach distance.

The following requirements apply to work performed on towers or other structures that support overhead lines:

1. We shall ensure that no employee is under a tower or structure while work is in progress, except when we can demonstrate that such a working position is necessary to assist employees working above.
2. We shall ensure that employees use tag lines or other similar devices to maintain control of tower sections being raised or positioned, unless we can demonstrate that the use of such devices would create a greater hazard to employees.

3. We shall ensure that employees do not detach the loadline from a member or section until they safely secure the load.
4. We shall ensure that, except during emergency restoration procedures, employees discontinue work when adverse weather conditions would make the work hazardous in spite of the work practices required by this subpart.

Note: Thunderstorms in the vicinity, high winds, snow storms, and ice storms are examples of adverse weather conditions that make this work too hazardous to perform even after we implements the work practices required by this subpart.